INNOVATION AND THE ECONOMIC PERFORMANCE OF THE PRIMARY INFORMATION SECTOR: A MULTIDISCIPLINARY APPROACH

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DECLARATION

I hereby certify that this material, which I now submit for assessment on the programme of study leading to the award of *Doctor of Philosophy* is entirely my own work and has not been taken from the work of others save and to the extent that such work has been cited and acknowledged within the text of my work.

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ABSTRACT

The aim of this research is to understand and compare the implications of recent technical changes for the development and performance of three key component sub-sectors of the primary information sector (PIS): the Information and Communication Technology supply industries; Telecommunications services and Media services.

In this study, the author first reviews the most important economic theories explaining the links between technical change or progress and economic performance (i.e. Neoclassical and Neo-Schumpeterian / Evolutionary), as well as the relatively recent "New Economy" writings about the latest wave of technological innovations. Secondly, the author adopts an historical and evolutionary approach to examine the evolution of three main groups of activities representing the PIS industries in the case of the USA. The study provides an account of the main technical innovations but also the regulatory, organisational, managerial and stylistic changes that follow and complete these innovations. These changes contribute to the creation of new industries and markets and, in a fundamental way to the harvesting of their benefits.

Three key groups of activities are taken as case studies for empirical and historical analyses: first, the computer industry, second, the wireline telecommunication industry, and third, the audiovisual content and distribution media services.

In the case of the *computer and media content industries*, while providing an account of the links between innovations and economic performance, the study also examines the evolution from manufacturing-type activities into activities better described as services. In the case of the *wireline telecommunication industries*, the author highlights the separation of different activities into different modules and highlights the role of the regulator as current "system integrator".

The perspective adopted in this research is critical of those approaches that rely on mainstream economics to provide the main framework for explaining the effect of technical change on the economic performance of these sectors. This study, rather, emphasises the necessity of using a variety of theories to explain the evolution of these sectors. In addition to an historical and evolutionary approach, this study proposes a re-defined version of Baumol's theory of cost disease (based on a notion of "creative inputs"). It also draws on relevant aspects of the service economics literature and modularity theories (defined as a subset of theories within the Complex Evolving Systems' school of thought).

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LIST OF ABBREVIATIONS

3GPP	3G Partnership Project
ACTA	Administrative Council for Terminal Attachments
ALP	Average Labour Productivity
AMPS	Advanced Mobile Phone Service
AOL	American Online
AT&T	American Telephone and Telegraph Corporation
ATIS	Alliance for Telecommunications Industry Solutions
AWS	Advanced Wireless Services
BEA	Bureau of Economic Analysis
BLS	Bureau of Labour Statistics
BTAs	Basic Trading Areas
CARP	Copyright Arbitration Royalty Panel
CATV	Community Antenna Television
CBS	Columbia Broadcasting System
CDMA	Code Division Multiple Access
CEI	Comparatively Efficient Interconnection
CEO	Chief Executive Officers
CEPT	Conference of European Posts and Telecommunication
CES	Complex Evolving System
CFR	Code of Federal Rules
CLEC	Competitive Local Exchange Carriers
CMAs	Cellular Market Areas
CMOS	Complementary Metal–Oxide–Semiconductor
CoPS	Complex Products Systems
CPE	Customer Premises Equipment
CPM	Cost per Mille
CPP	Cost per Point
DBS	Direct Broadcast Satellite
DM	Design Modules
DMA	Designated Market Area
DNS	Domain Name Server
DRG	Diagnosis Related Groups
DSL	Digital Subscriber Line
DTV	Digital Television
DVD	Digital Versatile/Video Disk
DVR	Digital Video Recorder
EDA	Electronic Design Automation

ESS	Electronic Switching System
ETSI	European Telecommunication Standards Institute
FCC	Federal Communication Commission
fin-syn	Financial Syndication Rules
FIRE	Financial, Insurance and Real Estate
FM	Frequency Modulation
GATT	General Agreement of Tariffs and Trade
GDP	Gross Domestic Product
GHz	Gigahertz
GRP	Gross Rating Points
GSM	Global System for Mobile Communications
GTE	General Telephone and Electronics
GUI	Graphic User Interface
HBO	Home Box Office
HDTV	High Definition Television
HP	Hewlett-Packard
HSD	Home Satellite Dish
IBM	International Business Machines
ICC	Interstate Commerce Committee
ICT	Information and Communication Technologies
iDEN	integrated Digital Enhanced Network
IGS	IBM Global Services
ILEC	Incumbent Local Exchange Carrier
IMT	International Mobile Telecommunications
IP	Internet Protocol
IPR	Intellectual Property Rights
ISDN	Integrated Systems Digital Network
ISG	Interconnection Service Group
IT	Information Technologies
ITU	International Telecommunication Union
Kbps	Kilobits per second
KHz	Kilohertz
KIBS	Knowledge Intensive Business Sectors
LATA	Local Access and Transport Areas
MCI	Microwave Communications Inc.
MDF	Main Distribution Frame
MFJ	Modification of Final Judgment
MFP	Multifactor Productivity
MHz	Megahertz
MIPS	Millions of Instructions Per Seconds

MMDS	Multichannel Multipoint Distribution Services
MPVD	Multichannel Video Programming Distribution
MSAs	Metropolitan Statistical Areas
MTAs	Major Trading Areas
MVPD	Multichannel Video Programming Distribution
NAICS	North American Industry Classification System
NAPCS	North American Product Classification System
NATO	National Association of Theatres Owners
NBC	National Broadcasting Company
NCR	National Cash Register
NGN	Next Generation Networks
NIPA	National Income and Product Accounts
NISS	National Institute of Statistical Sciences
NMT	Nordic Mobile Telephone
NSF	National Science Foundation
NSFNet	National Science Foundation Network
NTSC	National Television System Committee
NVOD	Nearly Video On Demand
OCA	office, computing and accounting
OECD	Organisation for Economic Co-operation and Development
ONA	Open Network Architecture
OSI	Open System Interconnection
OTA	Over-the-air
OVS	Open Video System
PC	Personal Computer
PCB	Printed Circuits Board
PCI	Peripheral Component Interconnect
PCS	Personal Communication Services
PICC	Pre-subscribed Interexchange Carrier Charges
PIS	Primary Information Sector
PPF	Production Possibility Frontier
PSTN	Public Service Telephone Network
R&D	Research and Development
RBOC	Regional Bell Operating Companies
RCA	Radio Corporation of America
RMA	Radio Manufacturers Association
RPG	Report Programme Generator
RSAs	Rural Statistical Areas
S&T	Science and Technology
S/360	System 360 (IBM)

SBC	Service Bureau Corporation
SHIVA	Satellite Home Viewer Improvement Act
SIC	Standard Industrial Classification
SLA	Service Level Agreement
SLC	Subscriber Line Charges
SLC-Sys	Subscriber Line Carriers Systems
SLT	Solid Logic Technology
SMR	Specialized Mobile Radio
SMS	Short Messages Services
SOC	System On Chip
SPC	Stored Program Control
SS7	System Signalling 7
SVOD	Subscriber Video On Demand
TACS	Total Accessed Communication System
TDMA	Time Division Multiple Access
TE	Terminal Equipment
TFP	Total Factor Productivity
TIA	Telecommunications Industry Association
UMTS	Universal Mobile Telecommunications System
UNDP	United Nations Development Programme
UNE	Unbundled Network Unit
UNE-P	UNE Platform
UPN	United Paramount Network
US	United States
VA	Value Added
VCR	Videocassette Recorder
VHF	Very High Frequency
VOD	Video-on-demand
VoIP	Voice Over IP
WARC	World Administrative Radio Conference
WB	Warner Brothers/ Bros
W-CDMA	Wideband CDMA
WINTEL	Windows-Intel

Chapter 1 - Introduction

1.1. Why is the New Economy "New"? A Brief Introduction

The term "New Economy" has been adopted by many analysts primarily to describe the "internet revolution" and the establishment of internet-related companies and trading. Alternatively and in academic economic papers in particular, this term is frequently associated with the economic upswing experienced in the United States and some other developed and developing economies from the mid 1990s.

This economic expansion is fostering and fostered by many characteristics such as rapid technological change, increased transnational trade and de-regulation, a term commonly used to describe the tendency for many governments to decrease their intervention in markets in favour of self-regulation. Yet, it cannot be considered the most radical economic revolution, nor can its peculiarities be clearly and fully defined for the simple reason that it is still unfolding as trends of labour productivity statistics testify.

In this research, we will argue that the mainstream economic approach is not *alone* suited to explain change and the economic performance of the information sector and that this latter should be complemented by other theoretical frameworks. However, much of the current understanding of the information sector and especially its role in shaping the New Economy is purely based on neoclassical economic theories. To demonstrate this statement, we review a number of models investigating productivity trends and explain how the recent statistical changes are shaped by these models built on neoclassical assumptions. Moreover, we provide some new arguments and report on many others demonstrating that many regulatory changes are motivated by a vision of the economy based on manufacturing activities, producing substitutable goods and introduced as a result of large Research and Development (R&D) efforts.

However, the first evidence that the New Economy is a neoclassical concept can be found in the choice and diffusion of this particular label. Nelson and Winter (1982) describe the neoclassical doctrine, which they referred to as the orthodoxy, as a set of theories characterised by the extensive use of mathematical modelling and (necessary) simplifying assumptions, such as perfect information, the use of two commodities for illustrating economic dynamics and the existence of a static equilibrium. Clearly referring to mainstream economics, they argue that a theory "*defines the economic variables and the relationships that are important to understand,* *gives a language for discussing these, and provides a mode of acceptable explanation. Implicitly, therefore, a theory classifies some phenomena as peripheral, unimportant, and theoretically uninteresting*" (Nelson and Winter 1982 p46).

According to mainstream economics, historical analysis is not an acceptable methodology and past economic revolutions, empirically unquantifiable because of a lack of consistent data, are less important than the current one.

The terms "Digital Economy" or "Semiconductor Economy", which represent attempts to label the current economic momentum after the technologies that most characterise it, are less widely used as is the notion of "fifth long wave of development" that gives this economic upswing an historical dimension. Regardless of the importance of previous long term economic upswings characterised by technical change and in spite of the radical changes that past innovations have brought into societies in their own times, the current mainstream economic doctrine defines the current economy as the *NEW* one.

The adjective "new", however, suits well as a label for the current economic momentum for one good reason; this is that there is still a lot to discover about it.

1.2. Key Research Questions

Our contribution to this body of knowledge about the new economic momentum starts with a review of key research questions and with the definition of some central terms. First, however, we will begin by stating the overall objectives of this project.

1.2.1. The Broad Aims of the Research

Our primary objective in this study is to propose an alternative analysis of the relationship between innovation and economic performance in the information sector and the influence of the latter on current economic momentum. Our secondary objective is to promote the utility of a multidimensional and multidisciplinary analysis of economic dynamics; in fact, we believe that innovations are increasing the complexity of economic dynamics and the simplifications that the neoclassical framework propose are better suited to explain the past, more homogenous economic environment. In the current economic environment, using a more complex set of theories represents a better strategy for understanding change.

1.2.2. Key Questions and Challenges

In order to reach the primary and secondary objectives, this project attempts to provide an extensive analysis of several key research questions. Although these research questions are intertwined and in the research they are dealt with together, for clarity here they can be divided into three subject areas: (1) the information sector, (2) the New Economy and (3) economic theories.

With regard to the information sector, we attempt to address the following questions: how is the information sector changing? What are the main innovations introduced in this sector over the last twenty years and how is their introduction explained? What is the rationale for the success of some inventions instead of others? What is the influence of these innovations on the economic performance of the information sector and the industries included in this sector? What are the effects of these innovations when they are applied to other economic activities? How do we understand the changing information sector in the New Economy?

In an attempt to answer these questions, we make the following choices. First of all, we agree with those neo-Schumpeterian accounts that see in the spreading of computerised technologies the potential for a new long wave of economic development. Although it is difficult to define the characteristics of a long wave of economic development while it is still unfolding, some of these accounts already recognise the semiconductor industry as the motive branch and the provider of the key factor (in this case, the semiconductor) at the core of the swarm of innovations. Neo-Schumpeterian accounts also recognise the computer and the telecommunication industry as the carrier branches, or the industries that make the most intensive use of the key factor (e.g. Freeman and Louçã 2001). As we embrace this viewpoint, we look for further evidence of the existence of this new wave of development as well as for its characteristics.

Secondly, in this research we draw on recent work in the service innovation literature and make the assumption that the role of the service sector is generally underestimated in economic analysis and that the most common economic theory frameworks (mainly the neoclassical school of thought, but also the neo-Schumpeterian) use the manufacturing sector as their main model. Therefore, in order to understand contemporary change, we apply what can be defined as a "service-friendly" notion of innovation.

The second set of research questions concerns the New Economy: what is really "new" about the New Economy? How is the New Economy understood and why? How is the New Economy (with its set of established criteria, policy and regulations regimes) affecting the evolution of the information sector?

The third set of questions concerns the role of economic theories and they comprise: what are the theories that best help us to interpret the effects of new technologies on the current economic momentum and why? What are their shortcomings and strong points? What are the consequences of the understanding of the existence of a New Economy (and of its characteristics) through the eyes of mainstream economists?

1.2.3. Definitions of Key Concepts

In order to define the Primary Information Sector (PIS, often shortened to Information Sector) we adopt a narrower definition of the same concept adopted by others (e.g. Preston 2001). Within the wider set of activities that Preston considers part of this sector, we choose three sub-sectors: computer industry, telecommunication (both part of the ICT suppliers) and the media (part of the core info-intensive industries). Many reasons justify this choice: the first is that the chosen methodology requires a rather intensive historical analysis, and time constraints suggest a selective focus only on *some* of the components of the PIS; the second reason is that among the sectors Preston includes in the PIS, these can be considered the most innovative; third, they play a fundamental role in neo-Schumpeterian accounts and fourth, these sectors all play a key role in the New Economy debate.[1]

Moreover, we use some of the terminology concerning industrial organisation in a slightly different way than mainstream accounts. These changes are motivated by the choice of making these concepts more service-friendly. First of all, "*industries*" are considered here the sub-units of a sector; they are business activities leading to the production of final or intermediate goods or services. Sometimes we refer to "service industries"; in this case, we are only referring to the business activities that provide a service, whether to the final consumers or to another productive process, leaving out manufacturing activities. The concept of a service will be extensively defined in Chapter Three, especially by drawing from Gadrey (2002).

Then we attach a particular definition to the concept of "*activity*"; in this account we refer to an activity as a task, a sub-unit of an industry and a part of its production process. This concept of activity is close to the idea of a "step" in the value chain of an industry: an activity is not necessarily a standalone business, with a distinct owner from other activities of an industry or a sector. In this regard, instead of looking at the mere production processes from a technological perspective, we include questions of ownership, referring to an "enterprise" or a "company" (alike) and to a conglomerate (a group of companies under the same ownership).

Moreover, in order to illustrate the differences between the components of the information sector, we choose four case studies. These case studies are the computer manufacturing industry, the wireline telecommunication industry, the wireless telecommunication industry (in

[1] For simplicity these sub-sectors of the PIS are referred to as "sectors".

Appendix E) and the audiovisual media service industry. This choice is motivated, on the one hand, by the importance of these industries in New Economy discourses, and on the other hand, by the various differences characterising each one of these industries and by the interesting observations that come from their comparison.

These sectors present specific characteristics; among the most important, is the fact that the computer industry is still characterised by an important share of goods manufacturing activities, while nowadays telecommunication and media sectors are mainly services. Moreover, telecommunication and media are highly regulated, while the computer industry is not, although the influence of institutions played a key role in its development. Additionally, while all of these industries are providing the technology and delivering the services responsible for the diffusion of content (information, knowledge or entertainment), the media is certainly the sector where the production of content plays the most important role.

The concept of *innovation* is another concept that is key to this research and so is worth briefly defining here. In this project, the term innovation refers to any change undertaken within an activity, leading to and/or having an influence on the generation of new - or the modification of existing - product(s) produced or service(s) delivered. As explained in more detail in section 1.3.3 below, in order to use a notion of innovation that is “compatible” with the different theoretical frameworks employed here, the choice has been taken to highlight and consider five different dimensions of innovation: stylistic, managerial, organisational, technological and regulatory. Moreover, various other concepts of innovation used in writings of the neo-Schumpeterian tradition (e.g. the definition of radical or the incremental innovations, as explained in section 2.3.2) are also employed here.

1.3. Methodology, the Main Assumptions and the Research Framework

After outlining the focus of this research project, we now describe how we intend to reach these objectives and answer the research questions explained above.

1.3.1. The Methodology

In our analysis we focus on the United States; first, because this country is certainly the most studied and influenced by this idea of a New Economy, as policy decisions and regulatory changes testify. In a paper published in 1998 (therefore, about only two years after the change in productivity trends) the influential Federal Reserve Chairman Alan Greenspan (1998) admitted in a few words that although it was not yet clear whether the changed labour productivity trend was caused by the adoption of new technologies, some observed economic dynamics (e.g. a mild response of prices and wages to the strong performance of the real economy) had no precedent and were defying the current understanding we have of them. In this sense, the United States may be said to be the first to experience a New Economy.[2]

The second reason justifying the choice of the United States as the objective of this research, is the relative abundance and availability of comprehensive economic data and statistics at the detailed industry level. The Bureau of Economic Analysis (BEA) and the Bureau of Labour Statistics (BLS), among others, regularly release and update their full databases online.[3]

As noted above, as we recognise the complexity of the subject that is the focus of this research, we decided to build a theoretical framework by drawing from a variety of theories. We did this to better interpret the impact of technologies on the economic performance of the information sector and the impact of the information sector on the New Economy.

Two other main methodological choices need to be defined here. First, we chose to comply with the principles of evolutionary economics and as a result, to favour inductive reasoning. We review historical accounts, compare the evolution of different sectors that are the main object of this study, then use these observations to illustrate or expand the indications of my theoretical framework. Historical accounts are mainly taken from academic books and papers. The most frequently cited sources used to explain the evolution of the IT industry include the work of Campbell-Kelly and Aspray (2004), Chesbrough (2005), Cusumano and Gawer (2005), Dedrick and Kraemer (1998), Freeman and Louçã (2001), Holbrook et al. (2000), Langlois (2002), Langlois and Steinmueller (2000), Lazonick (2005), Linden and Somaya (2003), Mayer, Anzani and Walsh (2005) and Usselman (2004). On the other hand, the work of Arden (2004), Cannon (2003), Fransman (2002), Hochheiser (1989), King and West (2002), Loomis and Swann (2005), Melody (1997), Nadiri and Nandi (1999), Nall (1993) and Weber (2003) represent the main sources of the account of the wireline sector's evolution. Finally, the description of the audiovisual media services' evolution is mainly based on writings from Aksoy and Robins (1992), Bielby and Bielby (2003), Christopherson (2006), Corn-Revere and Carveth (2004), De Vany and Mc Millian (2004), Einstein (2004), Ferguson (2004), Gomery (2004), Maule (2003), Parsons (2003), Prince (2003), Robins (1993), Scott (2004), Storper (1989), Strover (2005) and Winston (1996, 1998).

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[2] Even though this particular research is focussed on the United States, I intend to use the same type of framework in the future and for my post-doctoral work, in order to analyse the evolution of the PIS in Ireland and other European countries.

[3] Moreover, these sources of data and indexes are characterised by a degree of detail in describing the economic trend of industries that is superior, for example, the widely consulted Organisation for Economic Development and Co-operation's (OECD) STructural ANalysis (STAN) database.

The rich information drawn from academic writings is integrated with the information drawn from, firstly, the specialised press (e.g. Giardina 2007, Hallerman 2007, IT Facts 2004, Market Wire 2004, The Economist 2006 and Waters 2004), secondly, writings produced by (former and current) employees of the corporations whose transformations are described (e.g. Hundt 1994, IBM Corporate Archives and AT&T 2006) and thirdly, official reports by governmental organisations with relevance to the sectors researched here (e.g. FCC 2000, 2001, 2003, 2005a, 2005b, 2006, FCC Media Bureau 2006, Itven, Olivier and Sepulveda, 2000). Drawing information from these last three different types is important for this research because of the need for either long past historical or very recent detailed information about technical, managerial, organisational, stylistic and regulatory changes. Most of the facts reported in this research are drawn from at least two sources. In the rare cases when the necessary historical information has been found only in one source, this latter is necessarily uncontested. We understand that is a shortcoming of our approach. However, this is also somehow inevitable given our interest in managerial and organizational changes in the industries of the information sector: details about these are rare and mainly (if not, exclusively) provided by a company press office or from by other “inside” sources, such as former employees.

The second choice of methodology concerns the use of empirical data to support my arguments. In this respect, my main purpose is not to attempt to propose new techniques or criticise the methodology used in other models. On the contrary, as the empirical exercises are mainly complements to the arguments illustrated with historical accounts and justified by the theoretical framework, where possible, we prefer the use of simple statistics or widely used indexes with which we compute simple manipulations. In this way, the soundness of the arguments is less likely to be undermined by the choice of the methodology of the empirical illustrations.

On one occasion, however, and specifically to demonstrate the unbalanced growth of *creative industries*, we adapt a model firstly proposed by Nordhaus (2002) and later modified by Tang and Wang (2004). The methodology is detailed in section 2.4.1.3 below.

1.3.2. About the Regulator and the Rationale for its Choices

In this research, it is argued that the regulator plays a crucial role in influencing the innovation patterns of the information sector. In this section we explain how to interpret the regulator’s behaviour and in particular, the rationale for its choices. In general, we include in the notion of *regulator* all bodies, state or federal, with regulatory power over the information sector, the most common being the Federal Communication Commission (FCC), the Government (and in particular the Department of Justice), the Senate and District Courts. In particular and especially in Chapters Eight, Nine and Ten when we discuss the fitness of the current regulatory framework to promote innovation in the information sector and its rationale, we focus our attention on the FCC, the branch of the regulator responsible for the design of this framework that evaluates and rules on various changes proposed by the industry.

The FCC adopts the principle of the *public interest* when it evaluates proposals and issues new rules. According to this principle, changes are approved and carried out if they comply with the FCC policy goals and if the "net effect" on the public interest is expected to be positive: i.e. the potential benefits generated by the changes under consideration outweigh potential drawbacks.[4] However, policymaking does not occur in a vacuum and the concept of the public interest which a regulator draws upon can be shaped by its own position within wider political economic contexts, its partiality to ideological arguments, and the institutional relationship between politicians, policy makers and the economic interest groups that a regulator seeks to regulate. In the majority of cases, these benefits and shortcomings cannot be exactly forecasted nor precisely estimated or compared. For example, as we will explain in more detail below, when evaluating the consequences of changes leading to increased concentration in the audiovisual media service industry, the FCC gathers information from the industry or companies involved through their proposals as well as various opinions from other parties through public hearings (e.g. consumer associations, academics, etc…), then evaluates the trade-offs of such change in order to take a decision. For example, when evaluating the merger between American Online (AOL) and Time Warner Inc., the benefits of such a change include reduced costs through economies of scale for the company, and potential lower prices and increased product quality for the consumers. The drawbacks include a reduced diversity of sources of information for the consumers (see FCC 2001 and section 7.3.5 for a more detailed discussion). A key issue here, critics maintain, is the relative lack of alternatives that a regulator has when the public interest is conflated with the neoclassical distribution of commodities to consumers, and/or, when political support for regulatory tools which may allow for more positive interventions to be taken are absent (leading to regulatory capture). In these situations the regulator can only achieve its goals through overseeing competition or timidly negotiating regulatory requirements that previously existed.

Because advantages and drawbacks cannot be mathematically compared, the FCC's analysis and interpretation of the consequences of such changes become highly consequential. In the literature, we find two influential interpretations of contextual features which shape the FCC's interpretation of the public interest: the thesis of *regulatory capture* and the *neoliberal paradigm*. Analyses of *regulatory capture* investigate the processes through which vested

[4] As explained in the FCC's MEMORANDUM AND OPINION ORDER about the transfer of licences between AOL and Time Warner Inc. "Among the major policies and objectives that may be affected by significant mergers are preserving and enhancing competition in related markets, ensuring a diversity of voices, and providing advanced telecommunications services to all Americans as quickly as possible. To gain approval, an applicant bears the burden of establishing that the potential for benefits to the public interest outweighs the potential for harms." (FCC 2001 p4).

interests affect state intervention in different forms (Dal Bó 2006). For example, in a recent literature review of mainstream economic models and political science theories, Dal Bó (2006) explains that the following case scenarios may induce the regulator to favour certain institutions and in particularly companies and industries: pressure from politicians who pursue selfish objectives (Stigler 1971), the need to minimise complaints from certain firms and in particular, from regulated firms (Hilton 1972) or bribes and threats from particular interests groups (Dal Bó et al. 2006). Moreover, the regulator can also take decisions based on biased information, as company directors have a personal interest in increasing the equity value of the company they work for, and this is what happens (although it might be only short terms) following a merger and that is grounded in (over-)optimistic expectations about the synergies that can be generated by the new company (Carpenter et al. 2003)

On the other hand, others suggest the problem of the "revolving doors" (e.g. Gormley 1979 cited by Dal Bó 2006): officials with a past career in the industry or aspiring to future employment in the industry are more likely to have a pro-industry biased opinion. On the other hand, other analyses, especially from the political economy and political sciences perspectives, identify the bias of the regulator's decision in favour of the industry as arising out of the existence of a dominant neoliberal doctrine. As argued by McChesney (1999), neoliberalism is a political doctrine supporting free market policies encouraging private enterprise and consumer choice, promoting personal responsibility and entrepreneurial initiative. Moreover, according to this doctrine, the free market is the ultimate efficient allocator of goods and services, a role that cannot be fulfilled by a central authority. However, according to its critics, although neoliberalism has been promoted as an ideology of freedom and democracy, it actually supports national and international politics maximally supportive of the extension of market relations throughout all social affairs (McChesney 2001 cited by Jin 2008) and therefore favours big corporations and rich investors. Moreover, the neoliberal doctrine envisages the retreat of the state from critical areas of social life, including the communication arena where the state historically was directly involved in building infrastructure, setting technical standards, regulating market access and directly providing services (Mosco 2002).

In other words, according to the proponents of the neoliberal paradigm thesis the regulator is "captured" but by the dominant ideology, promoting the role of the market at the expenses of governmental intervention. Moreover, the neoliberal paradigm certainly has currency within the communication industry, as suggested by the discourse we find in the official documents that are utilised for this project. For example, the current strategic goals of the FCC always refer to the information sector users only as consumers, implying that the satisfaction of their utility comes before the satisfaction of wider social, political and cultural needs. Furthermore, according to the FCC's viewpoint, regulation is clearly secondary to the logic of the market: the

FCC, for example, maintains that "that program diversity is best achieved by reliance on competition among delivery systems rather than by government regulation" (FCC 2003 p72) when there is no proof that program diversity is fostered by competition (see FCC2003 or Doyle 2002b).[5] Added to this, the regulator has the power to provide structural incentives or even to impose a diversification of programming upon broadcasters in the same way it imposed public interest obligations upon them in the past e.g. the fairness doctrine and fin-syn rules in the US.[6] Therefore, although the possibility exists, the FCC no longer takes into consideration structural regulation of media output in order to obtain the goal of product diversity, a scenario that is in line with the neoliberal paradigm.

Consequently, acknowledgement of regulatory capture and the pervasiveness of neoliberal ideology, represents a useful critical intervention and complementary to our account because, first of all, it will allow us to provide wider contexts and rationale for explaining the regulator's choice. Secondly, both viewpoints are compatible with Nelson and Winter's (1982) assumption about the existence of an orthodox economic approach (which is a tool of the neoliberal doctrine) and both critiques reinforce our assumption that mainstream economics has become the most important source of inspiration for regulation affecting the information sector (i.e. in Chapter Eight).

However, although in reality the regulator can be influenced by a variety of factors, obviously there is no acknowledgement of external pressure, ideology bias or bribes in the various official documents that the regulator publishes to inform the public opinion about its choices. As we will argue, these decisions can be evaluated by the same basic concepts of mainstream economics that inspire them. However, how important is economic theory in the formulation of these decisions? Although the thesis of regulatory capture and the neoliberal paradigm imply that economic theory plays a secondary and instrumental role in determining the outcome of a wider choice, it still plays an important role in justifying this choice. It can be argued that the peculiarity of media economics, and the particular economic characteristics of media production, provide an important critical standard by which we can evaluate the application of mainstream economic models to the media sector (Doyle 2002). In this research we propose to present alternative concepts drawing from a set of theoretical approaches that, as we will argue, are more suitable to understand the dynamics of the information sector activities.

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[5] For example, Doyle (2002b) explains that concentration of ownership in the media can lead to increased pluralism, because in a market with many competitors, broadcasters choose programs that can attract the broadest audience possible, while in a market that is more concentrated, broadcasters have more incentives to deliver programs for smaller nice audiences.

[6] See Croteau and Hoynes 2001 for information about the regulations on Public Interest obligations.

In order to explain how mainstream economics inspires these regulations, but also how an alternative economic framework like the one we present in this research, can lead to different conclusions, we introduce a third case scenario that may inform the regulator's choices: the economics of the Good Regulator. This is a normative concept based on the possibility of positive application of institutional economic theory for regulatory use and wider social benefits. Whereas the critical political economy and regulatory capture arguments are valid, it is suggested here that the institutional capacity for regulation via sociologically informed economic modelling presents a potential third way between neoliberal and regulatory capture, and thus the possibility of an institutional third way.

The *Good Regulator* actively attempts to maximise the benefits of its "employers", the citizens. Moreover, the *Good State* and its "branch" the *Good Regulator* act to a certain extent as the *homo economicus*, the imaginary "economic man" used to rationalise human behaviour by mainstream economic theorists. Like the economic man, the Good Regulator is rational. Moreover, by pursuing self-interest, the *Good State* pursues the wellbeing of the citizens, because it is democratic. As a consequence, given the variety and the asymmetry between citizens' interests, when choosing between different courses of action, the *Good Regulator* chooses the one that maximise the interests of the largest possible number of individuals. Therefore, when a situation presents a trade-off between favouring the consumer or a company (or a group of companies), the Good Regulator chooses to maximise consumer's benefits because consumers are the largest group.

However, in contrast to the idea of *homo economicus*, the good state is not "perfectly" informed, but only '*well' informed*. With this difference in mind, what we would like to underline is that the regulator, although informed, makes mistakes even if often in good faith. Situations are understood and course of action chosen, not based on some kind of "absolute truth" like the idea of "perfect information" implies, but grounded on contingent information and beliefs. This specification is crucial to comply with the assumption that innovation is in fact evolutionary and the result of a trial and error process. Last, the regulator interprets information through media specific economic theory, because this is thought to be objective and impartial.

In other words, the *Good Regulator* is a normative attempt to realise positive economic regulation in the public interest, or how the FCC should, but does not necessarily behave. Blevins and Brown (2007, 2006), indirectly, provide a good illustration of the importance of the Good Regulator, as they demonstrate how economic theory underlined regulatory decision making more so than other political, social or cultural frameworks in justifying recent regulatory changes.[7] Moreover, according to Napoli (1999), the FCC is certainly not new to this kind of procedure, as it has employed neoclassical economics as the primary analytical tool since the mid 1970s. These authors criticise the dominance of the economic criteria and conclude it has negative effects on society because economic values prevail over other social values.

In the present research we present a complementary argument as we attempt to persuade the readers that this order of values does not stem from the use of economic theory per se, rather from the adoption of a *single* economic viewpoint. We will argue that institutional economics provide an alternative approach particularly useful for those decisions where the trade-offs between benefits and shortcomings of regulatory changes cannot be quantified algebraically, because, as Hodgson (2008) explains, this framework promotes an analysis that is openly interdisciplinary, that recognizes insights from politics, sociology, psychology, and other sciences. As such it provides both a critical standard and a potential alternative to the neoclassical economic approaches that tend to undermine the positive potential of economic regulation.

1.3.3. The Research Framework

In this project we choose different types of academic literature and specific theories so that together they can be used to better define and characterise an *economic trajectory* of the information sector. A trajectory can be characterised by first defining an origin and a point of arrival; for obvious reasons, the trajectory in question is better represented as a continuous motion, so we look at the *history* instead of the origin of the trajectory, and at the *goal* instead of the point of arrival in order to understand and describe its direction. Secondly, we are interested in explaining any important *changes* undertaken by this trajectory.

The literature review starts with the New Economy literature; this includes recent writings generally based on neoclassical theories and considered developments of "New Growth" theories, focused on empirically demonstrating (or refuting) the pervasiveness and positive influence of ICTs on every sector of the economy. In more technical detail, these accounts mainly concentrate on labour and multifactor productivity growth and attempt to find a correlation of their positive trend (which indeed is observed starting from 1996) with the increase in investments in ICTs.

[7] As these authors explain, in 2003 the FCC decision to relax the rules about the concentration of ownership in the information sector was taken following the publication of the results of 12 studies about the implications of increased ownership in the information sector on diversity, localism, and the changes in the level of competition in the market involved. Of these 12 studies commissioned by the FCC, three did not cite any literature; one had few references to communication writings, while the other eight were purely grounded on economic literature.

We find this literature pertinent and important in the formulation of our research questions mainly for three reasons: the first is its popularity and its influence on shaping the concept of (and the policies influencing) the New Economy; the second is because its authors, and more generally all the other “growth accounting” economists, are the main advocates of the official statistics methodology and these official statistics include the industrial and sectoral data which we used for the empirical illustrations. The third reason is that it contributes to my attempt to describe the economic trajectory of the information sector, not least when characterising the speed and quantifying the effects of innovations on the economic performance of U.S. industries and the economy more generally.

However, the concept of innovation in these accounts is heavily influenced by the notion of technological change, or the use of new artefacts, and explained by the use of data series on investments in new technologies. Innovation dynamics in this model are not only not service-friendly, but are actually rather simplistic: innovation is (largely) said to be an exogenous phenomenon and its own development is not considered. Moreover, most writings in this area are focused on short term analysis and are not interested in the long historical series; the idea of the *goal*, which is implicit in many writings, is defined as economic growth and the maximisation of consumer welfare.

Given the fact that the information service sector is considered an important source of change in that part of the (aggregate) economic trajectory named the New Economy, a theoretical framework that is more focussed and better suited to describe innovation is required. Therefore, in order to offset the limits of neoclassical accounts, we draw upon evolutionary and neo-Schumpeterian theories, which recognise the multiple dimensions of innovation. Writings within this school of thought are very descriptive of various types of change (according to their roles and effects) and of the dynamics of innovations. As technological change is a very important factor and the enabling feature of a long wave of economic development, this school of thought often uses the concept of *technological trajectory* to indicate the evolution of different technologies, and *techno-economic paradigm*, to indicate the economic momentum that is characterised by the diffusion of a particular family of technologies.

Therefore, this literature’s contribution to the present project is fundamental; not only is the description of the history of technology and economics important in characterising the current economic momentum, but also in understanding the current and future shape of innovation. In other words, the main methodological choice of neoclassical accounts is mathematical modelling, then neo-Schumpeterian accounts draw upon the analysis of historical accounts to provide *a theory* of the “evolution” of the techno-economic environment that can be used to understand present and future trends. As we make this methodology our own, we can now talk here about explanatory elements of a *techno-economic* trajectory.

However, the theoretical framework needed to understand the *history*, *goals* and *change* of the techno-economic trajectory of the information sector would not be complete if it were only composed of neoclassical and neo-Schumpeterian accounts. It also requires insights of theories that are more specific to the sector, which is the focus of this project. Both accounts described above have the level of labour productivity as the centre of the analysis; investments in new technologies are made to improve it and as a consequence, improvements of its level reflect the status of the evolution of technologies. However, this might not be necessarily the case in the service industries, in general, or in branches of the information service sector in particular. For example, in the production of blockbuster movies, investments in new technologies are generally made with the objective of increasing the quality of the products and the chance to achieve higher revenues as a result of this increase in quality, instead of reducing costs of production. In this case, productivity (at least in its essential and more "engineering" sense) decreases as more money is invested in new technologies increasing the cost per movie.

Secondly, neoclassical and (most) neo-Schumpeterian viewpoints share the same idea of the techno-economic trajectory's goal: progress, in the sense of a "positive evolution", is to be understood here as economic growth and increased possibilities of consumption realised through the search for profit. This viewpoint cannot be used to explain the goal of some service activities; notably, there are many of these activities that are not profit seeking and whose economic performance expressed in pure quantities that are made available for consumption, do not necessarily explain the achievement of core objectives (e.g. health care and education).

Thirdly, both neoclassical and neo-Schumpeterian accounts present a version of the concept of innovation largely shaped by the idea of the economy based on manufacturing and mostly grounded on a notion of technical change which is the result of "formal" - financed with this specific intent –R&D. However, in this study we need to take into account further aspects of the innovation process in order to explain change in the information sector, as explained below. For example, innovation in the film industry can also be identified with a new style of narrating a story. Similarly, even computer manufacturers rely on "soft"-innovations; in fact, they do not research and introduce new technological artefacts as many of them are only assemblers of different components and consequently they rely on the component makers for new and improved technical features. In fact, as illustrated by Dell's success story, a computer manufacturer can gain an advantage over its competitors as a result of changed organisational settings and customer relations.

Therefore, the relevant body of writings includes the service innovations/ service industry literature. First of all, by looking at theories of service innovation, it is easy to identify and understand the centrality of manufacturing activities in the mainstream economic theories and thinking. As explained above, innovation is mostly identified with technological change. Given the fact that formal R&D benefits from economies of scale, mainstream and neo-Schumpeterian economic thinking *support* the idea that the bigger the company is, the larger the potential of generating important innovations will be (unless a company finds itself in a position of a monopoly). However, this is not necessarily the case when other forms of innovation are taken into consideration. Moreover, even when it comes to understanding the current absorption of new technologies, ICTs represent relatively affordable investments that even medium and small size companies can put to a highly productive use (e.g. many of the current largest software companies introduced important technological changes when they were very small businesses).

Therefore, as an alternative to the "loose" definition of the mainstream economic approach, in a way that is consistent with neo-Schumpeterian theories and following the example of the service innovations literature, we prefer to propose here a more structured notion of innovation and choose to use five types of *changes* or "dimensions", affecting the techno-economic trajectory. These types of changes, which together form the notion of innovation used in this research, are technological, organisational, stylistic, regulatory and managerial.

Technological change refers to the creation and use of new artefacts, while organisational change defines modifications to the organisation of the production process and how the different tasks forming activities and businesses are linked together. Moreover, stylistic innovation, a concept borrowed from Schweizer (2003), provides a practical definition for understanding how novel forms and shapes of content can be considered breakthroughs; regulatory change includes new laws and regulations affecting the behaviour of industries and sectors, while managerial change refers to all the other innovations introduced by businesses that are the result of "informal" (i.e. as the result of managerial decisions, but not proper research) and/or non-technical research (e.g. marketing choices).

Furthermore, mainstream economists suggest that potential economies of scale and scope are also key factors for success in the New Economy (e.g DeLong and Summers 2001); the chances to realise these economies and the extent of their effects are correlated with the size of the companies. The wave of relaxation of concentration rules in the media and telecommunication sectors find a theoretical justification in mainstream economic theory; in this case, the perceived increased competition between industries (which is the result of the convergence of media) suggests that the benefits realised from mergers and acquisitions, the realisation of economies of scale and scope and the increased pace of innovation can be passed on to the consumer.[8]

In this research we agree with the analysis of the *service innovation literature* regarding the shortcomings of the mainstream economic thinking, which has been largely shaped around the centrality of manufacturing activities. For notions and definitions of service activities this study draws on the work of Hill (1999), Gadrey (2002) and Gallouj (2002). Moreover, the works of Gallouj (2002), Wolff (2002), Miles (2001 2003) Den Hertog and Bilderbeek (2000), Schweizer (2003) and Vourinen et al. (1998) provide the theoretical concepts explaining the importance and the role of service-type / "soft"-innovations. In addition, illustrations and notions explaining the importance of soft-innovations that are specific to the information sector are included in the chapters dedicated to its evolution.

Furthermore, this study's analysis of the current economic momentum is based on the modularity literature. Specific to this research, what is included here under the label of "modularity" is a sub-set of the literature on complex evolving systems which is directly inspired by the evolution of the semiconductor and computer industries as well as some (rarer) writings on complex systems dealing with service activities. We adapt the concepts expressed in this literature, which highlight in particular the links between organisational change and other types of innovation, so that they can be better applied to and provide interesting insights about the service industry sector in general and the information service sector in particular.

The modularity literature suggests that, firstly, technological change increases the complexity of goods produced (and service delivered); secondly, the characteristics of the goods produced (and services delivered) define the organisational structure. Thirdly, that there are benefits in separating tasks (i.e. creating systems that are modular instead of integrated), the most important of these benefits being a higher (overall) innovation rate, starting from the simple principle that the higher the number of specific tasks, the larger the number of simultaneous research efforts. These research efforts are defined as "local" (and leading to modular innovations) and their existence is motivated by the fact that complex systems are improved by dividing them into small (and simpler) tasks.

Therefore, in an industry providing a modular system, such as the personal computer, different companies (such as hard drive or peripheral manufacturers) are concentrated in producing specific products, improving them and creating new ones providing the same (but improved) and additional functions. The "space" of these companies' research efforts has boundaries: on

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[8] E.g. see FCC 2001.

the one hand, their future products must be compatible with the system they are an extension of, and, on the other hand, their functionality must be in line with the system's developments. The compatibility with the system is the prerogative of one or more special contributors: the architect or platform integrator. This role is allocated to the companies or bodies that produce or own the knowledge necessary to design the interfaces between components. In the personal computer industry (i.e. the WINTEL platform) this role is assumed by two main companies: Intel, the company that designed the standard as well as producing most of the hardware interfaces between components, and Microsoft, the company that produces the most widely used operating systems, which act as the interface between the hardware and other applications.

The second "limitation" to the creativity of the local (or modular) research is given by the technological trajectory of the system: module producers have an interest to follow the technological development of the system. The latter is certainly stirred by the platform integrator(s), but it is also generally shaped by the improvements of its modules or, in other words, by the combined effect of several, local research activities. Still following the example of the personal computer system, the technological trajectory is currently designed by the transformation from a pure office tool to a tool used also for personal use to communicate and as a multimedia station. As a result, nowadays hard drive manufacturers have a strategic interest in concentrating on research in order to deliver products with larger storage capacity (which defines the modular technological trajectory). This is because given that computers nowadays are increasingly used to experience multimedia (which defines the technological trajectory of the system) and multimedia files such as music, images and videos, are much larger in size than word documents and spreadsheets.

We apply these principles of modularity to other industries in the information service sector, such as the wireline telecommunication industry and the audiovisual media service industry in order to provide an alternative viewpoint on the role of the different stakeholders and on the characteristics of the main technological trajectories of these industries so as to understand past and future directions of innovations, as well as arguments on the fitness of recent regulatory changes.

Finally, the literature review on service innovations that are specific to the information sector is completed with a detailed analysis and reconstitution of Baumol's theories of cost disease and unbalanced growth. These theories represent one of the most ambitious attempts to describe the general laws determining the impact of technological change on the economic performance of different types of activities, including cultural activities. As we will argue, however, the actual and potential implications of Baumol's work have been much misunderstood.

Fundamentally (and in his latest formulation) Baumol states that personal services and the activities of the cultural industries are stagnant. This means that they do not benefit from technological progress as most of the other "normal" and progressive activities do. As a result of this and due to their particular technological structure, in the long run their productivity level does not increase; moreover and in view of the mechanism highlighted by the theory of the unbalanced growth, when compared to the average, their cost (and price) increases in time.

We review Baumol's theories of cost disease and unbalanced growth as they were first stated at the end of 1960s and how they have changed over time up to the latest version which dates from the 1990s. Initially Baumol defines progressive and stagnant activities, as manufacturing and services activities respectively; with the appearance of service activities presenting characteristics of being progressive Baumol refined his definitions and explained that stagnant activities are those that are either personal services or extensions of the live performance. Nowadays, even this definition presents some grey areas as new technologies allow "progressive" extensions of the live performance and some personal services, which requires the interaction between users and providers, to be de-personalised" (e.g. retail and software).

That said, stagnant industries do exist, examples include the health and education sectors and many activities within the cultural industries, and their status has not changed since the first formulation of the cost disease. Moreover, not included by Baumol's definition because they are not "personal" nor an extension of the live performance, but present symptoms of stagnancy (according to Linden and Somaya 2003) is the activity of designing semiconductors, and this despite its affiliation to one of the most progressive industries of the New Economy. Therefore, in this project we explain that Baumol had a very fascinating intuition. However, we argue that the definition of cost disease concentrates on the effects instead of concentrating on the principles. This theory needs to be re-defined and re-formulated in more unconditional terms.

As a result of this intuition, we can state that while technological change is increasingly replacing labour with machinery and redefining its role, there are aspects of the human contribution to economic activities that cannot be replaced by technologies. Using a simple illustration and looking at the latest technological changes, it would be difficult not to agree on the fact that computers and computerised technologies, although they have more memory and they are millions times faster in executing any type of algorithm than the human brain, they have no intuition and originality of thought. Therefore, we make an attempt here to define the source of the cost disease in these terms and propose a *creative input*, defined as *labour's originality of ideas, concepts and actions and the capacity of troubleshooting and finding solutions*.

Creative inputs affect economic performance in the way Baumol (et al. 1985) describes (asymptotically) stagnant activities: the more the quality and the quantity of an activity's output depend on the use of creative inputs, the more stagnant is the activity. Therefore, for argument's sake, if a thousand hours of human creative inputs are used to design new microchips resulting in several million units of output, and the same amount of creative inputs results in the production of a few hundred newspaper issues, this would mean that the latter activity is expected to be more stagnant than the former.

1.4. The Rationale for This Research

Before concluding this introduction, we will explain the reasons for pursuing this research, for choosing these particular research questions and for other high level choices.

The first set of arguments includes my personal background and interests. Most of my bachelor degree in economics was characterised by the study of neoclassical theories. By the time of my master's studies, I had cultivated an interest in alternative economic thinking which is why I undertook a master's in development studies. In a few words, I agree with those economists who find that the neoclassical framework and its supremacy contribute to undermining the role that non profit activities exercise in society. I also observe in the current economic dynamics that non-profit activities are expanding to include categories of activities (including commercial ones, like retailers and banks) once exclusively characterised by the existence of profit seeking companies. Therefore, I agree with those who advocate a change in the way we understand the economy, that the current metrics of economic performance should be integrated with other indices, indicating the fulfilment of other objectives as alternative to profits.

Ultimately, we agree with economists such as Amartya Sen (1999), who promotes the idea of an economic system that is subject to the needs of citizens, instead of the mainstream idea of the citizens being inputs of the economic system.

My interest in the information sector is also due primarily to personal reasons: before and during my master's studies, I worked as an Information Technology (IT) specialist for a large computer manufacturer. During this period I learned to understand ICTs and their potential and since then I have followed their development with interest. Moreover, I think that a full understanding of the economic dynamics and technological trajectories of the information sector is ultimately important in order to be in a position to interpret current economic dynamics. Moreover, although this sector is the most important and celebrated of the New Economy, because its industries are the main providers of technologies and content used in combination with these technologies, given some of its specificities, the economic dynamics of this sector demonstrate that the mainstream economic approach is rather inadequate to fully understand the operations and evolution of the latter.

These specificities, for example, include the fact that this sector is mainly characterised by service activities, and that some of its activities, notably within the telecommunications sector and the media, play the double role of profit seeking as well as providers of public services. Moreover, the media industry is also characterised by the presence of strong externalities; therefore, pure market-led choices have to be weighted by potentially undesired consequences (e.g. the promotion of antisocial behaviour).

Finally, a study of this sector is interesting and important in order to understand general economic dynamics because, according to neo-Schumpeterian accounts, it includes the motive and carrier branches which are responsible for driving the process of innovation of the entire economy for the entire length of a long wave of economic development.

1.5. Thesis Outline

In line with the arguments laid out in the previous sections, the next chapter includes a review of the main neoclassical (with focus on the "New Economy") literature and neo-Schumpeterian accounts. After explaining their origins and their collocation among other economic theories, we describe and compare their viewpoints on the idea of innovation and change.

Chapter Three completes the literature review but also introduces some of the original ideas of this research: it starts by presenting theories of service innovations, whose contribution to the understanding of the *history* of the techno-economic trajectory of the information sector and the notion of *change* is fundamental. Moreover, it includes the presentation and the analysis of the evolution of Baumol's theories of cost disease and unbalanced growth, as well as the redefinition of the cost disease as a consequence of the existence of creative inputs.

Chapter Three is completed by two empirical exercises whose aim is to demonstrate the validity of the creative input as a source of economic stagnancy: after dividing and classifying activities by adapting concepts of the service innovations literature, we demonstrate that activities that are more dependent on the creative input are the most stagnant, first taking a sample of activities within the cultural industries, and then by dividing all the economic activities of the U.S. economy (except agriculture) between stagnant, asymptotically stagnant and progressive.

Chapter Four presents the first of the evolutionary accounts of the information sector. Each chapter that is part of this historical review has a double objective: one common to all, which is describing the evolution of the techno-economic trajectory by employing a common notion of innovation, and a second one that is specific to the story presented. The first of these chapters contains a short description of the evolution of the semiconductor industry, but it is mainly focussed on the computer manufacturing industry. It describes the evolution of this industry from an activity characterised by its sales of high-technology products and by small and minor service branches, whose main purpose was to support customers and increase the value added of the technology sold, to an activity mainly focussed on selling services.

The most important point we make in this account of the "services-ation" of computer manufacturing activities is that the change of focus from manufacturing to services is more revealing than the change of proportion between revenue shares. In fact, innovation in this industry is now more demand and service-driven and innovative efforts focus on the delivery of new services, while new technologies are designed to be functional and to add value to these new services.[9]

Chapter Five describes the literature on modularity. Although we consider this literature as a contribution to theories of service innovation as it can be used to interpret and understand change, the theoretical, economic dynamics it describes are deducted from changes in the semiconductor and computer industries; therefore it follows the evolutionary account of the IT sector of Chapter Four.

Chapter Six focuses on the wireline telecommunication industry and its regulatory changes. In this account, organisational changes are compared to modular changes of a system, and the role of the regulator is compared to the one of a system architect. In other words, we describe the decisions of the regulator taken in order to put in place new interfaces or "rules of the game" in the attempt to separate different activities (i.e. the modules) within the industry. The criteria shaping these *rules of the game* are selected in order to offset the shortcomings resulting from the separation of activities into different companies and/or different ownerships.[10] The many examples presented in the study of this industry, including the specifications of *rules of the game*, justify the use of the modularity literature as an appropriate theory to understand change in the service industry.[11]

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[9] This change of focus from manufacturing to service activities can be observed in the business models of many activities that have been developed during the New Economy: for example, many software companies sell copies of their products rather cheaply, sometimes at production costs, and generate most of their revenues from the services they provide with their products: training, consultancy, technical support, etc.

[10] For example, when long distance communication was a monopoly of AT&T, the knowledge regarding how the price of a long distance communication was determined by the costs of the local loop and of the long distance network and in which proportion, was tacit and privately owned by the company; with the separation of the two markets (long distance and local loop), this knowledge had to become public information, for the use of many current and new potential communication providers.

[11] The evolution of the wireless telecom industry, on the other hand, is part of the appendices: this account is used to explain the process and the advantages of different approaches leading to the formation of standards. Two main dynamics of standards' formation are contemplated here: one where the central authority plays a bigger role in the standard selection and one where the

Chapter Seven examines the case of the audiovisual media services. As in Chapter Six, we compare the evolution of this set of service activities to the one of a system; however, in this case the main objective of this service industry is to provide different types of experiences to users, of which feature films exhibition, broadcast television, and home entertainment systems, all represent a different kind. Providers of these different types of experience have in common the use of audiovisual material, such as feature films or television programmes, as the main inputs.

Chapters Eight, Nine and Ten present the conclusions of this study. The first of these chapters focuses on the audiovisual media industry. Based on the account of the previous chapter, in light of the suggestions of the modularity literature and the analysis of Baumol's cost disease, Chapter Eight delivers arguments which address the following research questions: what criteria can we use to define "quality" in the delivery of media entertainment experience? From the viewpoint of the final consumers, what are the advantages and shortcomings of a concentrated sector as opposed to a sector where activities are more separate but interdependent? How are these two models related to the existence of a cost disease? How is innovation fostered in this sector? Does the new direction taken by regulatory changes facilitate the innovation process in the sector?

Chapter Nine critically engages with some New Economy claims grounded on mainstream economic analysis and provides a critique of these claims based on the analysis of the information sector carried out in this research.

Chapter Ten, starts from a comparison between sub-sectors and presents a summary of the key concepts and notions used to characterise the information sector and of the original contributions presented in this research. These key concepts include the idea of technological trajectory, the role of organisational change, technological convergence, mass-customisation and the services-ation of information industries, as well as the role of the regulator. Moreover, arguments explaining the shortcomings of merger and acquisitions between activities vertically connected in the value chain of the production of information products are presented. This chapter ends with an analysis of the shortcomings, and an explanation of the future developments, of this research.

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standard selection process is more market based. In order to characterise different forms of the two standards, the evolution of several generations of mobile communications' tools and networks, also between the US and Europe, are compared.

Chapter 2 - Explaining the Impact of Innovation on the Economic Performance of the Information Sector: a Literature Review

"economic theory learns nothing from economic history, and economic history is as much corrupted as enriched by economic theory"
(Solow 1985 p328)

2.1. New Economy Claims and the Need For an Historical Perspective: an Introduction

A lot of hope and expectations have been put into the developments of the Information and Communication Technology (ICT) sector in the last few decades and their consequences for the economic realm: technically grounded ideas such as *Grosch's Law* (computer power increases at the square of the cost), the famous *Moore's Law* (semiconductor's performances double every eighteen months) and *Metcalfe's Law* (the cost of a network increases linearly, the value exponentially) have become classic leitmotivs of the financial and economic press.

As economist Paul David once wrote (1999 p2):

> "Not since the opening of «the atomic age,» with its promises of power too cheap to meter and threats of nuclear incineration, has a technology so deeply captured the imagination of the public."

Many recent changes in developed economies are deemed to be direct and indirect consequences of the rapid technological innovations in new ICTs and their diffusion and application in most, if not all, productive activities. This has been a particularly prominent theme in recent studies of the United States (US) where the New Economy has seemingly started and materialised (see for example DeLong and Summers 2002 or Nordhaus 2002). The relevant changes include facts, such as an observed and empirically quantified low level of inflation, increased production and employment especially in the second half of the nineties, and claims which are trends that cannot be empirically justified or precisely analysed within a long-term historical context.

A famous claim of interest here concerns the new role of regulators, as stated by DeLong and Summers (2002). According to these authors, the economy is moving from "Smithian", characterised by "rival" goods which cannot be consumed by more than one user at a time, and by competitive markets with constant return of scale, to “Schumpeterian”**,** where innovation is the key factor for growth and *increasing economies of scale are more frequent*. Given the growth of oligopolistic and monopolistic market structures in the “Schumpeterian” economy, the model of automatic regulation of the market that leads to maximised consumer welfare is only applicable to a lesser extent.

The New Economy is not a phenomenon or belief that is confined to the financial press and economists’ academic writings; it is often associated or even identified with *Globalisation*, a process debated in other disciplines to describe intensified space-time compression and a tendency towards convergence and standardisation of cultures, languages, politics and other elements in the social, cultural and political spheres. As explained by Mann (1997 cited in Preston and Kerr 2001) the group of supporters of the Globalisation thesis comprises sociologists, political and cultural theorists and business economists, who “agree about very little” else except that contemporary changes are weakening the nation-state and the salience of national identities (p473).

In this context, activities included in the Primary Information Sector play a key role. In fact, semiconductor, computer, software manufacturers and telecommunication providers are deemed to have assumed the role of new leading sectors as they create, use in the most efficient way and deliver the latest innovations. However, these are not only taken as leading-edge economic entities because of their fast increasing share of output. They are also assumed to have a pervasive influence on the rest of the economy, not least as their products are thought to increase productivity in every sector where they are employed.

The diffusion of information and knowledge is also playing an important role in shaping the economic realm, on the one hand, but also contributing to the globalisation process on the other hand. Thus, in order to understand current and emerging socio-economic developments, it is important not only to study the sector that provides most of the technologies for the distribution of information, but also the activities that create, package, distribute and deliver knowledge, information or more generally content, such as the case of the industries within the media sub-sector.

2.2. Theories of Economic Change: The Origins and Main Principles

There is certainly a large number of economic writings celebrating the New Economy as an unprecedented event; here, we take the first step towards our goal of explaining what is really *new* about the New Economy by (briefly) describing the origins and reviewing the main characteristics of two bodies of literature we are going to draw from, in order to understand the dynamics of economic change.

2.2.1. Mainstream Economics: from the Classics to Neoclassical New Growth Theories

Firstly, this review considers the viewpoint of writings considered to be “mainstream” economic literature. Many literature reviews (such as Hunt and Schwartz 1973; Hunt, and Sherman 1990; Hodgson 1993) identify the fathers of the *classical* and mainstream approach with authors such as Adam Smith (1776), David Ricardo, Thomas Malthus, John Stuart Mill (e.g. 1844), Jean Baptiste Say (e.g. 1819), to name just a few fundamental contributors. These authors investigated and expounded on important ideas in the field of economics, such as the laws of supply and demand, the dynamics and the benefits of the market and the idea of economic change. Their approach was multidisciplinary, drawing from humanistic studies in the fields of philosophy, political sciences, but also, as Hodgson describes (1993) from more scientific approaches such as the natural sciences.[12]

The more modern neoclassical approach, which stems in part from the ideas of these authors, has also been identified as the current “orthodoxy” by some of its critics (e.g. Nelson and Winter 1982) because of its overpowering influence in the fields of economics, not only because it provides the main source of inspiration for policies, but also because of its “academic” power of defining the boundaries of the economic field in terms of “suitable” assumptions and methodology.

Neoclassical theories, on the one hand, build from the principles of the classic authors mentioned above, and on the other hand, they are characterised by the algebraic accuracy of the theoretical background’s formulation, which is possible through the endorsement of fundamental assumptions on human behaviour and on market dynamics. The most frequently used neoclassical assumptions, according to Gomulka (1990), are: (1) a rational and perfectly informed optimisation-decision-making process by all individuals, (2) the absence of profit or loss by firms in perfectly competitive markets and (3) the existence of prices of goods matching supply offers and consumer demand.[13] However, not all of the writings that can be considered neoclassical share *all* or *all of the same* assumptions. Many writings for example, investigate the consequences that the relaxation of one or more of these assumptions brings to the model. Nevertheless, while the assumptions of neoclassical models might vary, the separation of economic dynamics from their more general “social” context and the centrality of mathematical modelling for demonstrating these economic dynamics are common characteristics of this line of thinking.

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[12] The author is aware of the high degree of imprecision of this very short literature “review” of classical economic writings. The only purpose of this point is to introduce the review of the theories that are relevant to this research and to report the interesting observation that classical economists had a multidisciplinary approach.

[13] With the notable exception of public and “free” goods.

A review of the work of classical and neoclassical authors, however, is not the purpose of this chapter; as indicated in the introduction, its focus is to define economic change according to different theoretical perspectives. According to mainstream economics, "economic evolution" is fundamentally defined as economic growth and in more practical terms with the expansion of the Gross Domestic Product (GDP), which is measured in monetary terms as either the sum of outputs, revenues or value added of a country. The most recent studies analysing the dynamics of economic growth within this framework are part of the research-area labelled "New Growth Theories". In more practical terms all models and theories which are extensions and\or refinements of Solow's (1956 1957) fundamental work are included in this subject-area.

In Solow's (1956 1957) pioneering model he explains growth as the result of an increase of capital (machinery or human) and a residual factor, which is supposed to include the effects of the advancement of quality of the capital used, in addition to unavoidable statistical errors. In the case of machinery and other equipment, capital quality is assumed to increase mainly as a consequence of technical change, while, on the other hand, training, general education and managerial decisions explain labour quality improvements. The quasi-totality of models that follows Solow's example are focused on adding more variables or re-fine the estimates of capital and labour, in order to better explain this "residual element" .

In this regard, a very interesting classification method is proposed by Amable (1994). In his paper, this author provides multiple criteria to classify traditional and New Economic Growth models. The first criterion is the **type of competition mechanism** that is assumed in the different models. This can be of "perfect competition", as a result of constant returns and the consequent absence of economies of scales or externalities, "imperfect competition", which normally assumes the existence of increasing returns to scale; or Marshallian externalities, which denote the existence of externalities in a situation of perfect competition. The second criterion is the **main source of growth** identified in the model. This can be the accumulation of physical capital through investment (e.g. Solow 1956 and Rebelo 1990), technological innovation and resources invested in R&D (Romer 1990, and Aghion and Howitt 1992), the accumulation of human capital (Lucas 1988) or the role played by the existence (and investments) in public goods and infrastructure (Barro 1990, and Barro and Sala-I-Martin 1992). A third criterion, although not contemplated here, is related to **the measure of growth**, whether this is measured in terms of output or utility.

However, there are many shortcomings identified with this type of approach and most of them point at the traditional and general weakness of the neoclassical approach: unrealistic assumptions and strictly binding conditions imposed by algebraic requirements. In fact, as Amable explains (1994), all models rely on "razor's edge" conditions that justify the existence of a steady state of growth. If parameters are slightly modified, the trend of growth explained in the model can either collapse or explode. Moreover, one of the most important limits of any of the model belonging to the neoclassical tradition is the fact that each considers *one source* of innovation at a time. Of course, this is an important oversimplification of the dynamics of change, which are manifestly a complex phenomenon and which seems definitely better explained by approaches based on historical accounts. Indeed, these not only take into account several factors, but also the environment outside the pure economic realm. As Robert Solow explains in a paper relating economic growth studies to economic history, that given the limits of analytical economic models, these should be used to (Solow 1985 p329):

> "Organize our necessarily incomplete perceptions about the economy, to see connections that the untutored eye would miss, to tell plausible - sometimes -even convincing - causal stories with the help of a few central principles, and to make rough quantitative judgments about the consequences of economic policy and other exogenous events."

Moreover, this set of theories does not provide an explanation for long term period of slow economic growth, such has been the timeframe including the 1970s up to the beginning of the 1990s; the only explanation for such a phenomenon that can be worked out within the orthodox hypothesis is a situation caused by external shocks, temporarily deviating from the equilibrium trajectory of steady growth. Alternatively, economic accounts based on historical analysis provide a structured theory of long-term waves of development, mainly dependent on technological change.

2.2.2. The Neo-Schumpeterian Approach and the Analysis of Long Waves of Economic Development

According to Dosi and Nelson (1994), the evolutionary line of thought represents an attempt to adapt Darwinian principles of evolution to the field of economics. Generally speaking, firms are seen as creatures struggling for survival in a competitive environment; the "fitness" of the firm will determine its survival and the survivors will influence the environment. More specifically the main characteristics of this type of account, according to these two authors can be summarised as follows: it implies an analysis that is expressively dynamic, meaning that the explanation of something is to be looked for in its development; such explanations accept the existence of random elements that have an influence on variables, but also the existence of mechanisms that systematically deal with variations. Models in the evolutionary approach assume a system of discovery based on imperfect learning, or in other words, mistake-ridden. Some key fundamental works in this line of thought include contributions from Nelson and Winter (1982), Winter (1984), Dosi (1988) and Dosi and Nelson (1994).

Moreover, evolutionary economic theories can certainly be said to have a strong inclination to be comprehensive economic analyses of historical trends, and to use the analysis of past events as a starting point and fundamental framework for understanding current and future developments. Therefore, most writings provide theories and models that are not as abstract as in the neoclassical approach as they are backed up by illustrations of past events; in most cases, therefore, these theories and the models do not require the same type of simplifying assumptions used by neoclassical models.

Those evolutionary economic accounts that focussed on the study of macroeconomic dynamics provide the theoretical background, the economic rationale and causal explanations for long waves of economic development. These long waves of economic developments are structural changes responsible for an output and productivity upswing and downswing for a total of 47 to 60 years and although Kondratieff (1928) was not the first to work on long waves analysis, as his work followed the ones from Hyde Clark (1847), De Wolff (1925) and Van Gelderen (1913) (Louçã and Reijnders 1999; Freeman 1992), his writings represent the most important and pioneering contributions to their explanation.

There are many different attempts to explain the dynamics of long waves; for example, among these are new accounts of the Marxist tradition. These accounts look at tensions between social classes or as the result of power struggles for the explanations of long waves of economic development. The most important analysis within this type of approach was formulated by Mandel (1992) and by the "Regulationist school" led by French economists Aglietta, Boyer, Mistral and Lipietz.

Kondratieff is also thought to have had a fundamental influence on "Schumpeterianism"; firstly, because, as Freeman (1992) points out, not only did he pioneer the quantification of long wave cycles with modern statistical methodology, but also, he was the first to explain the dynamic of the long waves with endogenous factors, a characteristic that seems to be a common principle in both Schumpeterian and neo-Schumpeterian thinking.

According to Clark (1985), Schumpeter's main line of argument has changed during his career. Starting from a viewpoint that is compatible with a neoclassical approach, notably in his "Theory of Economic Development", Schumpeter (1911) argues that economic development is pushed by "heroic entrepreneurs" investing in innovative technologies in the search for profits. The process of diffusion of the new technology and the competitive environment, clearly following a neoclassical scenario, cancels out any profits in the short-medium term. The later Schumpeter, author of "Capitalism, Socialism and Democracy" (Schumpeter 1942), departs from the idea of perfect markets. As Clark reports (1985), R&D plays the crucial role of indirectly fostering economic growth, through innovation. Moreover, R&D is associated with large enterprises and monopolistic or oligopolistic market structures.

From Schumpeter's heritage a new set of literature, influenced by Marxist and neo-Marxist analyses, and with aspirations of providing a contribution to macroeconomic theories, was born. Some of the most important writings in the neo-Schumpeterian tradition are certainly the works of Freeman and Soete (1997) and of Freeman with Louçã (2001), where the authors present historical descriptions of the waves of technical changes that have marked the four (and the beginning of the fifth) different Kondratieff waves; the work of Perez (1983 1985 1986) and Freeman with Perez (1988), on the other hand, are often referred to as the theoretical frameworks for these historical analysis. As mentioned above, this type of analysis relies on the study of past trends to explain current and future developments; moreover, they focus on the role of R&D and innovation as a key element for progress and on the interaction between firms, society and institutions.

2.3. Producing Growth and Increasing Welfare through Technical Change and Innovation

After having briefly characterised neoclassical and neo-Schumpeterian accounts and their origins, it is now time to turn to explain and compare "how" innovation affects economic growth / evolution according to these sets of theories.

2.3.1. Innovation, its Sources and Effects According to Neoclassical Theories

First, we start by presenting the main economic questions and problems which became the subject of a literature that originates from the neoclassical New Growth Theories and that we refer to as the Productivity Literature; second, we move on to introduce two of the main frameworks that are used in these studies and a third that, although much less popular, is used later on in this research to demonstrate the existence of a Baumol Cost Disease. Thirdly, we summarize the results of this body of literature and illustrate its influence on the official (BLS and BEA's) productivity statistics. We end this section by highlighting the shortcomings of this type of literature and the questions left open: questions that find answers in the writings of the neo-Schumpeterian school of thought, which is the subject of the next section.

2.3.1.1. From Productivity Paradox to Productivity Literature

Productivity is possibly the single most important indicator in economics. As simply expressed in the Economist (2000 p1):

> "the main reason why the average American today is seven times better off than his counterpart at the turn of the century is that he is seven times as productive."

As outlined by Federal Reserve economists Steindel and Stiroh (2001), textbook economics suggest that productivity growth and growth of real wages are equal. This happens of course in the theoretical framework with one good produced and constant returns of scale; however in the real world, productivity trends and real wages are positively correlated. This relationship can be weak in the short term but is normally stronger in the long run.

Productivity measurement not only is important to determine real wages, but more importantly to determine a government budget: future inputs trends, such as labour and capital, are relatively stable, therefore easy to forecast. Consequenly, productivity trends are key elements that need to be estimated in order to understand what these (easily predictable) future inputs will produce and what (taxed) proportion of this production will be available for a government to spend.

However, more importantly for the focus of this research is another indication that the level of productivity provides: the level of technological change. It is by referring to this meaning that in the mid 1980s and following almost two decades of sluggish productivity growth that Solow famously pointed out (1987) that "you can see the computer age everywhere, but in the productivity statistics" (p36).

Already at the time, in the opinion of a large majority of economists, the diffusion of computers was supposed to be at the origin of an unprecedented economic revolution; therefore explaining the productivity paradox became the core research question of a (now) large body of literature specialised on productivity trends.

This body of literature (the *productivity literature*) has the same roots, i.e. Solow's fundamental work (1956 and 1957), and shares many methodological aspects with the New Growth Theory approach; however, it has a different focus. In fact, while New Growth Theory models try to explain growth by comparing different countries and their evolutionary paths and focussing on the question of economic convergence of the different countries, the *productivity literature*, alternatively, develops Solow's model in order to look into the weight and importance of different factors in determining productivity trends.

Contributors to this literature mainly share the same few basic models; examples of these models and of the methodology used are presented below. Also explained in more detail below is that the main difference among these studies is the way in which estimates of capital and labour, which incorporate qualitative changes, are calculated. These models are the result of the pioneer works of Denison (1962) and Jorgenson and Griliches (1967) who, according to Gordon (2000a), were the first to try to include quality in their inputs' estimates.

Some of the most influential writings of this school of thought include writings from Jorgenson and Stiroh (2000), later also in collaboration with Ho (2002), Triplett and Bosworth (2003) and Federal Reserve economists Oliner and Sichel (2002) and Gullickson and Harper (2001).[14]

These papers try to measure the impact of the ICT industry on the economy, with the underlying hypothesis that productivity trends are currently underestimated and that the ICT sector has had a bigger impact than the one measured by the current "official" methodology (i.e. of the Bureau of Economic Analysis – BEA).

Alternative in some respects but certainly influential, is the viewpoint provided by Gordon (1999, 2000a, 2000b, 2002). Using different estimates of (quality constant) inputs of capital and labour and longer time series starting from before 1959, he suggested that the change in productivity trend observed from 1996 was mainly the result of a methodology change, but also explained by a favourable business cycle. His hypothesis stemmed from the belief that the effects of the ICT industry on the overall economy were of minor importance compared to the consequences of the "major" inventions of the past, such as the steam engine or the electric light, and that the claimed "New Economy" was of a more modest extension than the economic revolutions that have been fostered by these inventions.

These writings were all published in the first years of the new millennium, when productivity was growing, but the concept of New Economy was loosing ground following the dotcom crash and the recession that followed the terrorist attacks of September 11, 2001.

In the next section, I present the current viewpoint of the official statistics that represent the main source of data of writings of productivity literature.

2.3.1.2. The Productivity Trend Revival in the Official Statistics

As explained in more detail in the methodology sections, there are two main measures of productivity: the first is a measure of output per hours worked and is normally referred to as Average Labour Productivity (ALP). It is an estimation of the average capability of human capital of producing a given output. The second measure, Total Factor Productivity (TFP or Multifactor Productivity MFP) is the measure of the "residual", the increase in output that is not the result of increase in the quantity or the quality of capital and labour employed. As a result, it is commonly identified with a general concept of "level of technology". However, given that this measure is estimated as a residual, it also incorporates all the other changes that are not captured by the other factors: economies of scale, any unaccounted inputs, resource allocations,

[14] See Stiroh (2002) for a literature review of the subject.

and also measurement errors and potential bias due to approximations (Steindel and Stiroh 2001).

It is recognised that productivity trends have an important cyclical component and they can vary significantly from one year to another.

In the long run, productivity always grows; therefore data indicating the average productivity trend from 1948 to today will just provide a poor piece of information. What is more interesting is to compare productivity trends to economic analysis and determine why in some periods this growth can be faster than in others; it is useful to break down productivity time series into intervals. The choice of this interval should be taken in order to represent economically consistent periods; however, this choice is subjective and of course it determines the magnitude of the average figures.

Table 1: BLS Productivity Measures, 1958-2006

Intervals	***Average % increase per year***	
	Output per Hour (ALP)	***Multifactor Productivity***
1958-1973	2.82	1.96
1974-1995	1.40	0.39
1996-2006	2.70	*1.41*

Source: Averages are own calculations; data available from http://www.bls.gov, [retrieved July 2007][15]

Here the choice has been made to (roughly) follow Steindel and Stiroh (2001) in their choices of intervals and to apply these intervals to currently available BLS statistics. As reported in table 1, ALP grew by 2.82 percent on average in the period from after the war until 1972/1973. Following these golden ages of productivity growth, the American economy experienced a period of weak increase, reaching an average level of 1.40 percent per year between 1974 to 1995. The revival of productivity trend, which provides the main argument for the existence of a New Economy, according to the official statistics has started in 1996 and is still ongoing. Since that year and up to 2006, on average, output per hours worked has increased by 2.7 percent, a level similar to the one the American economy had reached in the much celebrated 1960s.

Almost identical trends but different measures are observed when multifactor productivity is considered. The annual increase of overall technological level was 1.96 percent between 1958 and 1973. This same measure dropped to 0.39 percent between 1974 and 1995; while the revival

[15] The interval of the 1996-2006 MFP measure is calculated using a different Accounting System than the previous intervals.

starting from 1995/1996 is then characterised by an annual level of average multifactor productivity increase of 1.41 percent.

2.3.1.3. The Neoclassical Viewpoint on Innovation and Economic Performance: the Productivity Literature

In order to explain how the productivity estimates just presented are calculated and, more importantly, to explain the neoclassical viewpoint on innovation and economic growth, three models are reviewed in this section. The first two of these models can be referred to here as (1) the "*sources of productivity growth model*" and (2) the "*industry aggregation model*". These are two examples of established methodologies; many papers investigating on the effects of the New Economy employ these models and differentiate themselves on the methodology employed to compute the data series used as variables (e.g. capital services) in these models.

I label the third model presented here as the "Nordhaus" model from the name of its author; in this model, the growth of productivity is explained as the result of three different dynamics or effects. This model is particularly important in this research, as it will be employed below to demonstrate the existence of the Cost Disease.

The Sources of Productivity Growth Model

The modern methodology used in this model for explaining the sources of labour productivity stems from the framework proposed by Solow (1957 1960) and developed more recently by Greenwood, Hercowitz, and Krusell (1997) (Jorgenson and Stiroh 2000).

As explained in the original Solow model, annual income can be explained by inputs of capital and labour and a residual, calculated by exclusion, and representing a theoretical level of technology allowing an increase of output (or income in this case) that is more than proportional to the increase of inputs (capital and labour in this case). The clear problem of the original Solow model is of course the absence of "qualitative-adjustment" ratios: from a theoretical point of view, all investments are perfect substitute over time (Jorgenson, Stiroh 2000).

This model develops from the fundamental identity of the Production Possibility Frontier (PPF) and relies on common neoclassical assumptions: these include perfectly competitive markets and constant returns of scale in every sector; complete mobility of input factors capital and labour, and the omission of any adjustment cost necessary to substitute capital (Oliner and Sichel 2002). The PPF can be represented as follows (Jorgensen and Stiroh 2000; and Steindel and Stiroh 2001):

$$(1)\ Y(I_t, C_t) = A_t \cdot X(K_t, L_t)$$

The equation describing the PPF shows that the aggregate output (Y), which is composed of investment goods (I) and consumption goods (C), is determined by the a production function (A) which is applied on the aggregate input (X) composed of capital services (K) and labour services (L).

In terms of growth, this identity can be represented using log-linear terms and by adding weights. The growth of the (weighted) terms of output is equal to the growth of (weighted) inputs and a residual term (Jorgenson and Stiroh 2000):

$$\overline{w}_{I,t}\Delta \ln I_t + \overline{w}_{C,t}\Delta \ln C_t \quad = \quad \overline{v}_{K,t}\Delta \ln K_t + \overline{v}_{L,t}\Delta \ln L_t \quad + \quad \Delta \ln A_t \tag{2}$$

Share-weighted growth of outputs	=	***Share-weighted growth of inputs***	***And***	***Growth of TPF***

Where $\overline{w}_{I,t}$ is the investment's average share of nominal output; $\overline{w}_{C,t}$ the consumption's average share of nominal output; $\overline{v}_{K,t}$ the capital's average share of nominal income and $\overline{v}_{L,t}$ the labour's average share of nominal income. Naturally, the sum of weights is equal to one; $\overline{w}_{I,t} + \overline{w}_{C,t} + \overline{v}_{K,t} + \overline{v}_{L,t} = 1$.

An advantage of this model is that it allows a breakdown of different (but mutually exclusive) sets of inputs and outputs: Jorgenson and Stiroh (2001) for example divide the total capital services (K) into computer capital, software capital, communication capital and other capital; while total consumption services can be broken into computer and software; non-computer or software. This breakdown represents the first step to understand the sources of productivity growth: for example, by calculating the contributions of the different factors, these authors estimate that computer investments grew by 0.385 percent between 1995 and 1998 or the equivalent of just over 8% of the total growth of Private Domestic Output (Y).[16]

The most fundamental equation of the *Source of Productivity Model* is one explaining the relationship between Average Labour Productivity (ALP) and Total Factor Productivity (TFP). ALP can be defined as output per hour worked or $y_t = Y_t / H_t$, where Y_t is the output at time t and H_t is the total or hour worked, while the ratio of capital services to hours worked can be

[16] As long as the components are mutually exclusive, different sets of contributions can be calculated: Jorgenson, Stiroh and Ho (2002) and Oliner and Sichel (2002) for example use a similar breakdown of the contribution of capital services, while Jorgenson, Stiroh and Ho (2002) "disaggregate" output into Information Technology (IT) investment goods, computer hardware, computer software, communications equipment, and all other non-IT output.

expressed as $k_t = K_t / H_t$. These formulae are integrated in equation (2) and after manipulation we obtain an expression for ALP's growth that is the sum of different contributions is obtained (Jorgenson and Stiroh 2000; Steindel and Stiroh 2001):

$$\Delta \ln y_t \quad = \quad \bar{v}_{K,t} \Delta \ln k_t \quad + \quad \bar{v}_{L,t}(\Delta \ln L_t - \Delta \ln H_t) \quad + \quad \Delta \ln A_t \tag{3}$$

ALP = ***Capital Deepening*** + ***Labour Quality Improvement*** + ***TFP***

In other words, ALP is explained by the penetration and use of new and more productive capital by workers (the capital deepening) plus labour quality improvements and the total factor productivity, which, as described above, is not only the measure of the hypothetical level of technology, but also includes the effects of factors that are not accounted for, because of the way the expression is formulated and/or because of the model's assumptions (e.g. economies of scale and any unaccounted inputs).

Of course, all of the terms in the equation above are estimated; the equation is then used to reveal the correlation between these terms. By estimating the terms of the equation, i.e. labour and capital services, attempts are made to include "quality" and the methodology used to produce these estimates, which according to Gordon (2000a) is built on the pioneer works of Denison (1962) and Jorgenson and Griliches (1967), is actually what really leads users of the *sources of productivity model* to present different results.

On the one hand and generally speaking, estimates of labour inputs are obtained through a system of weights, built on relatively available and reliable data, which increases the quality of the labour input according to professional experience and qualification. On the other hand, including qualitative aspects in the contribution of capital to aggregate productivity measures represents a much more complicated challenge. This challenge presents two difficulties: the first is to capture in aggregate productivity the effects of increases obtained by a shift towards a utilisation of more productive capital; the second, is to capture the effects of ameliorations of the same type of capital over time. Both aspects need to be included in one time series (Steindel and Stiroh 2001).

The solution to the second part of this challenge, or the inclusion of qualitative aspects of capital assets over time, includes the use of deflations methods that incorporate quality changes. Notably, in order to attach a value to the computer's price series (and to other important IT components) that could better reflect the rapid technological change, in 1999 the BEA adopted hedonic price measures for its official National Income and Product Accounts (NIPA) data. In terms of effects on the estimates, the application of these measures considerably lowered the trend of computer prices, so that, a computer today is several times cheaper than a hypothetical computer dated ten years ago capable of the same technical performance.[17]

The estimation of capital services which reflects changes in the composition and amelioration of capital requires additional modelling. For a start, capital services are supposed to indicate the use and benefits drawn from, or the *marginal product* of the current stock of capital; this stock and its current value, notably, cannot be observed and has to be estimated. What is observed and used to build the concepts of capital services are investments, which can be transformed in qualitatively constant using the price deflators mentioned above, and tax rates. The latter of these are used in combination with depreciation rates to calculate rental prices, which are used as weights to aggregate the different types of capital. The use of rental prices as weights, according to a methodology introduced by Jorgenson and Griliches (1967), is justified by the fact that the bigger the marginal product of a certain type capital is, the bigger its contribution to the aggregate level should be (Steindel and Stiroh 2001). In a situation of perfect competition, as traditional neoclassical assumptions require, the marginal product of capital is equal to its cost which in turn is equal to its (rental) price (see Appendix A for more details).

The Industry Aggregation Model

Another measurement technique used by the authors of the "measurement error" thesis to better understand the evolution of the current productivity revival is a breakdown of the aggregate multifactor productivity.

According to Jorgenson and Stiroh (2000) the ***industry aggregation model*** is based on Domar's work (1961). The fundamental relationship of this model is the following:

$$(4)\ Q_i = A \cdot X_i(K_i, L_i, E_i, M_i)$$

Where Q indicates the output; K the capital services; L the labour services; E energy and M the materials of the industry i (time notation has been omitted for simplicity). After a short manipulation, this equation can be expressed as follows:

$$(5)\ \Delta \ln Q_i = \overline{w}_{k_i} \Delta \ln K_i + \overline{w}_{L_i} \Delta \ln L_i + \overline{w}_{E_i} \Delta \ln E_i + \overline{w}_{M_i} \Delta \ln M_i + \Delta \ln A_i$$

[17] Hedonic price measures exist for computers and peripheral equipment, semiconductors, pre-packaged software, and digital switching equipment (Nordhaus 2002). Other changes to the NIPA methodology which are part of the 1999 revision include the reclassification of software as a capital investment and the use of new data on banking transactions provided by the BLS to calculate the output of the banking sector (Gullickson and Harper 2001).

Where $\overline{w}_{I_i}$ is the average share of the input I (K,L,E or M) in the industry *i*; by assuming constant returns to scale and competitive markets, $\overline{w}_{K_i} + \overline{w}_{L_i} + \overline{w}_{M_i} + \overline{w}_{E_i} = 1$.

Domar (1961) first showed the relationship between this last equation and total factor productivity growth. According to his methodology, the aggregate TFP for the economy can be expressed as the weighted sum of the productivity of each industry, as expressed in the following equation (Jorgenson and Stiroh 2000):

$$(6)\ \Delta \ln A = \sum_{i=1}^{37} \overline{w}_i \cdot \Delta \ln A_i \text{, where } \overline{w}_i = \frac{1}{2}\left(\frac{P_{i,t} \cdot Q_{i,t}}{P_{Y,t} \cdot Y_t} + \frac{P_{i,t-1} \cdot Q_{i,t-1}}{P_{Y,t-1} \cdot Y_{t-1}} \right)$$

The numerator of Domar weights is based on a gross output concept: each industry's output (Q) includes the goods sold to the final demand as well as the goods sold to other industries as intermediary inputs. Although there are other specifications of Domar's weights, what they all have in common is that, because of the use of gross output in the numerator (*Q*) and of the aggregate output in the denominator (*Y*), the sum of the weights is bigger than the unity.[18]

This technique of aggregation is used to isolate the contribution of different inputs (Capital, Labour, Energy and Material) to an industry's productivity growth; moreover, it allows for the calculation of productivity growth of each industry and its contribution to the aggregate TFP. For example, this technique is used by Jorgenson and Stiroh (1999 and 2000) to analyse the contribution of approximately thirty-five sectors (roughly the first two figures groups in the Standard Industrial Classification - SIC -classification), and by Triplett (1996) and Oliner and Sichel (2002) to isolate the contribution of semiconductors.

The Nordhaus Model

The model described in this section was first developed by Nordhaus (2002) and more recently updated by Tang and Wang (2004). According to these authors, the rate of growth of real output per unit or labour input X_t, can be described as follows:

$$(7)\ g(X_t) = \frac{X_t - X_{t-1}}{X_{t-1}}$$

---

[18] For example, another basic formulation of Domar's weights, used by Jorgensen and Stiroh (1999), is the following: $\overline{w}_i = P_i Q_i / P_y Y$, where $P_y Y$ is the current dollar aggregate value added.

And after reformulation, it can be decomposed into three different effects. This is represented by the following equation: (Tang and Wang 2004 p425)[19]

$$(8)\quad g(X_t) = \sum_i w_{t-1}^i g(X_t^i) + \sum_i x_{t-1}^i \Delta s_t^i + \sum_i x_{t-1}^i \Delta s_t^i g(X_t^i)$$

Where:

- X_t indicates the real output per unit of labour at time *t*, at the aggregate level (X_t) or of the industry *i, (* X_t^i);
- x_{t-1}^i is the labour productivity level of the industry *i* relative to the aggregate labour productivity level at the beginning of the period, X_{t-1}^i / X_{t-1} ;
- Δs_t^i is the change in relative size of industry *i* from *t-1* to *t*, ($s_t^i - s_{t-1}^i$), where s^i (defined as $s^i = p^i l^i$) is the labour input share ($l^i = L^i / L$), adjusted for its real output price ($p^i = P^i / P$);
- w_{t-1}^i is the nominal output share of the industry *i* at the beginning of the period and equal to $x_{t-1}^i s_{t-1}^i$

Three effects or contributions that compose the concept of aggregate productivity, defined here as the growth of output per (thousands) of persons employed, are:

- The ***pure productivity*** effect, $\sum_i w_{t-1}^i g(X_t^i)$: Aggregate productivity increases because productivity increases within industries. Industries' contribution to the aggregate is proportional to their size. In the Tang and Wang as well as the Nordhaus specifications of the model, this effect is calculated as the weighted sum of the productivity growth

[19] $g(X_t) = \frac{X_t - X_{t-1}}{X_{t-1}} = \frac{\sum_i (s_t^i X_t^i - s_{t-1}^i X_{t-1}^i)}{X_{t-1}^i} = \frac{\sum_i \left[s_t^i (X_t^i - X_{t-1}^i) + (s_t^i - s_{t-1}^i) X_{t-1}^i \right]}{X_{t-1}} =$ $\sum_i \frac{X_{t-1}^i}{X_{t-1}} \left[s_t^i g(X_t^i) + (s_t^i - s_{t-1}^i) \right]$. Then by introducing x_{t-1}^i and Δs_t^i as defined above and by adding and subtracting $\sum_i x_{t-1}^i \left[s_{t-1}^i g(X_t^i) \right]$ we obtain $g(X_t) = \sum_i x_{t-1}^i \left[s_{t-1}^i g(X_t^i) + \Delta s_t^i + \Delta s_t^i g(X_t^i) \right]$; Then by introducing w_{t-1}^i as defined above, we obtain equation (8) (Tang and Wang 2004 p426).

rates, where the weights are equal to their nominal output shares at the beginning of the period.

- The ***changes in relative size,*** $\sum_i x_{t-1}^i \Delta s_t^i$: as Denison famously pointed out (1967, cited in Nordhaus), aggregate productivity increases when there is a shift of resources from agriculture to industry, or more in general, from low-productive to high-productive activities, and this without any ("pure") productivity growth at the industry level. This contribution in the Tang and Wang specification of the model is calculated as the sum of the weighted changes of relative size, where the productivity levels at the beginning of the period are used as weights.

- And the ***interaction effect,*** as named by Tang and Wang (2004), or the ***Baumol effect***, as named by Nordhaus (2002) and defined by the formula $\sum_i x_{t-1}^i \Delta s_t^i g\left(X_t^i\right)$. This contribution tries to capture any changes that are brought about by the combination of industries' slow productivity growth and increase of relative size, or industries' high-productivity growth and reduction of size. This effect is somehow the empirical testing of the unbalanced growth theory and the effects of the existence of a cost disease as described above. If the contribution is positive (as it is according to Nordhaus), it means that Baumol's prediction of unbalanced growth is not verified.

Indeed, the interaction effect provides a positive contribution to the aggregate productivity level if, between the starting and the ending year of the interval under investigation, the relative size of an industry shrinks and the productivity growth is negative or if the relative size of an industry increases and the growth of productivity is also positive. As it is going to be explained in more detail in the next chapter, any of these two last case scenarios work against Baumol's theory of unbalanced growth, as he forecasts an increase of relative size of the stagnant (and slow growing) industries. On the contrary, a negative industry's interaction effect on aggregate productivity sustains Baumol's hypothesis, as this is the result of a shrinking relative size and a positive productivity growth or an expansion of relative size coupled with a negative productivity growth.

As mentioned above, the Tang and Wang (2004) specification of the model is based on the previous model by Nordhaus (2002). The main difference introduced by Tang and Wang is based on the principle that real output price changes also influence the importance of an industry in the aggregate Gross Domestic Product (GDP). Therefore, they try to capture a "price" effect in the calculation of the series of weights named the **"relative size"** of an industry, by multiplying industries' labour shares (the "natural" approximation for the size of an industry when the object of the study is output per person employed) by the real output price of an industry (the ratio between the industry price index and the aggregate price index).

2.3.1.4. The New Economy According to the Productivity Literature

Many papers have been written about the 1996 revival of productivity growth and its foundations, using the same or similar methodologies already described. Here I report on the main results of, and opinions expressed in this literature.

Those writings investigating long term productivity trends tend to agree on a number of points: first, there was a period of sustained annual productivity growth between the end of the 1950s and the beginning of the 1970s; then a period of slow productivity growth in the 1970s, the 1980s and the beginning of the 1990s up to 1995, when the productivity revival is assumed to have started (Jorgenson, Ho and Stiroh 2002, Gordon 2000a, among others).

However, up to 2002/2003 the question of whether this revival was the result of a favourable business cycle and therefore short term and temporary, or the beginning of a new Kondratieff type of long wave of economic progress (and therefore long and structural) was one of the core issues in the productivity trend debate. Crafts (2002), for example, suggested (although implicitly) that ICT is at the origin of a structural change, as the aggregate productivity increase generated by its use (at least in its early days, between 1975 and 2000) is higher than the one triggered by the adoption of general purpose technologies such as steam in Britain (1780-1860) and electricity in the US (1899-1929).

On the other hand, the most notorious supporter of the short term characteristics of the productivity revival observed from 1995 was Robert J. Gordon. In his writings (1999, 2000a, 2000b, 2002) he provided mathematical evidence that recent productivity trends were in fact cyclical and he argued that ICT was not a source of an economic "forward leap" like the big inventions of the past. He suggested that new ICT has only limited capacities to expand people's capabilities (e.g. new powerful computers do not make people type significantly faster); that new technologies mostly provide different versions of existing services (such as business directories or shopping through catalogues) and that they are mainly used for leisure activities (e-mails, chat, etc). He also suggested that new ICTs do not improve labour productivity, indeed on the contrary, they are likely to distract workers from their tasks. His arguments seemed very sound and consistent and they also seemed to resonate with developments unfolding at the time they were published, i.e. concurrently to 2000 NASDAQ crash.

This view has been refuted by later studies, such as the recent writing of Jorgenson, Stiroh and Ho (2004), which mentioned not only the 2000 NASDAQ crash, but also the 2001 recession, the September 11 terrorist attacks, an investment bust, corporate accounting scandals, the war in

Iraq, and rising oil prices. Besides all of these events with potential negative impact, these later studies found a continuation of the steadily positive trend of the productivity wave initiated in 1995.

The combination of a widespread reduction of investments in ICT that took place during this time of uncertainty and the observed increase of productivity estimates seemingly convinced the formerly sceptical Gordon (2004) to accept the structural nature of the productivity wave and to endorse the mainstream line of thinking.

The second piece of evidence from this body of literature is that the leading industries of the ICT sectors, (i.e. semi-conductors and computer manufacturers, software publishers and telecommunications) have contributed *directly* and in virtue of their own high level of productivity growth and their increasing share of total output, to the acceleration of productivity growth in the overall economy.

The third piece of evidence is that the increase in investments in ICT has been the direct consequence of the progress of these leading industries and the steady reduction of prices.

However, there is an important question still open. This concerns the pervasiveness of ICT based technological progress with respect to the rest of the economy. Even though this is a question that the financial press seems to have already answered, *most* academic writing seems to currently leave it open for lack of consistent evidence.[20]

Therefore, over twenty years after the publication on the New York times of Solow's Productivity Paradox, the productivity literature seemingly provided a choral answer to it: this answer was that the effects of the computer age kicked in more than a decade later, from 1996, and that the lack of productivity increase in the late 1980s was partly due to measurement problems. Therefore, an imprecise share of the solution of the Paradox came from a change of methodology that certainly inflated the latest productivity statistics, although according to some, not in a decisive way.

Convinced of the pervasiveness of ICT investment to transform and ameliorate every productive process, theorists adopting the neoclassical growth accounting model searched for correlations between IT investments, output and other inputs; correlations that were missing at the time of the Paradox. That is why, seemingly, most of the authors who regularly contribute to this body

[20] Crafts 2002 is a notable exception; however he also suggests that the results he obtains using data showing the effects of general purpose technologies such as steam, electricity and (as he suggests) ICT on the aggregate productivity level, should be used carefully ["however, it must be remembered that the data that have been used to make these calculations are not entirely comparable across these episodes" (p13)].

of research naturally pointed out the need for better data and refined methodology in order to be able to compute the estimates that would solve the Paradox (see Grichlies 1994, for example).

In fact, two main sets of arguments concerning the shortcomings of the economic data available at the time of the Paradox and for another decade, were allegedly contributing to it: the first is the underestimation of ICT investments; the second is the problem of measuring the (underestimated) output of service activities. The ICT revolution was affecting mainly the service industry and particularly the Financial, Insurance and Real Estate (FIRE) sector, which was a big spender on new ICT equipment. As the service sector was notable for the slow productivity growth, an increase in the speed of productivity growth in some of its industries would have provided the decisive proof of the pervasiveness of ICTs.

As briefly mentioned above, following a general consensus on these two aspects in many academic writings, the 1999 revision to the [USA] National Income and Product Accounts (NIPA) tables introduced some important changes. These included: first, the reclassification of software as a capital investment, second, the use of systematic hedonic prices to “qualitatively” adjust the output of several industries deemed to be crucial to the perceived New Economy[21] (Nordhaus 2002) and third, the use of new data on banking transactions provided by the Bureau of Labour Statistics (BLS) to calculate the output of the banking sector (Gullickson and Harper 2001).

The first of these changes recognized software as an important part of ICT and also boosted equipment investment data over the past few years. The second of these changes is justified by the need for “qualitatively”-constant time series that are used to coherently compare old and new versions of a good in analyses using time series. Economists, with the support of the computer industry, therefore developed indexes that claim to better address the role or significance of technological change in ICT-equipment. As the latest equipment is also the most performing and given that the new deflators allowed to capture these improvements, the application of these hedonic price series increased the share of new ICTs in the total output (e.g. Landefeld and Grimm 2000) and increased the gap between (the value of) past and present investments.

In conclusion, the first two of these measures were taken to address the first of the two problems highlighted by the neoclassical growth accounting literature: the underestimation of ICT investments. The third measure was adopted in order to provide a better concept of output for a

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[21] computers and peripheral equipment, semiconductors, prepackaged software, and digital switching equipment (Nordhaus 2002).

part of the service sector; a part that was investing heavily in ICTs and expected to draw benefits from these investments

2.3.1.5. Shortcomings and Questions Left Opened by the Productivity Literature

The productivity literature has certainly many shortcomings; most of them are in common with the shortcomings of the neoclassical approach and specifically of the New Growth Theories, as discussed above. Here I limit my observations to what this theory does not explain, which is important to the subject of this research.

First of all the solution to the productivity Paradox that came specifically from this literature was mainly methodological and applied to the official data. In fact, even according to the new set of data published by the BLS, the average TFP growth for the period between 1988 and 1995, i.e. already in the middle of the computer age according to Solow (1987), is equivalent to 0.525 percent per year; a level which is in line with the average 0.39 percent increase of the dark years or productivity growth (1974-1995). So, what changed all of a sudden, in 1996, transforming ICTs into a productive investment? The productivity literature cannot provide an answer to this question and this, simply because of its focus. For example, as Schreyer puts it (2001 p49):

> "*Accounting* is not *explaining* the underlying causes of growth. Growth accounting and productivity measurement identifies the relative importance of different proximate sources of growth."[22]

Or, as Tuomi affirms (2004 p47):

> "Growth accounting equations and equilibrium models are not causal models. They can only show associative links between ICT investments and growth. The observed productivity growth rates are purely empirical, and the underlying theory does not make any claims about the causes of growth."

The neo-Schumpeterian literature, on the other hand, provides an analysis of technological change and the causes of economic change. In particular, this literature provides a very logical answer to the questions left open by the productivity literature. One of these questions, which we are going to answer in this chapter by borrowing from neo-Schumpeterian approach, reads: what is missing from the economic environment, in order for an important technology that is already diffused and visible to have an impact on the economic performance of industries investing in it?

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[22] *Italic* by the author.

2.3.2. Innovation and Economic Evolution in Neo-Schumpeterian Accounts

2.3.2.1. The Neo-Schumpeterian concept of Techno-Economic Paradigms

Economic evolution according to neo-Schumpeterian and evolutionary accounts can be said to be a virtuous circle of technical change and economic growth. In fact, economic growth here has a closed causal relation with innovation and R&D. Moreover, contrary to the idea suggested by the neoclassical approach, growth is not a positive and monotone trend, with accidental, un-ordinary negative counter-trends, assumed to be a temporary gap from a hypothetical optimal growth trajectory designed by the current stock of capital and technological capability.

The neo-Schumpeterian accounts that focus on macroeconomic trends explain economic evolution through the dynamics of Kondratieff-type long waves, which they identify as the "systematic" and natural evolution of modern society. The sources of the dynamics are supposed to be endogenous. In this evolution, a key role is played by fundamental inventions, one type of which becomes a key factor of a Kondratieff-wave upswing. Moreover, the relation between sectors is also crucial to explain macroeconomic trends, and sectors are classified following their role in the creation and diffusion of new technologies. In fact, Perez (1983 1986) distinguishes between **carrier branches**, which are the ones making intensive use of the key factor; **motive branches**, which are responsible for the production of the key factor and other inputs that are associated with this factor; and **induced branches**, which are the result of the growth and development of the carrier branches, but at the same time are complementary to them.

As different innovations play different roles in the upswing of a long wave of development, it is useful to classify them here according to their role and influence. Freeman and Perez distinguish four different types of innovation (Freeman 1988b; Freeman and Perez 1988):

- The first are **incremental innovations**: they are the result of "learning by doing" and "learning by using", or more specifically the modifications proposed and elaborated by engineers based on users' feedback;

- The second are **radical innovations**: these are discontinuous events and are the result of a deliberate R&D activity in private companies, universities and governmental bodies;

- **Changes to the technology system**: these are changes in technologies that affect several sectors and contribute to generate brand new ones. They are normally described as a mixture of radical and incremental innovations, coupled with organizational and managerial developments;

- **Changes in the techno-economic paradigm**: these are changes to the technology system that are so far reaching that have an influence on the entire economy.

Like Schumpeter previously indicated, different types of innovations have a different type of impact on the economy, and their importance and contribution change during the different stages of a wave. Changes in the techno-economic paradigm are essentially necessary conditions for an economic revolution to take place. Each new techno-economic paradigm has a particular input or set of inputs that becomes the trigger and sustaining element of the new paradigm. This key factor is understood to fulfil the following conditions (Freeman and Perez 1988; Perez 1986):

- Low and rapidly falling relative costs;
- An unlimited availability of supply over long-term periods;
- The potential of being used profitably in many products and production processes.

The key factors gradually mature during the downswing of a Kondratieff cycle; while at the same time the key factor related to the preceding wave and the products that have been generated from it, loses "momentum" as the limit of growth and future development are approaching. Investors start looking at the development of new technologies and are more ready to take risks (Freeman and Perez 1988). Moreover, compared to Schumpeter, this approach includes a further dimension: the evolution of social and institutional spheres. This added dimension and its interaction with the industrial development following the introduction of the new techno-economic paradigm helps to explain the existence of a downswing.

Perez's (1986) account of the dynamics of long-term waves comprises the following: at some stage, there is harmony between the techno-economic paradigm that has been maturing during the downswing of the previous Kondratieff, and the socio-institutional climate. It is in these conditions that investments are made so that the new paradigm is developed and fosters economic growth up to a new peak. During this period there is a bandwagon effect and every productive unit, one after the other, tends to apply what becomes the "*optimal form of productive organisation*". A new international pattern of investment, trade and production is established. Society and institutions also adapt themselves. New statistical quantifications are introduced to better understand the impacts of the new paradigm and the need of new adequate policies change. The peak is a sort of economic frenzy while the new techno-economic paradigm produces big success stories.

As Freeman (1988b) reports, Perez's idea of socio-institutional climate represents a development of a concept put forward by the neo-Marxist tradition. According to Tylecote (1992) the Marxist "regulationist school", led by French economists Aglietta, Boyer, Mistral and Lipietz, explains that a long-term type of economic dynamics is to be found in the complex relation between "regime of accumulation" and "mode of regulation". The first relates to the capitalist firm, its techniques and methods and depends on technical change and advances, and, the second to a wider society, its complex network of relationships and of check and balances. A new innovation, such as the implementation of the Fordist regime of accumulation can provoke the increase of the weight of profits and the reduction of wages, which consequently is translated in a shortfall of consumer demand and a depression of the economy. The way out is a new "*mode of regulation*", which may include the strength of unions and or adjustment to the welfare system, so as to recreate a harmonious equilibrium between "regime of accumulation" and "mode of regulation".

Going back to Perez's explanation of the long wave, the downswing is triggered by the exhaustion of new product and process investment opportunities associated with the new technology and at the same time a halt to the development of the performance of carrier branches. The capabilities of motive branches to maintain or further reduce the relative cost advantage of the key factor are worn out. Various disequilibria manifest themselves in the various markets (labour, inputs, money, equipment) as a result both of the contraction in the old dynamics and the uncertain market trends generated by the new investment patterns. More and more pressure is put on the central authority to find new means of stimulating and managing the economy. Furthermore, investments in new technologies become less risky and more logical as the power of the heuristics of the current/old paradigm has diminished.

As mentioned above, these types of accounts are built around the explanation of historical trends. In fact, the model just mentioned above can be applied to explain the past five long-waves as identified in the work of Freeman and Louçã (2001):

- The first wave starts in the 1780s, has a peak around 1815 and then ends in 1848. The key factors identified are iron, raw cotton and coal, while the techno-economic paradigm is characterised by the water-powered mechanisation of industry;

- The second wave starts in 1848, has a peak in 1873 and then a downswing until 1895, for a total duration of 47 years. The key factors are iron and coal, while the techno-economic paradigm is to be identified with the steam-powered mechanisation of industry and transport;

- The third wave starts in 1895, has a peak in 1918 and a following downturn ending in 1940. Key factors of this wave are steel, copper and metal alloys, while the techno-economic paradigm is characterised by the electrification of industry, transport and residential homes;

- The fourth wave starts in 1941 and should have peak in 1973. The key factors are oil, gas and synthetic materials, while the techno-economic paradigm is to be identified with the motorisation of transport, civil economy and war;

- These authors assume the existence of a fifth Kondratieff wave, even if they cannot provide at this stage a starting year or a peak. Key factors of this current wave are integrated circuits of "chips" and the techno-economic paradigm is explained by the computerisation (and the enhanced connectivity) of the economy;[23]

Therefore, according to this literature, the Productivity Paradox was a pro-technology declaration that came at the beginning of a time even before the upswing, generated from the semiconductor industry or the motive branch, and the carrier branches or the Computer and telecommunication industries. The upswing is still ongoing as the positive growth of productivity statistics are indicating.

2.4. Economic Accounts of Innovation and Economic Change: Some Conclusions

As we have mentioned in the introduction, we sought to review how some of the most important economic theories explain the origins or the past, the goal and the dynamics of economic change or a theoretical economic trajectory.

In summary, the mainstream economic approach does not carry out or rely on a comprehensive analysis of past events and past events are not used to understand current and future trends in any way. The goal of the economic change is economic growth and given that individuals are consumers and their satisfaction is measured in terms of utility, which is proportional to consumption, economic growth increases their satisfaction by increasing the possibilities of consumption.

In terms of the causes of economic growth and in particular the contribution of innovations, the neoclassical literature suggests that there is a correlation between investments in new technologies and productivity growth. Its focus is clearly on technological change: writings of

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[23] The author is aware that there is a debate within the evolutionary literature on the "shape" of the current long wave of development. The terms of this debate include the date of the start of the wave or of the peak. These specific subjects do not influence the answers we will provide to our research questions.

the productivity literature expect and demonstrate that an increase of productivity is correlated to investment in new technologies (although investments in ICT are not always correlated with productivity increase, as some service industries reveal).

Nevertheless, still according to mainstream economics, technological change is not *the only* source of the acceleration of production and productivity; there is an implicit notion of innovation that includes technical change but goes beyond it. This notion of innovation, however, is loosely defined and conceptualized as it is understood as any factor contributing to realise an increase of production that is not the result of an increase in inputs.

On the other hand, neo-Schumpeterian accounts rely heavily on the analysis of historical events in order to explain the current dynamics. They are focussed on the causal aspects of economic dynamics and in this respect new technologies play a key role. In fact, they explain economic change as a succession of techno-economic paradigms. Innovation is a concept that is broader than technological change: however, this latter concept plays a primary role as it is the enabling factor for the generation of a new paradigm. Many other factors however, influence the techno-economic dynamics and these include, for example, regulatory and institutional changes, as well as managerial changes, as companies and sectors get used to the new technologies as the paradigm matures.

However, a theoretical framework that aims at explaining change in the PIS requires the contribution of additional theories: in fact, even if the concept of innovation in neo-Schumpeterian accounts is rather broad and not-only-technical, regulatory and managerial changes are mostly considered part of socio-institutional climate, while the role of soft-innovations within the industry is overlooked. Certainly, the importance of non-technical innovations *in the media industry* is mostly ignored. Therefore, examples of the literature on service innovations more focused and conceptualizing "soft"-innovations are presented in the next chapter. Particular attention to those theories that well adapt to the case of the media,

Another factor of the analysis that does not suit all the industries of the PIS is economic growth and consumption as a goal. Notably, the branches of the PIS have an influence on society that goes beyond the economic sphere. Therefore a framework that can be used to understand the consequences of change on several aspects of the lives of individuals or groups of individuals, would lead to a more accurate understanding of the causes and reasons for this change.

The idea of exploring the advantages and different aspects of a general framework that can be used to understand the changing roles and goals of the PIS was an initial part of this project. We found many writings that conceptualise the goal of activities such as the media in ways that challenge the mainstream economists' focus on the maximisation of consumption. Most of these can be notably classified as part of the school of thought labelled the *political economy of communication*. McQuail's work (1992) on the notion of public interest, is probably the best example of a theory that partly reflects the economic notion of utility, but goes beyond and considers other basic human values such as freedom of speech and the right of an individual to access the media, as a user and/or an active contributor. However, the idea of exploring this subject in more detail has been abandoned due to time constraints and it has been referred to future developments of this research.

Chapter 3 - Creative Inputs and the Cost Disease of the Media and Service Industries

"The only confident prediction about the future is that it is going to surprise me" (Baumol 2007)

3.1. Introduction

This chapter's purpose is to conclude the literature review necessary for constructing the study's theoretical framework. By doing so I provide, firstly, a practical notion of innovation, describing its dynamics, and secondly, an understanding of the effects of innovation on the economic performance of the PIS. In this section therefore I first of all present a definition of service activity and then provide some ideas from the service innovation literature including a definition of stylistic change. I then go on to describe the most important theories on the economic dynamics of cultural industries: Baumol's cost disease and unbalanced growth. Here I provide the first original contribution of this research by retracing how these theories have evolved through the years and then proposing a rectified version based on the existence of *creative inputs*.

After this formulation I then furnish empirical evidence of the existence of a cost disease and unbalanced growth in the economy, specifically within the media sector. I conclude with some observations on the narrowness of thinking in the mainstream economic approach, in order to further explain the choices made in the analysis of the PIS which follows this chapter.

3.2. Services and the Service Sector: Definitions and Characteristics

Services have long been defined as intangibles, non-innovative and low-capital intensive. This definition erroneously characterises many elements of the service sector today.

3.2.1. Goods Vs Services

Nowadays goods are understood to be tradable, mostly tangibles, but also non-tangibles. As Peter Hill (1999) explains goods are entities over which property rights can be clearly established and therefore they can be easily exchanged. Because of these characteristics, goods can be produced, distributed and used or consumed at different locations and at different times. Furthermore, goods are generally tangibles with physical qualities and preserve their identity through time: they are objects that are produced, stocked, distributed and traded. However, a relative minority of goods is intangible; in fact, these particular goods, labelled by Hill as "originals", are creative and/or innovative products of authors, composers, scientists, architects, engineers, designers, software writers, film studios and orchestras (1999 p427). These originals apart from having no physical dimension and being mostly marketed "through" other goods (paper, films, tapes,…), comply with the other characteristics of goods. They also share an important characteristic with public goods: the non-rivalry of consumption, which means that one particular user's consumption of this type of goods does not affect that of other users.

Services, on the other hand, are described as generally intangibles with no quality of exteriority; they cannot be held in stock (Stanback 1979, cited in Gallouj 2002) and they cannot be produced without the agreement, co-operation and possibly the active participation of the consuming unit (Hill 1999).

3.2.2. From Gadrey's Definition of a Service Activity to the Definition of Service industry

As mentioned above, the main criteria to distinguish goods from services cannot be identified with the existence of exterior characteristics, as standard thinking suggests. In fact, as shown in figure 1, an intangible good can have more in common with a service than with a tangible good. Therefore, other characteristics must be taken into account, including the relation between the producer and the consumer that the qualities of a product, either a good or a service, enforce. On the one hand, this relation can be described as separated in terms of time and location, "distant" and almost neutral in the case of goods; and on the other hand, this relationship can be described as "close" sometimes co-operative in the case of services.

Figure 1 : Tangible, non-tangible goods and services. The main characteristics.

<table>
<tr><th></th><th>Exterior characteristics</th><th>Characteristics of Consumption</th><th>Relation between Producer and Consumer</th><th>Stock</th><th>Example</th></tr>
<tr><td>Tangibles Goods</td><td>have physical qualities and preserve their identity through time</td><td>Rival</td><td rowspan="2">Distant and separated: normally the relation is characterised by a trade, which is carried out by intermediaries</td><td>Can be held in stock</td><td>Car</td></tr>
<tr><td>Non-tangibles Goods</td><td rowspan="2">Have no physical quality</td><td>Non-Rival</td><td rowspan="2">Cannot he held in stock</td><td>Song</td></tr>
<tr><td>Services</td><td>Depending on the service</td><td>Collaborative</td><td>Banking</td></tr>
</table>

Source: various, as explained in section 3.2.

Therefore, an extensive and modern definition of a service has to highlight this latter aspect, and certainly Gadrey's definition of a service fulfils this requirement. Gadrey's explanation of a service stems from a work from Hill (1977 cited in Gadrey 2002). In fact, this latter describes a service as a change in the conditions of a person or a good belonging to some economic unit, which is brought about as the result of the activity of some other economic unit with the prior agreement of the former person or economic unit (Gadrey 2002 pp41-2).

Gadrey reformulates and details the relationship between these economic units, which he labels A, B and C for simplicity. These economic units are (Gadrey 2002):

- A: The *service provider*, public or private, an institution or an individual;
- B: *A customer or user*; an individual or a household or a private institution or a nation and either a final consumer or a producer itself;
- C: *The reality to be transformed or operated* on by A, for the sake of B: goods or material systems, coded information, individual or organizations.

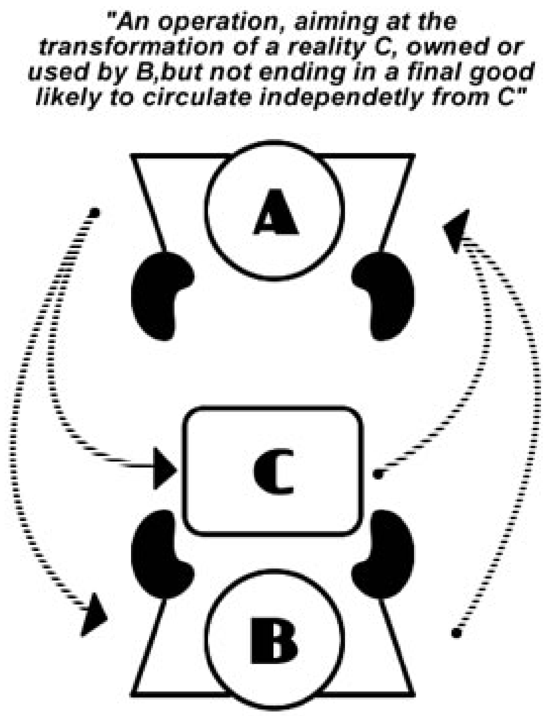
Gadrey's (2002) definition of a service is then an operation, aiming at a transformation of a reality C owned or used by B, with the operation carried out by a provider A on the request of and often in interaction with B, but not ending in a final good likely to circulate independently from C. Therefore, C represents a vehicle owned by B that is repaired by A; or money owned by B that are transferred or managed by A and so on (see figure 2 below).

This definition is certainly comprehensive of all products of the service industry sector; however the types of activities that are included in this definition, as well as the types of activities that are considered services in official national accounts classification, are very much heterogeneous. Therefore, one of the focuses of the service innovation literature is to divide activities into more homogenous categories, so that dynamics such as productivity trends, contribution to economic growth or innovation "routines" can be more efficiently analysed and better understood.

One of the most important classifications of services is provided by the classic work of Baumol (1967, and with Bowen 1966). This author, certainly one of the most prominent specialists on the economic aspects of cultural goods and services or the field of the arts, is the originator and main contributor to the notion of cost disease and the consequent theorem of unbalanced growth. The evolution of his thoughts on the subject and explanations of his findings have been reconstructed below in section 3.3 of the present chapter. Here, however, it is essential to highlight his criteria for dividing economic activities into a *progressive sector*, or a sector where innovations, capital accumulation, and economies of scale contribute to the cumulative rise in output per person per hour, i.e. increase labour productivity; and activities said to be *stagnant* (or in later works, asymptotically stagnant), where labour productivity is marginally or not affected by technical innovation and capital intensity (Baumol 1967; and with Bowen 1966).

As explained in more detail below, Baumol's hypothesis derives from the observation that the technological structure of some service activities is such that labour productivity cannot improve. This statement stems from the fact that for some activities labour is an end in itself and for most of these activities quality is directly dependent on the quantity of labour.

Figure 2 : Gadrey's service Triangle



Source: the author, based on Gadrey (2002)

Moreover, further studies based on Baumol's idea of cost disease have developed this line of thought and expanded the list of services that have a slow productivity growth, because of being heavily dependent on labour and\or labour quality. Wolff, for example, defines services such as transportation, communications, electric gas and sanitary services as progressive while wholesale and retail trade, finance, insurance and real estate, general services, government and government enterprises are seen as stagnant (Wolff 2002).

Alternatively, Miles proposes a different categorisation of service activities. His research interest is more focused on innovation in the service industry sector and on the role of services as innovators in the economy. Therefore, by grouping services by their "innovation routines" he distinguishes the following categories of services (Miles 2001):

- *Physical services*: which include all activities that maintain (as in preserving through time) or transport (as in relocating through space) facilities, goods or people;

- *Human and person-centred services*: which include all activities that aim to develop and maintain social and physical well-being (health, education, etc…) and activities more oriented to personal appearances (hairdressing, etc…) or to provide "home" comforts' as commodities (hotels, catering, etc..);

- *Information services*: which include all activities that process information as their core activity. These are divided into (a) mass media, (b) infomediaries, which are large information "carriers" such as the telecommunication sector, and (c) knowledge services that produce and interpret specialised information (such as advertising, accountancy, consulting,…).

In a later work focussed on Knowledge Intensive Business Services or KIBS), Miles (2003) details the different characteristics of activities included in this category. All these activities have in common the fact that information (or more precisely "knowledge", a broader concept that includes "information") is an important share of their output and inputs. The type of knowledge assumed, process and produced, is the main element differentiating these activities. In fact, he distinguishes between:

- Services focussed on knowledge of competitors and (financial) market environments; these are KIBS in consultancy, intelligence reports, financial analysis and forecasting;

- Services focussed on knowledge of consumer and client markets; these are KIBS in market research, public relations and advertising;

- Services specialised in knowledge of technological options and implementations; these are KIBS in systems integrators and technology advice services;

- And services specialised in knowledge of human resources; which are businesses dealing with training, personnel and recruitment.

3.2.3. Services and Innovation

Other than intangibles, services have long been thought of as being non-innovative, but mainly adopters and dependent on the manufacturing sector for technological change, as well as being low-capital intensive. As Gallouj explains (2002), this conception derives from a vision of innovation based and developed on a perception of the economy as fundamentally grounded in the production of goods. In fact, this hypothesis draws from the neoclassical theoretical notion of a production function and is limited to *process innovation as incorporated to technical equipment*. As a consequence, innovation is somehow proportional to the size of fixed capital and the level of R&D efforts.[24] Furthermore, the presumed low-capital intensity characteristic of

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[24] As explained by Gallouj, "The initial hypothesis underlying the compilation of the Frascati Manual is the notion that R&D is the main source and indicator of (technological) innovation and that it is actualised by clearly identifiable specialists working within clearly identifiable structures. Thus the indicators in the Frascati Manual have contributed to the underestimation of innovation in services, since innovation in this type of activity is not necessarily technological and can be, and often is, realised without any prior R&D." (Gallouj 2002, 147)

services is seemingly based on the evidence that these do not require the construction of expensive and extensive production plants (Gallouj 2002).

According to this "old" conception Gallouj refers to, innovation mostly contributes to Science and Technology (S&T) knowledge and originates from R&D but also from *technical* improvements emerging from business operations other than research activities. However, this concept does not include the non-technical, "upgrading" routines of the largest share of economic activities, and consequently cannot be used to grasp the complexity of innovation dynamics of advanced economies, especially in light of the changes brought about by the "New Economy". For this reason, Miles affirms that in today's economy, innovation should not be understood as just S&T based, but it can be aesthetic, cultural, social or organisational; consequently innovation does not depend exclusively on technical and scientific knowledge, but also relies on knowledge of markets and user requirements (Miles 2003).

Recent empirical studies show that there are a multitude of different investments that, together with R&D, can be considered essential or supporting elements of innovative activities. These not only are comprised of, for example, intangible investments in know-how, industrial patterns and design, patents and licenses, artistic creations, copyright, rights to receive royalty payments, training; but also other investments in human resources, market share, product certification, customer lists, subscriber lists and lists of potential customers, product brands and service brands, and software and similar products (Den Hertog and Bilderbeek 2000).

In light of such a shift in the "meaning" given to innovation and the increased importance of intangible investments as suggested in the economic literature, it is important and straightforward to question the non-innovative and low-capital intensive characteristics that mainstream economists generally attribute to the service industry sector.

Moreover, technical and "soft" innovations applied to the service industry contribute to change the relationship between users and producers, which is the most important characteristic of a service activity. In fact, as underlined by Tether and Metcalfe (2004) it is important to be clear on what this interaction involves and how it matters for the rate and direction of innovation.[25]

When different types of innovations are considered and alternative viewpoints embraced, service activities are no longer simply considered as "innovation-takers". As a recent study by Wolff (2002) clearly shows, services can innovate. In fact, in order to investigate the relation between services and innovation, data on changes in the skill level of workforce; change in the

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[25] Interestingly, these authors also mention that the Systems of Innovations literature "fails to demonstrate the nature and function of any interdependence between participating agents" (p 316).

occupational composition of employment; investment in total equipment per worker; investment in office, computing and accounting (OCA) equipment per worker and the change in the average age of capital, are taken into account. These indicators show that, in recent years, services have invested more in upgrading their production capabilities than manufacturing activities. Moreover, the so-called stagnant services, whose characteristics we will go on to examine in the next section, have been even more active in "modernising" their activities than stagnant services and goods producers.

Consequently, given that investments are the natural input of capital formation and if the idea of capital is also extended in order to include human capital or intangible goods such as software, for example, the characteristic of low-capital intensity is naturally becoming obsolete for many of the services.

3.2.3.1. Stylistic Change and Innovation and the Media

The general conclusions reached above about the service sector also apply to the specific case of the media industry. Furthermore, the deconstruction of media products into different inputs or activities, content and form, helps us to understand and characterise the process of innovation in the media industry. In fact, different types of innovation can be specific to, or mostly affect one particular element of a product of the medium industry. *Technical change* may be generally deemed to be an innovation routine affecting mostly the *form* element of media products, while aesthetic and cultural innovations and creative knowledge are more commonly associated with the *content* elements of media products.

Certainly, of the different "families" of innovations, the technical, R&D based type is the most celebrated and also the most straightforward to define and it does not need any further specification here.

Much less celebrated and analysed are the type of innovations that mostly characterise the content elements of media output; Schweizer for example, defines these type of innovations as *stylistic* and she characterises it as follows (2003):

> "Stylistic innovation is the sum of product and/ or process features, which: (a) Differentiate a (group of) producer(s) from other (groups of) producer(s), (b) Are based on particular cognitive structures leading to the realization of new means and/or ends in the product and/or process and (c) Are perceived as novel and therefore mismatching the collective expectations of a particular certification environment." (p28)

Therefore the required characteristic of "novelty" in stylistic innovations seems to be dependent on the existence of *professional certifiers*, comprising the leading critics or gatekeepers of style, taste and fashions in specific industries, or prize awarding institutions, or sometimes, depending on the specific sector, among the intermediaries between producers and consumers. These certifiers work within a set of environmental *stylistic norms*, which define the background and current standards used to measure and define what is generally perceived as a norm and what could be perceived as significantly "new"; and their role is somehow to decide on what could be generally accepted as an innovation (Schweizer 2003).

3.2.3.2. Modularity and Organisational Change

In this study, we shall also pay considerable attention to organisational innovations, how they evolve in relation to other types of changes and what their role is in determining a sector's or an industry's economic performance. By organisational changes we mean the adaptations of the production process within a company or between separated activities.

In order to understand this type of change better we shall employ service-industry-friendly notions described by the modularity literature, which we define as a subset of complex evolving system (CES) theories. The subset of writings we choose for this purpose is directly inspired by organisational changes which have occurred in the semiconductor and computer industries. The subset also includes the relatively rare writings which focus on organisational matters in IT service activities. Therefore, it is preferable to dedicate an entire short section to these theories in order to illustrate them better, we introduce them after the evolutionary account of the changes in the IT industries described in Chapter Four.

3.3. Baumol's Old and New Concepts of Cost Disease and Unbalanced Growth

As mentioned above, Baumol distinguishes two types of activities (1967, and with Bowen 1966): a progressive sector, which includes manufacturing activities and some services, and a stagnant sector, which includes only some specific types of services. The difference between these two sectors is given by their technological structure and its "reaction" to innovation. In the case of progressive activities, new technologies enable an increased production per worker, while in the case of the stagnant activities, because labour is the end of activity itself or because the quality of output might be a more important factor than the quantity of output, new technologies have marginal or no effects on labour productivity. Following this line of argument, the cost, and consequently, the price of the output of the stagnant sector increase in relation to the cost and price of the output of the progressive sector.

3.3.1. The First Formulation of Baumol's Theories: Stagnant Services vs. Progressive Manufacturing

Baumol's work on cost disease and unbalanced growth can be divided into early and late formulations, and what follows here is a summary account and explanation of his standpoint and how this has changed over time. The early formulations of the theories of cost disease and unbalanced growth can be traced back to two main contributions: the first one reported here dates 1967 and the second one written with Bowen in 1966.

Firstly, Baumol (1967) classifies economic activities into two types:

> "Technologically progressive activities in which innovations, capital accumulation, and economies of large scale all make for cumulative rises in output per man hour and activities which, by their very nature, permit only sporadic increases in productivity." (p51)

He then explains why some activities do not realise constant increases of productivity: firstly, he suggests a typology of sectors which comprises two sectors, a stagnant and a progressive and (in keeping with the conventional wisdom of its time, i.e. 1967) this division is taken as equivalent to the division between manufacturing and service activities. The stagnant activities are those activities that do not produce an increase in productivity because of their own "*technological structure*": the quality and the quantity of their output are proportional to the quantity and the quality of labour used to produce them.[26] Stagnant activities are not necessarily characterised by a slow growing output. The condition specified by their technological structure is an increase of labour that is (normally, at least) proportional to their increase of output. In periods of economic expansion, therefore, the output of stagnant activities can be expected to grow even faster than that of progressive activities.

The unbalanced growth theory can be considered as the macroeconomic consequence of the cost disease's existence. The basic principles of the unbalanced growth theory are possibly best explained in a later paper written by Baumol with Wallace Oates (1972). In this work the authors affirm that:

> "In an economy in which one sector of the economy persistently lags behind the rest in terms of rate of productivity growth, the products of that sector must invariably rise in cost relative to cost levels in the rest of the economy, and that the rise will be persistent and cumulative." (p87)

Moreover, in this paper Baumol and Oates (1972) further clarify the characteristics of the stagnant sector (at the time still identified with the service sector) and state that as a result of the

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[26] "I am making a stronger assertion: that the place of any particular activity in this classification is not primarily a fortuitous matter determined by the particulars of its history, but rather that it is a manifestation of the activity's technological structure, which determines quite definitely whether productivity of its labor inputs will grow slowly or rapidly (…) On the other hand there are a number of services in which the labor is an end in itself, in which quality is judged directly in terms of the amount of labor." (Baumol 1967 p52)

increasing labour devoted to it, the quality of its output progressively increases.[27] In light of Baumol and Oates statements, the relationship between a product's quality and price can be described as follows: on the one hand, in the case of manufacturing a price reduction is compatible (and it is a consequence of) productivity improvements; on the other hand, the quality of services is proportional to the quantity and quality of labour employed.

The unbalanced growth theory projects the consequences of the existence of "technological limitations" whereby some activities fail to produce an increased (volume) output per person employed. In the long run, more labour will be proportionally employed by the stagnant sector than the progressive sector and its prices (as a consequence of the relative increase in costs) are subject to a quicker growth than the progressive sector. The aggregate level of productivity growth is therefore destined to converge to the level of the stagnant industries.

It is striking that most economists' understanding of the economic dynamics described by the theories of a cost disease and unbalanced growth is informed by these early writings. Thus, the theory of unbalanced growth is identified with the differential of output and costs between the stagnant services and the progressive manufacturing activities. Already in these terms, this model is certainly very appealing to explain a very important trend of developed economies. In fact, labour is gradually moving from most productive agricultural and manufacturing activities to the less productive service industry sector. Moreover, given the fact that the "New Economy" has accelerated the expansion of service activities, then the theory of unbalanced growth actually provides an interesting case for explaining the economic dynamic described by the productivity paradox.

However, a relatively recent re-formulation of Baumol's model leads to a totally different set of conclusions regarding the long term effects of the cost disease. In fact, Nick Oulton of the Bank of England, in a paper published in 1999, transforms Baumol's model by adding one simple assumption (Oulton 1999): the stagnant sector is not producing a final product, but an *intermediate one*, which, because of the existence of only two sectors, is an input for the progressive sector. Therefore, the stagnant sector only consumes labour, while the progressive sector consumes the output of the stagnant sector and labour, whose price or cost is the same for the stagnant sector, because of the assumption of perfect competition and mobility. The result of the model is the following: if the stagnant sector is assumed to have a positive total factor productivity, then the cost disease dynamic generates an increasing aggregate productivity and

[27] "*Productivity changes in the services, it is suggested, have taken the form of better output rather than increased quantity per unit of labor input.*" (Baumol and Oates 1972 p89) and "*The output of services would rise, because more labor is continually being devoted to their production; at the same time, manufactures would also increase since the decline in workers in this sector would be more than offset by the continuing rise in output per man.*" (Baumol and Oates 1972 p91).

economic growth trend. In fact, the productivity capability of the progressive sector is increased by two dynamics: first and directly, by the movement of labour (i.e. the reduction of inputs) from the progressive to the stagnant sector; and second and indirectly, from the productivity increase "inherited" by the stagnant sector, and generated by the increase of labour.

These conclusions, which are endorsed by the same Baumol (2002), provide an interesting and different explanation of current trends. First of all, Oulton's model provide the theoretical background for today's wave of outsourcing activities, i.e. the delegation of tasks, such as human resources administration, Information Technology (IT) support or customer service, to specialised businesses; secondly, his conclusions give more consistency to the mainstream line of thinking that expects the productivity of the service industry and the aggregate productivity levels to be underestimated. In fact, Knowledge Intensive Business Sectors (KIBS) which provide services for manufacturing activities and whose output is notably difficult to measure, have known important developments in recent years. Therefore, the productivity increase of this type of service, *supposed to be positive but almost un-measurable*, is supposed to be reflected in the productivity growth of the manufacturing activities they serve.

3.3.2. The Re-formulation of the Cost Disease and the Appearance of Asymptotically Stagnant Services

Here I wish to identify and describe how Baumol later reformulates and refines his theories quite consistently (Baumol with Blackman and Wolff in 1985, and with Hilda Baumol in 1987). Technological progress does not change the productivity of the string quartet, which Baumol famously defined as eternally "stuck" on a productivity level of 2 persons per hour, as in Mozart's time; rather, it is simply (or mainly) a matter of the analysis' viewpoint.[28] If we just considered the "content making" activities, the productivity is still the same as it depends on the live performance. However, if we look at wider set of organisations producing classical music, which comprise, *inter alia*, the content and the distribution activities, productivity has probably increased. In fact, the same Mozart string quartet is now "reproducible" by being recorded (or captured and "fixed" on some material as Adam Smith put it) and so it is also distributed in many forms (compact discs, radio waves, iTunes and other digital libraries, etc..). In sum, much more than a higher volume of "live performances" is now possible compared to the past: this is because new technologies and other types of innovations have changed the form part of this particular media activity and created different platforms to generate a larger output.

[28] As a Mozart string quartet comprise of four musicians playing for half an hour, when extended to the more standard measure of an hour, Baumol assumes that a 2 person-labour is needed.

The revised theory of stagnant and progressive activities advanced by Baumol in the 1980s does not focus on the Mozart string quartet of course, but sectors such as television broadcasting (see Baumol, Blackman and Wolff 1985; Baumol and Baumol 1987 and Baumol 1987) and the computer industry (Baumol, Blackman and Wolff 1985).

Television broadcasting is an asymptotically stagnant activity; this means that following the introduction of a new technical change, this activity responds like a progressive activity and experiences an increase in productivity, while in the long run its economic dynamics are destined to become stagnant unless other technological changes are introduced. This is because the creation of content, which is an extension of the live performance, is stagnant, while the distribution of content is 'progressive' (in Baumol's sense) and benefits from technological progress. As a consequence, the share of costs (and of labour) of content creation increases while it decreases in the distribution part.

The computer industry was also compared to a vertically integrated activity of this kind. In 1985 when most of the computer manufacturers were also major software makers, Baumol described the computer industry in a similar way to broadcasting (Baumol, Blackman and Wolff 1985): the manufacturing of computers is the progressive input while the production of software, which was described as a handicraft activity, represents the stagnant input.

It is important, therefore, to note that the definition of a stagnant activity has changed in the reformulation of the cost disease: stagnant activities are services, but certainly not all services are stagnant activities. On the contrary, some of the service activities can be the most progressive and even some activities that are stagnant might become progressive due to changes brought about by new technologies (Baumol, Blackman and Wolff 1985).

Clearly, the reformulation of the theory of cost disease was due to a change of conditions: already in the mid 1980s, some services had become progressive and the first formulation of the cost disease appeared to be historically contingent.

However, most of the *basic* stagnant activities were identified in Baumol's first formulation of the cost disease. They comprise activities such as live performing arts, automotive repair, health care, education, postal services, automotive and accident insurance and care of the indigent (Baumol and Bowen 1966 cited in Baumol 1993 p17). Furthermore, in a paper that followed the introduction of the notion of asymptotically stagnant services Baumol (1993) re-states (and at the same time, re-defines) the characteristics of the stagnant activities' *technological structure*, or the main source of the cost disease:

> "First, some of them entail production processes that are inconsistent with standardization. Before one can undertake to cure a patient or to repair a broken piece of machinery it is necessary to determine, case by case, just what is wrong, and then the treatment must be tailored to the individual case. (…) A second reason why it has been difficult to reduce the labor content of these activities is the fact that in many of them quality is, or at least believed to be, inescapably correlated with the amount of human labor devoted to their production…" (Baumol 1993 p20).

After this definition stagnant activities are not service activities, but activities that are (1) "personal" and inconsistent with standardization, because the output of these activities or, in other words, the service delivered must be individually tailored; and (2) those activities in which quality is believed to be inevitably correlated with the amount of human labour, i.e. such as the case of media content.

Yet, even after this latest refinement, the separation between stagnant, asymptotically stagnant and progressive is not neat and the definition of stagnant activity is still historically contingent. The same example provided by Baumol about the computer industry, no longer applies: at an aggregate level, the software industry is one of the most progressive. So, it is appropriate to pose the following questions: can activities once thought to be inconsistent with standardisation, become standardised? If so, what is determining this change?

I attempt to provide a modified definition of cost disease that takes these aspects into account.

3.4. Creative Input and the Stagnancy of Activities: an Empirical Exercise

As explained above, although some service industries have become progressive, stagnant industries still exist; they are, for example, the health and education sectors and many service activities within the cultural industries and their status has not changed since the first formulation of the cost disease. Baumol had a very interesting intuition: on the one hand, in most activities technological change is altering the nature of the contribution of labour and increasingly replacing it with machinery. On the other hand, there is a minor share of activities where labour provides a special contribution to the productive process that has not and will not be replaced by machinery.

However, the formulation of cost disease presents two shortcomings: first, it *concentrates on the effects* (e.g. the health sector is stagnant because of the relatively quicker increase of costs) rather than the causes. Second, it does not clarify how stagnant services can become progressive and for this reason, its definition is historically contingent. On the other hand, providing a definition that focuses on the characteristics of the technological structure, allows to define the cost disease in "unconditional" terms and therefore it completes this concept.

Therefore we propose to integrate two ideas with the concept of cost disease. The first idea consists of re-defining the “technological structure” that is at the origin of the cost disease and considering a creative input as this particular contribution of labour that cannot be replaced by machinery. We characterise a creative input as *original ideas, concepts and actions and the capacity of troubleshooting and finding solutions*. In more practical terms, creative inputs can be approximated with jobs providing these types of contributions.

The second idea we propose, is a useful “workaround” that can be used in order to understand which activities (obviously, excluding the ones providing the creative input) and for what reasons, have become progressive.

In general terms, the transformation of an activity from stagnant to progressive is due to innovations affecting another aspect of the technological structure of an activity: the relationship between providers and users. What is common to any activity that from stagnant becomes progressive is the “de-personalisation”, standardisation or commodification of the relationship between producers and consumers. However, these innovations are of course specific to an activity (and examples of these innovations will be provided in Chapters Five to Nine). Therefore, when various types of innovations transformed the retail industry into a sector dominated by “big box stores” and online shopping outlets, this sector realised its transformation from stagnant to progressive: the relationship between users and producers in big box stores and in online shopping is standardised as the need of exchanging information between them is minimised.

In the same way, the software industry when the providers of the most common products stopped having to build customised programmes for their customers (although custom software indeed still exists) became progressive. Thanks to different types of innovations they were able to produce pre-packaged software; this software provides the functions that most users needed (or it is easy to be customised by the user) and adapts to different types of operating systems and hardware, therefore the contact and the need of exchanging information between user and consumer is now minimised and the relationship standardised.

Finally, the large majority of activities is somehow influenced by the creative input as I have defined it here: the output or the cost structure of some activities, however, presents a closer correlation to it than others. Those activities, where the relative cost of the creative input (or labour) in proportion to the total cost of production / or the output is minimal, show progressive economic dynamics (e.g. the case of the semiconductors, where the cost of the design of microchips, is a very small percentage of the value of the output or the total cost of production);

for some other activities the cost of the creative input is rather dominant in the production process' cost structure (e.g. book writing and publishing), therefore the activity is stagnant.

3.4.1. The Specification of the Model

Here I intend to use a model (already introduced in section 2.4.1.3 above) in order to demonstrate the validity of the concept of the cost disease as a consequence of the existence of the creative input.

The model follows the methodology employed by Tang and Wang (2004) and originally developed by Nordhaus (2002). Here, in addition to these prior exercises, the data on productivity growth is further divided into progressive, stagnant and asymptotically progressive activities.

Within this conception, manufacturing activities, as well as certain services, are part of the progressive sector. These *progressive* services, which are activities where the relationship between users and providers is standardised and not "personal" or whose quantity and quality of output does not depend on creative inputs, are: *wholesale* and *retail trade* (in table 3, line number 34 and 35 respectively); *transportation* and *warehousing services* (36); financial services (53, 54 and 55), excluding lending and credit activities which are considered "personal" as the service delivered is not standardised but largely depends on the interaction with the users. Other services such as *broadcasting and telecommunications* (48) and the *publishing industries* (46) (the latter category includes software in the current NAICS system), are considered here as *hybrids*. In fact, these last groups of activities are asymptotically stagnant: this because they are composed of asymptotically stagnant activities (e.g. broadcasting and publishing) as well as "proper" progressive activities (e.g. telecommunications and software). However, since the shares of progressive activities are much more significant (in terms of output and labour) these hybrid groups are allocated into the category of progressive activities.

The group of stagnant and asymptotically stagnant activities includes those activities whose quantity and quality of output directly depends on the creative input. These comprise "personal" activities such as legal (in table 4, line 61), health (71 and 72), educational services (69), computer system design and related services (62), information and data processing services (49) as well as the miscellaneous professional, scientific, and technical services (63) and activities focussed on the creation of cultural content, such as the motion picture and sound recording industries (47) and the performing arts (76).[29]

[29] See appendix B for the complete list.

In this research, the selected model is also used in an effort to understand the sources of aggregate productivity growth between 1990 and 2003 and to highlight any important changes before and after 1995, the year that is commonly used to mark the acceleration in the use of ICT and the beginning of the New Economy (see Nordhaus 2002 and Triplett and Bosworth 2003, for example).

As explained in more detail in section 2.4.1.3, following Tang and Wang (2004), the rate of growth of real output per unit or labour input,

$$g(X_t) = \frac{X_t - X_{t-1}}{X_{t-1}}$$

after reformulation, can be decomposed into three different effects. This is represented by the following equation (Tang and Wang 2004 p425):

$$g(X_t) = \sum_i w_{t-1}^i g(X_t^i) + \sum_i x_{t-1}^i \Delta s_t^i + \sum_i x_{t-1}^i \Delta s_t^i g(X_t^i)$$

Where:

- X_t indicates the real output per unit of labour at time *t*, at the aggregate level (X_t) or of the industry *i, (* X_t^i);
- x_{t-1}^i is the labour productivity level of the industry *i* relative to the aggregate labour productivity level at the beginning of the period, X_{t-1}^i / X_{t-1} ;
- Δs_t^i is the change in relative size of industry *i* from *t-1* to *t*, ($s_t^i - s_{t-1}^i$), where s^i (defined as $s^i = p^i l^i$) is the labour input share ($l^i = L^i / L$), adjusted for its real output price ($p^i = P^i / P$);
- w_{t-1}^i is the nominal output share of the industry *i* at the beginning of the period and equal to $x_{t-1}^i s_{t-1}^i$

The three effects or contributions are:

The ***pure productivity*** effect, $\sum_i w_{t-1}^i g(X_t^i)$, which captures the increase of aggregate productivity resulting from the productivity increases within industries; the second contribution, the ***changes in relative size,*** $\sum_i x_{t-1}^i \Delta s_t^i$, which captures productivity increases from a shift of resources from less productive to more productive activities agriculture to industry; and finally, the ***interaction effect,*** $\sum_i x_{t-1}^i \Delta s_t^i g\left(X_t^i\right)$, which capture any changes that are brought about by the combination of industries' slow productivity growth and increase of relative size, or industries' high-productivity growth and reduction of size.

The interaction effect provides a positive contribution to the aggregate productivity level if, between the starting and the ending year of the interval under investigation, the relative size of an industry shrinks and the productivity growth is negative or if the relative size of an industry increases and the growth of productivity is also positive. Any of these two last case scenarios work against Baumol's theory of unbalanced growth, as he forecasts an increase of relative size of the stagnant (and slow growing) industries. On the contrary, a negative industry's interaction effect on aggregate productivity sustains Baumol's hypothesis, as this is the result of a shrinking relative size and a positive productivity growth or an expansion of relative size coupled with a negative productivity growth.

As mentioned above, the Tang and Wang (2004) specification of the model is based on the previous model by Nordhaus (2002). The main difference introduced by Tang and Wang is based on the principle that real output price changes also influence the importance (i.e. the weights) of an industry in the aggregate Gross Domestic Product (GDP). Therefore, they try to capture a "price" effect in the calculation of the series of weights named the "relative size" of an industry, by multiplying industries' labour shares (the logical and most common approximation for the size of an industry when the object of the study is output per person employed) by the real output price of an industry (the ratio between the industry price index and the aggregate price index).

This change in methodology might be the determining element explaining the different results (and the difference of opinion) between the Tang and Wang specification and those of Nordhaus. The former shows many negative interaction terms indicating the existence of unbalanced growth dynamics, whilst Nordhaus obtains the opposite results and refutes the existence of an unbalanced growth. In fact, given the faster increase of prices in the stagnant compared to the progressive industries (as assumed by the cost disease), the relative size of the stagnant industries should be larger (and have a bigger impact on the aggregate productivity figures) in the series where this is estimated by also including a "prize effect" (i.e. the Tang and Wang model) as opposed to the series where the relative size is purely based on labour shares (i.e. the Nordhaus model).

3.4.2. The Dataset

The data series for *current dollar value added (VA) by industry*, *chain type quantity indexes for value added*, *chain type price indexes for value added* are taken from the industry accounts section on the Bureau of Economic Analysis (BEA) web site and were released in April 2005.

Labour data are taken from the Bureau of Labour Statistics (BLS) web site. The BEA also publishes labour data by industry, however, (at the time of writing) it does not release consistent series covering the period between 1990 and 2003 defined under the same national accounting system. Therefore, given that the VA series is defined using the latest North American Industry Classification System (NAICS) revision and that the data published by the BEA defined under the same revised national accounting system only covers the period 1998-2004, labour data published by the BLS is preferred for this exercise. The data used to approximate the labour input are the production workers (thousands) for all industries except for *educational services* (line 69) and *government* (lines 82,83,86). Given the absence of labour data under this definition for these sectors, the "all employees" series is used instead.

The data series for value added and the chain type quantity and price indexes cover some 65 industries and 26 aggregates (these being NAICS 2-digits "headings", which are sum of NAICS 3-digits industries also included in the list). The labour data published by the BLS does not contain series matching all 65 industries of the BEA's VA series. Some series can be computed as aggregates of other series or as "residuals" from aggregated series and other industries.[30] However, due to such data limitations, the maximum number of industries that can be obtained by combining the two sets (The BEA and BLS) is 50.

The definition of GDP used here is equal to the total VA of the 50 industries. Given the fact that these 50 industries are NAICS 2 and 3 digits and they cover all sectors of the economy (as specified by the NAICS) except agriculture, this definition of the GDP can be identified with a nonfarm, VA-based definition of the GDP.

[30] A list of adjustments can be found in the appendix B

Table 2: Contribution from Progressive vs Stagnant and Asymptotically Stagnant Services to aggregate labour productivity.

1990-2003	Total	PPE	CRS	IE
Gross Domestic, nonfarm	**21.35%**	**21.81%**	**0.45%**	**-0.92%**
Progressive Activities	**20.89%**	**22.38%**	**-0.63%**	**-0.86%**
Manufacturing, Mining, Utilities and Construction	*10.28%*	*11.22%*	*-0.39%*	*-0.55%*
Other Services	*10.61%*	*11.17%*	*-0.25%*	*-0.31%*
Stagnant and asymptotically Stagnant Services	**0.46%**	**-0.57%**	**1.09%**	**-0.06%**
1996-2003	**Total**	**PPE**	**CRS**	**IE**
Gross Domestic, nonfarm	**16.90%**	**17.17%**	**0.24%**	**-0.52%**
Progressive Activities	**13.71%**	**14.71%**	**-0.46%**	**-0.54%**
Manufacturing, Mining, Utilities and Construction	*6.30%*	*6.88%*	*-0.23%*	*-0.34%*
Other Services	*7.40%*	*7.84%*	*-0.23%*	*-0.20%*
Stagnant and asymptotically Stagnant Services	**3.19%**	**2.46%**	**0.70%**	**0.03%**
1990-1995	**Total**	**PPE**	**CRS**	**IE**
Gross Domestic, nonfarm	**6.83%**	**7.02%**	**-0.03%**	**-0.16%**
Progressive Activities	**7.94%**	**8.39%**	**-0.33%**	**-0.13%**
Manufacturing, Mining, Utilities and Construction	*4.20%*	*4.56%*	*-0.25%*	*-0.11%*
Other Services	*3.73%*	*3.83%*	*-0.08%*	*-0.02%*
Stagnant and asymptotically Stagnant Services	**-1.10%**	**-1.37%**	**0.30%**	**-0.03%**

NOTE: **PPE**: Pure Productivity Effect; C**RS**: Change of Relative Size Effect; **IE**: Interaction Effect; See the methodology in the text for a description of the different effects.

Source: Own calculations following the methodology detailed in the text. Definitions of the sectors can be found in appendix B.

The Real GDP series are computed using chained type quantity value indices and the current value GDP series. In order to remedy the non-additivity property of the chained type quantity values indices and obtain industry data that can be manipulated to obtain estimates for the progressive and the stagnant sectors, the residual that is obtained in the dollar value series (given the non-additivity property of the chained type quantity value indices) is redistributed to the industries. The weights used for this purpose are calculated from the real GDP series before redistribution.

In order to reduce the statistical distortions created by the non-additivity property of the chained type quantity value indices (and affecting mostly the shares of industry value added out of the total), depending on the interval, different base current dollar value years are used as reference. Therefore, the real GDP series for the years 1990 and 2003 used in the analysis of the 1990-2003 interval based on nominal GDP in 1997 dollars; real GDP series for the years 1990 and 1995 used in the analysis of the 1990-1995 interval are based on nominal GDP in 1993 dollars, and real GDP series for the years 1996 and 2003 used in the analysis of the 1996-2003 interval are based on nominal GDP in 2000 dollars.

Given the fact that the choice of the base year of the chained type price value indices influences the relative output price of an industry (the ratio of the price of an industry out of the GDP price), the choice of the different base years used in the different intervals matches the choice of the current dollar value base year in the calculations of the Real GDP series.

Growth rates, which are calculated here in logarithmic terms, as well as contributions, are not annualised, but they refer to the entire periods under investigation (1990-1995 1996-2003 or 1990-2003).

3.4.3. Presentation of the Results

In the period between 1990 and 2003 the industries classified here as stagnant and asymptotically stagnant have shown a labour productivity growth of less than one percent. This is in sharp contrast to the labour productivity growth of almost 21 percent indicated by the activities categorised as progressive. In addition, table 2 reveals significant productivity growth differences between the stagnant and progressive services applied over the two sub-periods 1990-1995 and 1996-2003.

In the short run, stagnant and asymptotically stagnant service can be characterised by a positive productivity growth. At least, this has been the case between 1996 and 2003 when these activities have grown by over three percentage points; among the stagnant activities that have grown the most in this period, we find the *Securities, commodity contracts and investments* industries (113%) and the *computer systems design and related services* (almost 21%).

More generally, we note that the results obtained in this exercise are broadly in line with those obtained in prior studies by Tang and Wang (2004), and, in some respects, with those obtained by Nordhaus (2002). Our detailed estimates show especially high output per person and total productivity growth rates for certain progressive-type services categories. For example, over the

Table 3: Output per Person Employed and Contributions to the Aggregate VA of selected industries, 1990-2003, Part 1

Interval: 1990-2003									
Bea series number and description		PA	PS	S&AS	**Output per person**	**SUM (PPE + CRS + IE)**	**PPE**	**CRS**	**IE**
1	**Gross domestic product**					**21.35%**	**21.81%**	**0.45%**	**-0.92%**
	Manufacturing	**o**				**9.44%**	**10.39%**	**-0.45%**	**-0.50%**
	(Selected industries)								
19	Computer and electronic products	o			308.72%	4.80%	5.27%	-0.12%	-0.36%
20	Electrical equipment, appliances, and components	o			49.51%	0.29%	0.33%	-0.02%	-0.01%
	Services					**10.70%**	**9.95%**	**1.16%**	**-0.41%**
	(Selected industries)								
34	**Wholesale trade**	**o**	**o**		**56.24%**	**3.21%**	**3.43%**	**-0.14%**	**-0.08%**
35	**Retail trade**	**o**	**o**		**56.33%**	**3.71%**	**3.94%**	**-0.15%**	**-0.08%**
36	**Transportation and warehousing**	**o**	**o**		**31.01%**	**0.89%**	**0.92%**	**-0.02%**	**-0.01%**
46	Publishing industries (includes software)	o	o		53.73%	0.46%	0.47%	-0.01%	0.00%
47	Motion picture and sound recording industries			o	-9.04%	-0.01%	-0.03%	0.01%	0.00%
48	Broadcasting and telecommunications	o	o		68.33%	1.60%	1.70%	-0.06%	-0.04%
49	Information and data processing services			o	-0.96%	0.02%	0.00%	0.02%	0.00%
52	Federal Reserve banks, credit intermediation, and related activities			o	9.95%	0.41%	0.30%	0.10%	0.01%
53	Securities, commodity contracts, and investments	o	o		177.77%	1.26%	1.35%	-0.03%	-0.06%
54	Insurance carriers and related activities	o	o		-3.17%	-0.01%	-0.07%	0.06%	0.00%
55	Funds, trusts, and other financial vehicles	o	o		-80.08%	-0.08%	-0.09%	0.02%	-0.02%
57	Real estate			o	8.43%	1.08%	0.95%	0.13%	0.01%
58	Rental and leasing services and lessors of intangible assets			o	21.53%	0.22%	0.23%	-0.01%	0.00%

Notes: **PA**=Progressive Activities; **PS**=Progressive Services; **S&AS**=Stagnant and Asymptotically Stagnant; **PPE**=Pure Productivity Effects; **CRS**=Change in Relative Size; **IE**=Interaction Effect

Source: The author, the full table of the 1990-2003 interval and tables of the 1990-1995 and 1996-2003 intervals can be found in the appendices

1990-2003 period, this applies especially to the *Securities, Commodity Brokers and Services* category (a service defined as stagnant, but which produced a 177.8% rise in output per person employed), *Wholesale Trade* (progressive, 56.2%), Retail Trade (progressive, 56.3%) as well as the Telecommunication and Broadcasting services category (progressive, but "hybrid" 68.3%). Note that the latter category within the available data series, still groups telecoms together with broadcasting services which is somewhat unhelpful for our concerns.

More importantly, and like many if not all productivity analyses in the "New Economy" literature, the overall productivity rate is shown to be directly and highly dependent on the productivity increase of manufacturing industries supplying the new Information and

Communication Technology (ICT) products. For example, the productivity rates calculated for the industries indicates that the manufacturing activities classified under the heading of computer and electronic products contributed a striking 308.7% rise in output per person employed over the 1990-2003 period. Contrary to most of the productivity literature type of analysis, we show that new services offered by IT companies, such as *computer systems design and related services, information and data processing* and *Miscellaneous professional, scientific and technical services* have produced modest (i.e. at the same level of other stagnant services) or even negative productivity growth.

Table 4: Output per Person Employed and Contributions to the Aggregate VA of selected industries, 1990-2003, Part 2

Interval: 1990-2003										
Bea series number and description		PA	PS	S&AS	**Output per person**	**SUM (PPE + CRS + IE)**	**PPE**	**CRS**	**IE**
1	**Gross domestic product**					**21.35%**	**21.81%**	**0.45%**	**-0.92%**
61	Legal services			o	-11.85%	-0.15%	-0.18%	0.04%	0.00%
62	Computer systems design and related services			o	10.36%	0.11%	0.06%	0.05%	0.01%
63	Miscellaneous professional, scientific, and technical services			o	8.61%	0.40%	0.33%	0.06%	0.01%
69	**Educational services**			**o**	**-24.41%**	**-0.14%**	**-0.17%**	**0.05%**	**-0.01%**
70	Health care and social assistance			o	-16.65%	-0.78%	-1.01%	0.28%	-0.05%
71	Ambulatory health care services			o	-22.72%	-0.61%	-0.74%	0.16%	-0.04%
72	Hospitals and nursing and residential care facilities			o	-18.67%	-0.37%	-0.46%	0.11%	-0.02%
73	Social assistance			o	-3.68%	0.01%	-0.01%	0.03%	0.00%
76	Performing arts, spectator sports, museums, and related activities			o	5.08%	0.03%	0.02%	0.01%	0.00%
77	Amusements, gambling, and recreation industries			o	-10.40%	-0.03%	-0.05%	0.02%	0.00%
78	Accommodation and food services			o	4.22%	0.15%	0.11%	0.03%	0.00%
79	Accommodation			o	23.21%	0.19%	0.18%	0.00%	0.00%
80	Food services and drinking places			o	-0.40%	0.02%	-0.01%	0.03%	0.00%
81	**Other services, except government**		**o**		**-19.39%**	**-0.42%**	**-0.48%**	**0.08%**	**-0.01%**
82	**Government**			**o**	**-6.45%**	**-0.74%**	**-0.91%**	**0.19%**	**-0.01%**
Notes: **PA**=Progressive Activities; **PS**=Progressive Services; **S&AS**=Stagnant and Asymptotically Stagnant; **PPE**=Pure Productivity Effects; **CRS**=Change in Relative Size; **IE**=Interaction Effect									

Source: The author, the full table of the 1990-2003 interval and tables of the 1990-1995 and 1996-2003 intervals can be found in the appendices

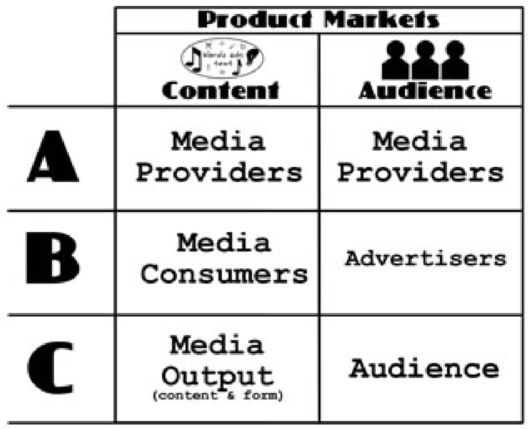
3.5. Adopting the Service Literature Viewpoint to Define the Media Sector

In order to map out the different activities of the media sector, we employ here the service triangle concept introduced by Gadrey (2002) (see figure 2). Firstly, using this concept, we are able to define media activities by establishing service providers, users and the object of the relationship between the two stakeholders; secondly, we can group all different media activities into three types, defining three vertical phases (also value chain stages) of the realisation of a media product: (1) the creation of content, (2) the packaging, marketing and distribution and (3) the delivery and exhibition. During the first phase the “first copy” of content, or Hill’s (1999) “original” is generated; this includes for example, the production of a movie or of a television programme, the writing of a book or newspapers’ articles. As explained above, new technologies are likely to change the nature of the content (i.e. improve the quality), but they are not likely to have a determining effect on the production’s volume.

During the second phase, media products are assembled: television programmes are lined up to form a schedule, newspaper articles are grouped to form a newspaper issue, and a media product is given one or more forms. Generally, the marketing of a media product is a prerogative of the packager/distributor and therefore it is included in this stage. Media products are then distributed to activities functioning as the final outlet, which delivers the final products to users: this phase includes for example, the resellers of books and newspapers, cinema theatres or cable television distributors.

Moreover, more elements should be added to our definition of a media service: according to prior work of Smythe (1981) and Picard (1989) the media industries participate at different levels and simultaneously in one or two of the following markets: the *“content”* market and the *“access to audience”* market.

Figure 3: Value chain stages of the Media service industry



Source: the Author

Using Gadrey’s service triangle, we can identify the provider (A), the use (B) and the entity of the exchange (C) of both markets: in a generic media industry framework and in the content market, we can name these stakeholders, the media provider (A), a media consumer (B) and a media output (content and/or form, C); in the audience market, on the other hand, we can name a medium provider (A); an advertiser (B) and the audience (C). The services provided in the two markets can be described as follows: in the content market, a user (B) experiences a medium product (C), that is supplied (produced/packaged/distributed and delivered) by the medium provider (A); in the audience market, the advertiser buys access to selected audiences from the provider, produced on the content market.

Figure 4: Mapping Content and Form Activities, the example of Cable Television

		CONTENT Market	AUDIENCE Market	
Production	A	Producers	Producers	CONTENT ACTIVITIES
	B	Broadcaster	Advertisers	
	C	Programmes	Product Placements / Programmes' Sponsorships	
Packaging, Marketing and Distribution	A	Television and Radio Broadcaster	Television and Radio Broadcasters	FORM ACTIVITIES
	B	Viewers (audience)	Advertisers	
	C	Programme Schedule	Audience	
Delivery	A	Cable Service Provider	Cable company	
	B	Cable Consumers	Advertisers	
	C	Packages of TV and Radio Channels (Tiers)	Dedicated channels / Audience	

Source: the author

This framework can than be used to detail various industries and value chain stages of the media sector. As an example, we can consider here the markets (audience and content) of television broadcasting; for simplification, but only for the moment, we consider only one type of final outlet: cable distribution. The first activity can be described with the following elements (see figure 4): the programme producer (A); the network or channel broadcaster ("B"); and finally the programmes or more generally the rights to broadcast the programme ("C"). This market is characterised by a private good, programmes, which are generally bought or commissioned by broadcasters from programmes' producers, in order to attract a specific audience. Sometimes and relatively frequently for the low budget productions, the programme maker can be the same broadcaster.[31]

The second stage of television and radio broadcasting is the packaging and distribution of the content. Using the same framework, we can identify: the radio and television broadcaster (A), the audience (B) and the programme schedule (C). In short, broadcasters package different

[31] Notably, in the case of Public Service Broadcasting, the format and the content of the programme, in addition to attracting an audience, it also aims at fulfilling the service objectives (e.g. educate / inform, etc…).

programmes into a schedule trying to reach a result in terms of audience that can be sold on the advertising market.

The third stage of the television broadcasting industry considered here is the cable distribution sector. In this market the provider (A) is represented by the cable service provider, the receiver (B) is the cable service consumer, and the reality (C) is different television and radio channels' packages.

Most of the television industry activities are also engaged in the audience market other than in the content market. The television industry's audience market of the distribution and packaging stage, is composed of the television and radio broadcaster or the cable service provider (A); the advertisers (B) and the audience (C). As usual, the service is described by the interactions between these different elements: in this case A sells to B advertising spaces watched by an audience created on the content market.

Cable service providers also generate revenue on the audience market. As companies within this industry often may have little or no control over the content of the television and radio channels that they carry and deliver to the final consumers, companies within this industry may provide a service to advertisers by adding dedicated "shopping" channels to the packages of channels they offer.

Programme producers are also involved in the audience market as they sell advertising space that is "embedded" in the content of the programme. This takes the form of product placements in movies, products' advertising in televisions programme or advertising that is digitally added to the transmission of sporting events.

Therefore, Gadrey's service triangle can be used to identify the various participants in every stage of an industry as well as their roles, in order to describe the different media markets. However, this can be done by making a small change to his original definition; in fact, so far and in the empirical exercise that follows (and because of its irrelevance at least for the moment) I have not considered questions of the extent of media ownership. In the case of television broadcasting, for example, the packaging and delivery of the media products, if we consider the transmission through airwaves as the delivery methods, are performed by the same company or television network.

Therefore, according to Gadrey's original definition and in virtue of the exclusion clause ("…but not ending in a final good likely to circulate independently from C", Gadrey 2002 p42), the delivery of the television signal is not a service in itself. However, as I focus on the changes caused by new technologies as they affect the performance and the shape of different media activities and this regardless (at least for the moment and before getting into aspects of regulations) of questions of ownership, I employ Gadrey's definition without considering the exclusion clause.

3.6. The Cost Disease of the Media Sector: an Empirical Exercise

As explained in more detail below and with the support of the modularity literature, as the modern systems of mediated communication evolve and expand, two trends can be established: on the one hand, media increase in complexity, new forms of media are created and therefore the number of activities or tasks and the number of links between the different activities have increased. For example, in the mid 1980s when Baumol used the case of over-the-air television broadcasting to illustrate the existence of asymptotically stagnant activity, production companies (mostly branches of the film making "majors") used to produce almost all of prime time programming that was commissioned by television stations, while television stations used to create a schedule and broadcast their programmes to end users using radio transmitters.[32] Some other users, although still a minority, would receive that signal through the service of a cable distribution company.

On the other hand, nowadays, television broadcasters are better understood as part of an audiovisual media service industry as the number of links between different activities have increased. For example, the programmes that appear on over-the-air television, may also be delivered to end-users using several other "windows"; dedicated (pay-per-view or advertisement-supported) cable or satellite channels, digital versatile disks (DVDs) - that are rented or bought in media outlet stores - or television channels' web sites.

Organisational changes in the media industries, however, are going to be detailed in Chapter Seven; what we are interested for the current purpose is the fact that compared to the time when Baumol et al. (1985) performed a similar analysis, the number of activities involved in, firstly, media content, and secondly in the generation of a form for this media content (i.e. the packaging, distribution, delivery and exhibition activities together) is increased. It is therefore somehow easier to find general economic patterns for describing how the technological structure of these activities, which is defined by the dependency on the creative input, for example, affects economic performance.

[32] Notably, as per effect of the Financial Syndication Rules, television stations were not allowed to own the rights or produce the content of their prime time programming, unless the content of this programming was sport or news (see Bielby and Bielby 2003 or Christopherson 2006).

Using the theoretical framework introduced above in the previous section and statistics for the US economy provided by the Bureau of Labour Statistics (BLS) and the Bureau of Economic Analysis (BEA), we can now seek to examine whether there is any evidence of Baumol's unbalanced growth trend within media activities, using the U.S. market as a case study.

Therefore, very simply, the list of industries and/ or groups of industries and establishments that are linked to the media sector, has been divided into categories: content making activities (hereafter *content activities*), which includes all the activities whose output becomes media content; activities involved in the last two phases or groups of activities as explained above, i.e. the packaging, reproduction, marketing, distribution, delivery and/or exhibition of media content (hereafter *pure form activities*) and finally, industries where both these two functions of making and packaging information are inputs and are carried out in the same establishments (hereafter *composite content and form activities*).

Because of the importance of the creative input in the production of an output, content activities are expected to be more stagnant than form activities and activities that include both functions are theoretically expected to be in-between the two. However, as the shares of content and form inputs of these "composite" activities are not known, in practical terms the behaviour of the latter is unpredictable. These content and form activities are compared to pure form activities and expected to be more stagnant for the empirical tests when data on content activities is not available.

The indicators that are taken into consideration here comprise the following: an indicator of productivity, namely output per worker; the components of this indicator, namely an index of output volume and labour (thousands of employees); the industry price levels and unit labour costs. All the indicators supplied by the BLS are indices. The base of these indices has been changed to either 1990 or 1987 in order to consider a trend over the longest period possible, the end year of the series is the last year available in the dataset.[33] In some cases the index series calculated by the BLS do not include "pure" service activities, such as the services involved in performing arts, because of the difficulties in estimating quality constant output, for example. When there are not enough series available to calculate a content activities' group, composite content and form activities are compared to pure form activities and expected to be more stagnant.

[33] The interest of this exercise is to compare groups of sectors and the choice of the base year is not expected to have a specific impact on one of the two or three groups.

Unfortunately, the data relevant to the different indicators for all the sectors that have been assigned to either group, is not always available; moreover, the index built from these indicators tend to be even patchier as the data that is available for each indicator tends to vary.[34] These indices can notably be aggregated in two ways: using specific weights, in this case the share of output or employees, or by simple average. The first methodology can be used to produce an indicator for the theoretical group, let's say, of media content activities, as this was an industry in which the activities were different inputs, each with its specific weight in the production process. Using a simple average, instead, is the same as considering each element of the group as a unique technology and the group as an average of "technology mix". The latter methodology is preferred to the former, because in this way we can create groups of technologies and test Baumol's idea of the existence of stagnant and progressive activities.

In essence, according to Baumol's assumptions, we discuss and expect the following five statements to be verified when we identify content and composite content and form industries as stagnant and the pure form industries as progressive.

Statement 1: An increase of the stagnant sector's output that is accompanied by an increase in the number of workers, while the increase of output of the progressive sector is accompanied by a slow increase or reduction of employment.

The data collected for this exercise clearly shows that on average, employment has increased more significantly in the content industries (+50% between 1990 and 2006), compared to the composite content and form industries (+11%) or in the pure form industry (+4.6%). On the other hand, output has grown faster in pure form industries (+102%, between 1987 and 2004) compared to the composite content and form industries (+90%).

Statement 2: *Following this first point, labour productivity increases more significantly or rapidly in the case of (the most) progressive activities;*

The index of output per worker clearly indicates a more rapid increase in the pure form industries (+103.6% between 1987 and 2004) than in the case of the composite content and form industries (+30%). The increase in productivity in both cases is characterised by a faster growth in the output produced than the increase in the labour employed.

[34] Therefore the "average" output per worker of the distribution activities, for example, is the average of a group of establishments that is different from the group of establishments used to calculate the average price trend of the same group. The criterium used here to select the groups is the following: we start from the definition of the group according to their function, and we use as many activities whose data is available.

Statement 3*:* Industry prices increase more rapidly in the case of stagnant activity than in the case of progressive activities;[35]

Table 5: Economic Trends of Content, Content and Form and Pure Form Activities

	Content activities			Composite Content and Form Activities							Pure Form Activities						
	Employment		Price	Employment		Price	Output	Output per worker	Unit Labour Cost	Labour Compensation	Employment		Price	Output	Output per worker	Unit Labour Cost	Labour Compensation
	Index	*Share*	*Index*	*Index*	*Share*	*Index*	*Index*	*Index*	*Index*	*Index*	*Index*	*Share*	*Index*	*Index*	*Index*	*Index*	*Index*
1987			100.0			100.0	100.0	100.0	100.0	100.0			100.0	100.0	100.0	100.0	100.0
1988			105.9			105.3	101.9	99.5	98.8	103.6			101.7	111.0	105.5	96.7	105.9
1989			110.5			111.5	103.6	98.7	98.2	108.5			104.9	122.6	107.5	95.4	113.6
1990	100.0	26.6%	116.2	100.0	32.9%	118.2	103.7	95.7	108.6	119.8	100.0	40.5%	106.5	129.2	108.8	96.1	120.2
1991	101.3	27.0%	121.1	99.5	32.7%	123.9	101.1	94.1	119.3	123.1	99.5	40.3%	108.3	127.8	109.3	98.9	124.2
1992	101.5	27.5%	123.9	99.1	32.5%	128.6	103.5	96.7	136.3	134.2	97.5	40.0%	109.2	133.0	115.3	99.5	129.2
1993	103.7	27.4%	126.5	101.3	32.6%	132.4	104.2	94.7	144.6	140.8	99.4	40.0%	109.5	140.5	119.2	99.2	134.7
1994	109.7	27.6%	130.5	104.3	32.2%	136.3	107.3	95.5	142.8	145.8	103.8	40.3%	110.6	152.0	125.4	94.1	138.7
1995	119.9	28.4%	135.4	108.4	31.4%	142.0	112.6	95.8	148.0	161.4	108.8	40.2%	113.4	163.7	133.4	95.6	150.2
1996	128.7	29.3%	139.7	112.8	30.9%	148.5	116.8	95.0	152.1	173.9	112.9	39.8%	114.1	148.2	123.7	104.9	156.8
1997	133.4	30.0%	143.3	115.1	30.5%	153.4	123.0	98.9	163.8	194.8	115.6	39.5%	113.5	149.2	125.5	111.6	166.0
1998	138.1	30.2%	141.6	118.2	30.4%	162.3	147.1	110.3	157.1	217.3	118.5	39.4%	113.5	157.3	137.7	114.3	178.8
1999	153.4	31.2%	148.9	120.8	30.1%	167.4	160.2	115.0	163.9	242.6	120.3	38.7%	112.9	173.2	146.9	107.7	173.1
2000	167.9	32.0%	156.3	125.7	30.0%	172.5	173.8	116.7	171.1	266.1	123.1	38.0%	113.4	180.4	151.3	105.7	175.4
2001	162.7	32.3%	162.5	125.7	30.2%	178.4	170.0	111.3	179.5	272.9	119.9	37.5%	113.4	178.9	152.4	107.1	173.1
2002	148.6	32.4%	167.1	119.7	30.3%	181.8	176.5	116.9	172.0	277.5	114.3	37.2%	111.6	177.5	160.2	108.8	172.1
2003	141.4	32.8%	173.0	113.3	30.1%	186.9	182.3	127.1	174.0	300.6	109.6	37.0%	110.7	184.2	175.5	108.6	173.8
2004	144.1	33.5%	178.3	110.8	30.1%	190.2	190.3	130.1	177.2	328.6	106.0	36.4%	110.4	201.7	203.6	103.5	180.1
2005	146.6	34.3%	185.2	110.5	29.9%	195.2					105.4	35.8%	111.5				
2006	150.0	35.1%		111.3	29.7%						104.6	35.2%					

Source: Computed by the author based on data and indices published by the BLS and the BEA. For a definition of the sectors, see Appendix 2

The indices of prices built on the BEA and BLS data show that on average, prices have increased in the composite content and form industries by 95% (between 1987 and 2005); followed by the content industries' 85% and finally the pure form industry, by 11.5%.

Statement 4*:* Given a general increase of output in the long run and the expected differential of productivity growth, we should be experiencing a shift of employment in the media sector from progressive activities to stagnant activities;

If we sum up the employment in the media related industries and classify them into the usual three groups used so far, we notice that in 1990, over 26% of the total employment was

[35] Following Baumol et al (Baumol, Blackman and Wolff 1985), under neoclassical assumptions the increase of prices should be proportional to the drop in productivity. Given the differences in the composition of groups used to calculate the index of prices to the one used to calculate the average index of labour productivity, the change in price is not expected to be proportional to the drop in productivity and this comparison is not carried out.

provided by the content industries, while almost 33% was based in the composite content and form industries and over 40% from the pure form industries. This situation presented itself as being quite different in 2006, as over 35% (+9%) of employment is provided by the content industries, while just less than 30% (-3%) from the content and form industries and over 35% (-5%) from the pure form industries.

Statement 5: Stagnant activities may be expected to experience, not only an increase in the total cost of the salary because of the increase of total labour employed, but that this will be faster than the growth of output. Therefore the indicator of unit labour cost, (which estimates the cost of labour input used to produce a unit of output)[36] should register a faster growth in the case of stagnant industries than in the case of progressive industries.[37]

Given the faster increase in the employment level in the composite content and form industries compared to the pure form industries, the index of labour compensation shows an increase of over 228% in the case of the former (between 1987 to 2004) and only 80% in the case of the latter. Unsurprisingly then, we find that the index of unit labour cost reveals a much larger growth (+77.2% between 1987 and 2004) in the composite content and form industries, compared to the pure form industries (+3.5%).

Let us now summarise the results of this exercise. First of all, we constructed the indices by using groups of different industries depending on the availability of data and indices, the categorisation of these industries, however, is consistent with the functions they provide within the media industry and with how many of these functions characterise one single establishment (which is the unit measure of official statistics to specify the nature of an activity). In other words, all media industries for which we have relevant statistics are divided into three categories: content, composite content and form and pure form industries. Secondly, the trends revealed by our analysis are highly consistent with the assumptions we formulated based on Baumol's theories and this is so if we identify content industries as the most stagnant and pure form industries as the most progressive.

3.7. Towards Alternative Productivity Measures

The clearest challenge to providing a coherent productivity measure for a service sector is plainly and ironically spelt out in this statement from Baumol and Oates (1972):

[36] And calculated as the ratio of current dollar labour compensation to constant dollar output (BLS 1999 p2).

[37] This statement is taken from Baumol's explanation of unbalanced growth and modified. The modification we apply is the non-applicability of perfect markets. In Baumol's models, markets are perfect and therefore, the labour moves from the most progressive to the most stagnant activities while salaries stay the same in relative terms. If we do not consider perfect markets, we can explain the relative increase of salaries in the stagnant sector as the response to the increasing demand for new (and better) labour, which is triggered by the existence of the cost disease.

> ”Productivity changes in the services, it is suggested, have taken the form of better output rather than increased quantity per unit of labor input. Although the direction of change in the quality of education or in the adequacy of repair services is sometimes questioned, there seems little reason to doubt, for example, that an appendectomy today is a much better product than the corresponding operation in 1900.” (p89)

As explained and demonstrated empirically above, for the activities where the use of the creative input is highly correlated to the output produced, measuring the quality of the service becomes crucial. In fact, without quality increases productivity is likely to show a slow increase or no increase at all. What we gather from Baumol’s ideas, is that a measure of quality of the output of the currently stagnant industries should reflect the quality (e.g. level of salary, education, etc…) of the creative input involved.

On the other hand, here I would like to provide some examples on the direction of the research about quantifying quality of output in the service sector. This research is seemingly characterised by what appears to be a common, although “implicit” trend in the service innovation literature: understanding a service requires understanding the relationship between providers and consumers, more than the nature or the characteristics of the object, or economic entity C, as Gadrey defines it, that is integrating part of this relationship.

The new direction of productivity measures for service activities tends to embrace the fact that quality trends can be extracted from customer feedback. Moreover, new concepts of productivity are better understood as some kind of customer-focused efficiency. In fact, efficiency is generally defined as either the capacity of producing the maximum output with a given input, or, the capacity of producing a given output with minimum inputs. A new definition of productivity can be understood to express the capability of producing a targeted qualitative (as per customers’ opinion) and quantitative output, with minimum inputs; or the *best* output with a given input.

As reported by Adam et al. (1995, cited in Vuorinen at al. 1998), from the work carried out during the First International Research Workshop on Service Productivity held in Brussels in1994, six general requirements to guide the formulation of a service productivity concept have emerged (Vuorinen et al. 1998 p392): (1) Service output has to be seen as the value for the customer and from the perspective of the customer; (2) Service output must be defined by its quality level; (3) The customer must become a part of the productivity concept; (4) Measures of productivity must be more customer-related; (5) Dynamic indicators of productivity must be used instead of static output/input measures; (6) Situation specific measures have to be available to allow for the complexity and diversity of service operations.

Two examples of indications for a modern service productivity measure are mentioned here. Vuorinen et al. (1998), simply define productivity as the quality and the quantity of output divided by the quality and the quantity of inputs. According to these authors the output quantity is determined by the volume of the service and the inputs' quantity is determined by labour, raw material and capital; while the quality of output is determined by customers' perception and the quality of input by intangible and tangible elements. Without specifying further any additional steps to be taken, they support the idea of transforming the different measures into monetary terms in order to combine the different elements.

An alternative and more detailed approach is proposed by Gadrey (2002). First of all, a notion of operational efficiency is preferred to the notion of productivity; as output is re-defined, the concept of productivity is renamed to reflect this change.

Hence, according to this author, *ad hoc*, detailed, sectoral studies should be undertaken in order to provide different categories for different types of output. These types of output are then divided into homogenous groups, weighted for their "case mix complexity" and for an index of "quality per case" (also referred to as "service intensity"); an aggregate service output measure is then defined by combining these three indices. The formula is the following (Gadrey 2002):

$$O = Q \times C \times I,$$

Where "O" is the service output index, "Q" the quantity of cases, "C" the case mix complexity and "I" the service intensity or quality per case. The utility and application of this type of index is explained through different examples, the most straightforward being possibly its application to hospital output.

In fact, as Gadrey reports (2002), the number of visitors can be considered hospitals' crude output. However, given the wide range of types of case and their different complexity, the number of visits can manifestly result in a very poor index to measure and compare different levels of performance. Therefore, "a case mix complexity" principle, as defined above, can be applied and cases divided into groups. In the case of hospitals, visitors are classified according to their conditions and divided into Diagnosis Related Groups (DRG). These groups are then assigned a degree of complexity and an average cost. However, for the same type of cases, two different hospitals can apply, for example, different standards in terms of nursing, accommodation and food services. These characteristics, among others, are supposed to be part of the final component of the service index, called service intensity or quality

3.8. Some Conclusions

According to Peter Hill (1999), Adam Smith generally defines the workforce employed in the service sector as "unproductive" labour, because the output it generates does not increase the stock of assets or because it is not "vendible", and not because it is understood to be "unnecessary". However, the first to introduce the concept of "material" and "tangible" to describe goods and differentiate them from services, is thought to be Jean-Baptiste Say in his "*traite' of économie politique*" first published in 1803 (Hill 1999).

Generally speaking, definitions and characterisations of a service and the service industry sector have originally been developed around very simple principles: a service is what a good is not; and any economic activity is part of the service sector if it does not belong to agriculture or manufacturing. One could argue that this conception, despite its clear limitations, is still very influential in modern economic thinking. In fact, it is clearly at the origins of the most widely used categorisation of economic activities, i.e. the division between agriculture, manufacturing and services. However, especially with the multiplication of specialised service activities, one must nowadays question the utility of this categorisation, which divides into different groups the computer and the IT support industries, but classifies under the same heading the local barber shop, a research institute and a large financial holding company. Classifications of activities according to different criteria, such as Baumol's simple division between progressive and stagnant sectors, are certainly less celebrated, but might appear more useful to understand the dynamics governing modern economies.

As a consequence of this long-surviving conception, the service sector has protractedly been described as producing intangible products, being dependent from the manufacturing sector for technical innovation, and, as a consequence, playing a rather passive role in contributing to economic growth. Moreover, because the service sector generally does not require extensive factories full of expensive machinery, a service is generally and superficially defined by low capital intensity.

Seemingly, many academics are departing from this conception and new definitions for services and the service sector industry are put forward. These highlight and analyse the existence of an interaction between different units and their respective roles. However, even though the service sector has been re-defined in the economic literature, analysis of its economic growth and dynamics are still generally and implicitly based on goods producing activities, as the three arguments presented here testify.

Studies of the productivity literature such as the one introduced in section 2.4.1.3, or other mainstream approaches normally *do not consider pure stagnant services*, such as those provided by the sector of education and health, because of the notable problem of measuring and providing a monetary value of their output. Even though statistical requirements clearly justify this proceeding, logically, it appears that particularly strategic sectors that can be influential to the same productivity level are unduly ignored or left to rarer, specialised studies. Indeed, as per the effect of unbalanced growth, employment in the stagnant industries is proportionally increasing. Therefore productivity studies are leaving out of their estimates a growing share of the economy.

Moreover, *current productivity measures do not include customer feedbacks*, as to reflect the fundamental aspect of goods' production process, which is the clear separation between production and consumption. Theoretically, if the notion of productivity were modelled by a modern definition of services, customer feedback would be naturally included in the definitions of output and input. Moreover, including customer feedback in productivity analysis can provide a methodology to incorporate product quality into outputs and inputs to goods and services industry sectors, whether stagnant or progressive.

Innovation is often approximated with investments in R&D or investments in new technologies, an estimation that is definitely more suited to manufacturing than the services industry. In fact, as mentioned above, this latter seems to be generally characterised by other intangible investments, which can be considered sources of innovation (such as in know-how, industrial patterns and design, patents and licenses, training, customers' lists, etc…); progress in product quality is rarely included in the analysis, and this happens, for example, when technical developments of a product can be clearly identified and measured (such as the case of hedonic price measures for computer industry output).

The chapters that follow, on the other hand, attempt to provide an analysis of the sub-sectors composing the PIS that is evolutionary, neo-Schumpeterian and "service-friendly", as it is based on the description of successive events, on the understanding of how these events are chained. The notion of innovation used in this analysis stems from a neo-Schumpeterian perspective, to become more service focussed and therefore inclusive (at a microeconomic level) of other types of change. Certainly technical change plays a fundamental role as it enables the existence and expansion of markets; however, institutional, organisational, managerial and stylistic changes also play an important, even irreplaceable role.

Chapter 4 - Modularity, Services-ation and Technological Trajectories: The Evolution of the Information Technology Sector

"… one sees that the evolution of firms and of economies does not lead to any easily predictable equilibrium, much less an optimum, but is a complex process, probably continuing indefinitely, that is probably best understood through an examination of its history"

(Simon 1996 p47).

4.1. Introduction

In this chapter, we select and describe a number of changes and characteristics to the production processes of the ICT sector, in order to introduce (in the following chapters) some concepts that will be employed to understand the innovation dynamics of the wireline telecommunication and audiovisual media service industries. These concepts, which are modularity, services-ation and technological trajectories, concern various aspects of the production process and innovation patterns. We choose to focus our analysis on the semiconductor and the computer industry, given the importance that neo-Schumpeterian theories grant to the motive and carrier branches in shaping other industries' production processes.

Specifically, we start with a brief account of the main developments and characteristics of the semiconductor industry. In this section, we want to stress the relevance to our viewpoint of findings put forward by Linden and Somaya (2003). These authors report that although the semiconductor industry is clearly cutting edge when it comes to implementing new technologies, it is experiencing a productivity gap between the design (slow growing) and the possibility of construction (fast growing) of new microchips. This example underlies the relevance and crucial role of the creative inputs as we explained earlier through Baumol's Cost Disease theory.

Following this brief history of the semiconductor industry, we provide an account of the computer industry. This account is divided into three phases; the first phase is dedicated to mainframes. During this phase, companies producing this type of product are vertically integrated; different standards co-exist and they depend on their manufacturer. The second phase described is the one of the Personal Computer (PC): following the introduction by IBM of an open standard computer, this type of computer becomes the *de facto* standard and the industry becomes mainly characterised by horizontally integrated market segments. The third phase is the one of the *services-ation* of large computer manufacturers. During this phase, which is still unfolding, large computer manufactures change into industries mainly characterised by service activities. For obvious reasons, this change also affects the drivers to innovation which become increasingly shaped by the demand (the customers' business needs). Even technological change becomes shaped by the value that can be generated when combined with the service activities delivered.

In other words, if we explain the change of trend in terms of sources of innovation using the "technology-push" versus the "technology-pull" dichotomy, we argue that both aspects influence the innovation process, although innovation seems to have been driven mainly by the first, from the start and until the 1990s, and by the latter from the 1990s to the current day. Moreover, before getting into the description of the technological change and the evolution of business models, the role that institutions played in shaping the sector and the methods used is briefly described.

The history of IBM is used here to describe some of the major events that have characterised the sector. Although the story told in here does not concentrate exclusively on the events that have characterised this company, this method could be thought as too simplistic. However, on the one hand, this choice is made in the interest of keeping this account succinct, and on the other hand, IBM is certainly the company which has influenced all three of these phases more than any other company: in fact, IBM was the largest producer of mainframes and the first to introduce a line of compatible machines; this same company introduced the PC that became the industry standard, and finally, after the adoption of a new strategy, this company also became the largest IT service provider.

From this account, there are two important subjects that might also be included because of their large influence on the history of the computer industry: the first is the evolution of the software industry, while the second is the invention and diffusion of the Internet and the World Wide Web. However, these subjects are only partially included in the story here, and the main rationale for this choice is the necessity of keeping the account short, although as comprehensive as possible. Therefore, the software industry is only examined here in relation to its direct contribution to the hardware industry, while the development of the Internet is mainly a background event enabling further technological progress. The omission of this latter is also justified by the fact that this chapter (and the following) mainly aims at providing more explanations for the economic performance of specific PIS industries and the Internet in itself does not constitute a singular industry.

The second main objective of this chapter is to provide a rationale for the modularity literature, using the changes which occurred in the semiconductor and computer industries. As explained above, this modularity literature will be used to discuss the indirect influence of the semiconductor and IT industries on the organisational settings of other industries, and particularly on telecommunication and media.

4.2. The Role of Public Intervention

This chapter starts with an account of the influence of institutions on the development of IT industry. We start with this subject because although the IT sector is certainly less regulated than telecom and media, we want to highlight the important role that institutions and governmental organisations, such as the Department of Defence, the Justice Department, courts of law and the Federal Communications Commission (FCC) played in shaping the semi-conductor and the computer industries.

The following account draws on Usselman's (2004) description of the relationship between institutions and the industries of the sector considered here and the evolution of that relationship. On the one hand, part of the institutions, including the powerful Department of Defense, were very interested in the development of valves, transistors and later of semi-conductor and computers and they were sustaining the revenue and the research of a selection of companies with large orders and contracts. On the other hand, another part of the institutions, notably the antitrust division of the Justice Department and the FCC, played the role of watchdogs, and shaped the structure of the industries through lawsuits, consent decrees and settlements.

The two types of institutions, however, pursued the same objectives: sustained rate of innovations and frequent introduction of new products. The importance of the influence of one or the other type of institutions changed from the mid-fifties (when the commercial market blossomed) and shifted from the Department of Defense to the watchdog institutions: in fact, it is after this turning point that important lawsuits were filed and consent decrees and settlements signed. However, throughout the entire period governmental agencies seemed to tolerate and even encourage the existence of dominant firms, as long as their innovative record could justify their large size and important market share (Usselman 2004).

The interest of the institutions was not only limited to the organisational structure of a sector, but also to the shaping of technologies. As Freeman and Louçã (2001) report, in the mid fifties, during the cold war, the government tried to stimulate the development of different types of transistors, which were thought to play a key role in the future of military equipment, by placing orders for a total of thirty different types of germanium and silicon transistors to about a dozen different semi-conductor companies.

Later, the Department of Defense was pushing for miniaturization and increased reliability of circuits, two characteristics which became two of the most important R&D drivers, through contracts with electronics providers Motorola and Sprague, among others (Holbrook et al. 2000).

The influence of the government through procurement was not only limited to the electronics industry, but also to the computer industry: in fact, the interest of government agencies in the high-end-performing machines and their links with IBM and other companies is well documented (see Usselman 2004).

Some of these lawsuits, consent decrees and settlements are of particular interest here and they deserve special attention in order to explain the technological trajectory and the evolution of the market structure of the industries. The first two important consent decrees date from 1956; Following the first of these consent decrees, because its parent company AT&T agreed not to pursue its interests and research in the computer industry but focus only on the telecommunications industries, Bell Labs was forced to offer licenses for its transistor technology to any party interested and willing to pay the upfront fee of 25,000 dollars (Holbrook et al. 2000). The second of these consent decrees, this time involving IBM, marked and imposed the beginning of unbundling of its product as well as of its organisation. In fact, following this decree the company had to sell and lease equipment which allowed consumers to purchase parts of the system from competitors (and therefore release licenses and patents); the consent decree also insisted that the company would separate its data processing services and create a new wholly owned and independent subsidiary (Usselman 2004).

Two other major and long antitrust lawsuits involved IBM and AT&T renouncing their monopoly practices in shaping the technology and the structure of the sector. These lawsuits were filed at different stages. The first, against IBM, was announced in 1969 (Usselman 2004) and the second against AT&T a few years later in 1974 (Hundt 1994). Yet, both were resolved in 1982 on the same afternoon. The asymmetry of the decisions taken clearly provides an unambiguous picture of the policy orientation towards market structure and innovation at the time.

The results of these lawsuits were that AT&T had to break up the company into local carriers and one long distance carrier (as explained in more detail in the next chapter), while IBM was allowed to pursue its business in its current form. The rationale behind this choice, apart from the increasing role played by deregulation arguments in public policy debates at that time, was that of promoting technological innovation and access in the industry. AT&T was found to limit this access, while IBM, in its current market position, was seen as highly innovative as well as playing more the role of a technology broker, providing stability to the market without hindering the forces of competition (Usselman 2004).

We can add to this analysis that these decisions are in line with the different regulatory takes characterising these two information sub-sectors: as will become clear from the accounts of the evolution of the IT and the telecom sectors in this and the following chapters. This history reveals that regulations in the telecommunication are obviously necessary and the involvement of different state departments in the telecommunication sector is direct and somewhat of a tradition: the creation of a natural monopoly following the 1921 Willis-Graham Act and the release of different "slices" of radio spectrum to foster the adoption of different mobile transmission technologies, are just two examples. However, the computer industry is an activity which is thought to grow and innovate independently in a manner more similar to a classical market situation: government intervention, although certainly highly influential, appears to have been more strategic, indirect and subtle. This is clearly demonstrated by the procurement contracts mentioned above and by the succession of computer enquires which attempted to separate voice services, the highly regulated activities of telecommunication industries from data communication, which was mainly provided by IT industries and had to be excluded from the regulatory framework designed for telecommunication services.

4.3. The History of Semi-Conductors

The rapid improvements of technologies in the semiconductor industries as predicted by Moore's Law have already been explained in Chapter Two; also in Chapter Two we have explained the viewpoint of neo-Schumpeterian account and the crucial role attributed by these accounts to the semi-conductor industry, the one of motive branch, in shaping the fifth Kondratieff wave of development. Here we simply trace the technological progression of the industry by outlining its stages as a succession of radical innovations and new products.

The modern semiconductor industry finds its origins in the production of transistors and valves. As mentioned above, the production and development of these products, which were used for radio transmissions, were exclusive to Bell Laboratories until the 1956 consent decree. In the years that followed this decree many other companies undertook the development of semiconductors in what was an oligopolistic yet competitive environment: Sprague Electric, Fairchild Semiconductors, Shockley Semiconductor Laboratories and Motorola were the most important players in the market. Moreover, in 1968 and after leaving Fairchild Semiconductors, Robert Noyce, Andrew Grove and Gordon Moore founded what would later become the most important company in this sector: the Intel Corporation (Holbrook et al. 2000).

As mentioned above, increased reliability, miniaturisation, as well as cost reduction, were the main drivers for R&D in the industry.[38] Therefore the technological trajectory of the semiconductor industry can be stylized with the following succession of more powerful, increasingly complex and relatively cheaper products: before the solid state revolution, valves and transistors were the main semiconductor devices. Later, the solid state revolution replaced the process of electronic conduction in gaseous state form using vacuum tubes, and introduced the use of silicon-based semiconductor devices.

Another important innovation is represented by monolithic integrated circuits, or multi-transistor circuits, which were introduced in 1959 by Robert Noyce (Holbrook et al. 2000).

Certainly even more important was another invention that changed the computer industry. Between 1971-1972 Intel Corporation introduced the microprocessor, a semiconductor with computing capabilities (Lazonick 2005, Freeman and Louçã 2000). Computers then benefited from the progress in the design and production of Printed Circuits Board (PCB) and different electronic components including semiconductors and microprocessors could be interconnected and used together as a system.

This type of system, even though still with more limited functionalities, can be built nowadays on a single chip (called Systems on Chip or SOC). These SOCs are chips that incorporate at least one processor, memory and any number of other functions, such as protocols converters, signal processors and input and output controllers (Linden and Somaya 2003) and are now the base elements for “smart” electronic devices.

These SOCs represent an improvement from systems assembled on a PCB as they are capable of quicker operating speeds, lower power consumption and improved system reliability. Moreover, SOCs can be used to produce final products that are of reduced size and complexity and they have lowered unit manufacturing costs (Linden and Somaya 2003).

We consider this progression from systems integrated on PCBs and SOCs a good illustration of the passage from a Fordist to a post-Fordist’s organisation of production according to the modularity literature. Although this difference will be better detailed below, we report here

[38] According to Rhines (2006), for example, cost reduction has been the driving factor toward miniaturization.

Linden and Somaya's (2003) explanation of the difference between the two production processes.

In the case of assembled PCBs systems, components are manufactured separately and transaction costs' are limited to the costs incurred in the traditional trading of goods: these are related to ensuring quality, good's delivery and the coordination of design. Alternatively, in the case of SOCs, the realisation of parts of the systems can also be delegated by the platform integrator to other suppliers. However, given the fact that the production of a single system is integrated (and performed by the integrator) what the main architect delegates is only the design of some parts/functionalities. This process is referred to by these authors as "licensing of design".

The emergence of the "licensing of design" and the appearance of design modules (DMs) in the semiconductor industry has been realised thanks to two historical developments: the first is the establishment, around 1980, of silicon-based CMOS technology as the dominant technology for semiconductor. The establishment of a standard, although only *de facto*, has contributed to the standardisation of interfaces; the second development concerns the creation of design software capable of characterizing the CMOS process limits of different chip plants (Lynden and Somaya 2003).

The possibility of decoupling design and manufacturing has allowed American firms to contract out the production of semi-conductor to specialised foundries, especially in the Far-East (Langlois and Steinmueller 2000).

Transaction costs are normally higher in the case of design modules than in the case of components and they depend on technological interconnectedness, the diffusion of various entitlements, the allocation of values and processes of monitoring and metering (Linden and Somaya 2003).

These authors also notice an important feature which is relevant to this account as it provides an illustration of Baumol's Cost Diseases as we have explained above, and this, in the case of one of the most innovative and fast moving industry. According to Linden and Somaya (2003):

> "The SOC movement interacts with an important design problem being faced by the semiconductor industry. While the complexity and density of ICs has increased rapidly in keeping with Moore's law, improvements in the productivity of IC designers have failed to keep up. This has resulted in a so-called design productivity gap in the industry […], which has grown substantially through the 90s." (p548)

The part of the production process that depends on human creativity and labour or the creative input, as we have defined it, is responsible for slowing down the overall rate of productivity growth of the industry. The solution to this problem can be found by applying different forms of standardisation.

In the specific case of the semiconductor industry, this standardisation has been partly achieved with the diffusion of Electronic Design Automation (EDA) software. EDA software automates various stages of chip design, simulation and verification. Moreover, these types of software contains libraries of pre-tested design elements (called “cells”), which are tailored to the design rules of one or more semiconductor manufacturer (Linden and Somaya 2003).

4.4. The Mainframe Industry

Following this brief account of the history of semiconductors, we now outline here some key developments explaining the evolution of computer systems and of its manufacturers. This account starts with mainframes and ends with the raise of the share of service activities, passing through the account of the introduction of the personal computer.

As explained above, one company among others has been the most influential in marking the history of computing: in fact, IBM was not only the most successful producer of different generations of mainframes, but also the company whose version of the personal computer became the industry standard in a very short time after its release. Moreover, some of IBM’s strategic and organisational choices, all deriving from technical developments, have shaped organisations and influenced the business model of the entire sector.

What follows in this section is a very short account of how representative generations of mainframe technologies, the organisational settings underpinning these technologies and the business models that have characterised them, have evolved: more specifically, the products chosen here are IBM’s 650 and 1401 models, the revolutionary System/360 (S/360) and the “G” series.

4.4.1. IBM Models 650 and 1401: A Service Approach as the Key to Success

Mainframes were the main computing technology between the 1940s and the 1980s after which time personal computers and client-server technologies provided a more viable (and later dominant) alternative.

During those early decades IBM was by far the main provider, as it controlled nearly half of computers’ world market: moreover the computers’ market in that period was characterised by the presence of a few, vertically integrated companies that produced many of their own components, developed their own software and sold their computers through their own sales force (Dedrick and Kraemer 1998).

IBM's 650 model differentiated itself from the other products on the market, because of the company's holistic approach in its design and delivery. IBM's engineers were instructed to build the 650 model by teaming up with marketing managers. This company was apparently the first to realise the importance of a customer-driven design of technology, a principle that, through several trial and error stages, is now quite clear to IT tools providers: in the opinion of customers, technological aspects are secondary to providing an easy solution to business problems. Therefore, the system's programming, customer transition, field services, users' training, the provision of spare parts and logistic aspects are all elements that carried weight in the decisions that influenced the design of the model (Campbell-Kelly and Aspray 2004).

This same principles also guided the creation of the 1401 model: IBM included in this model a Report Program Generator (RPG); this allowed people who were familiar with wiring up plugboards on accounting machines to use familiar notations and techniques, and after only a couple of days of training they could write business applications that could be used with this model. Although this seemed to be a feature that was appreciated by consumers, many companies kept ordering applications used for payroll, invoicing, stock control, production planning and other business functions from IBM. However, the 1401 model met with a rather unexpected level of success: the key of this success was to be attributed to a (rather marginal) module of the system: the new model was equipped with a new printer (the 1403 model) that could manage 600 lines per minute, or four times faster than the system it was replacing (Campbell-Kelly and Aspray 2004).

This success demonstrated that in the case of customers the solution to business problems can justify the purchase of new technologies: in fact, the resources saved thanks to the new printer alone justified the purchase of a new system, relegating the extra features to the role of a "free" and welcomed bonus.

4.4.2. The System /360: the First Modular Computer

Many circumstances led to the brave decision made by IBM management to undertake the "System /360" project, which revolutionized the entire production line. As explained above, at the time when mainframes were the most popular computing machines, companies were vertically integrated as they produced most of the modules necessary for their systems. IBM, however, although vertically integrated, with its seven products on the market it could have been described as a corporation of seven different companies (Campbell-Kelly and Aspray 2004).

When a new system was launched, the new design was unique: a new processor, a new operating system, new peripherals and business applications were produced, while the legacy systems were still in production. Buyers of new systems had to rewrite the existing applications and take the risk of losing critical data (Baldwin and Clark 1997).

The S/360, which was conceived in 1962 and launched in 1964 (Campbell-Kelly and Aspray 2004) was a single product line of systems of different sizes and capabilities that could share the same peripherals and applications (Baldwin and Clark 1997; Usselman 1996). The range of S/360's products could satisfy the needs of the entire pool of IBM's customers, from the ones using machines for data entry to the ones making more scientific uses (Campbell-Kelly and Aspray 2004).

The production of this new line of computers was achieved through modularity in design and a new organisational setting: the design of the S/360 was composed of visible and *hidden rules*. A Central Processor Control Office would establish the visible rules, which allowed the different components to communicate and work together. Dozens of design teams scattered around the world had to adhere to these rules, although they had the freedom to design the *hidden* elements of the different modules (Baldwin and Clark 1997).

The S/360 was then a modular machine with proprietary interfaces and therefore the supply of peripherals or other modules for the system remained entirely captive and exclusive to the company itself (Langlois 2002; Chesbrough 2005).

Moreover, following a suggestion made by Kelly, former research director of Bell Labs later employed by IBM, the company started also to produce its own integrated circuits (imitating the example of RCA and GE) in a new facility near its plant in Poughkeepsie. This new production was launched thanks to the consulting work of Texas Instruments' experts, who jointly worked with IBM personnel (Usselman 1996) in a collaborative effort that is rather common nowadays in the IT sector, but certainly quite innovative at the time.

However, instead of aiming to develop new semiconductors, IBM preferred to invest in a strategy of flexibility in order to be able to keep track of design changes and being able to respond to changes in demand (Usselman 1996).

Although the idea of compatible systems was already shared among computer manufacturers, IBM certainly benefited from its efforts and the S/360 became very popular: the strategic weapon in IBM's field, which gave it an advantage over its direct competitors such as RCA and GE, turned out to be its sales force, capable of marketing complex products to business people other than engineers and scientists (Campbell-Kelly and Aspray 2004).

4.4.3. The Post S/360 Era: the commodification of mainframes, the fall of IBM and a new strategy

In 1970 and following the success of the S/360, a new product line, the S/370, was announced and then launched. This new line of products was technically improved and, if compared to the performance of the legacy system, relatively cheaper. Technical improvements included better performing electronic technologies: true integrated circuits were used instead of Solid Logic Technology (SLT) modules and magnetic core storage was replaced with semiconductor memory. The architecture supported time-sharing and communication-based online computing, and the technique of the virtual memory, which maximizes the use of the physical memory, was also a newly added feature (Campbell-Kelly and Aspray 2004).

Although the S/370 was certainly a competitive system, from 1976 IBM's dominance of the computer industry started to suffer from the growth of its competitors. According to Campbell-Kelly and Aspray (2004), in 1976 IBM's sales still accounted for fifty percent of the total world's computer market (but up to two thirds of the market for all mainframes), a percentage that fell to 25% after only nine years. However, this reduction in IBM's share of worldwide computers was not due to a dramatic fall of the company's sales, rather, an increase in overall size of the market: in fact, while IBM's "rate of dominance" declined, its profits still increased, at least until 1985.

After the 1985 peak, IBM's profits started declining up to a point when, in 1993, the company had to report the largest loss ever by a private company. The main reason for this fall in profits is to be found in the mainframe market (IBM's main source of revenue) and its "commodification" (the opposite of *services-ation*). In fact, many of the functions that were performed by IBM personnel and their expertise (such as system integration) that gave IBM a competitive edge, were gradually performed by software; in terms of technical capability, IBM competitors' products were equally good but also cheaper, therefore an increasingly large share of the extra demand generated with the expansion of the use of computer was gradually fulfilled by other companies (Campbell-Kelly and Aspray 2004).

This account of the decline of IBM's dominance in the industry is crucial for understanding the strategy of the company; in fact, as described in more detail below, IBM's resurgence can be explained by a reversal of this trend. After the 1990s, IBM bet on increasing its revenue through the offer of new service activities, which increased the value added of its hardware (or rather, the hardware becomes value-enhancing for service activities). This bet paid off and put IBM back on top as one of the largest IT companies.

Moreover, another episode of the history of IBM and specifically in the mainframe market is important to illustrate the company's new business model: a business model that is not just specific to IBM, but a new characteristic of the computer market.

As Takahasi explains (2005), IBM realised in 1993 that its processor's technology (bipolar) had reached a bottleneck and that it was time to move to the CMOS standard. In fact, even though bipolar circuits were faster than CMOS, the aggregation of more circuits, which was the way forward to increase the speed (and the main driver for mainframes technology) would increase the temperature of the processor in such a way that the current water cooling system could not possibly deal with it. Therefore, even though bipolar technology was faster than CMOS at the time, it really had no future.

The switch to CMOS was not straightforward as is shown by the completely redesigned System/390 (or the "G" series): not only had the company to develop new processors, but also electronic buses instead of cables, fans instead of plumbing, new electronics and housing and new computer diagnostics. Every sub-system or module of the system had to be redesigned (Meyer, Anzani and Walsh 2005).

IBM engineers managed to go back to the drawing board and introduce a technology that was not designed in-house (which was the first time in the mainframe division, but not in the personal computer division, as explained below) and design everything else to be able to function with this technology. Another hurdle was that even though there was little doubt that CMOS technology would have quickly improved, at the time IBM was going to supply its customers with a technology that, although more efficient in terms of space and energy use, was four times slower. This problem was partly solved by introducing a tight coupling technology called Sysplex, which would share the workload across different machines: in fact, what the 400 Millions of Instructions Per Seconds (MIPS) bipolar processors were able to deliver, could also be delivered by four new coupled CMOS based mainframes (Meyer, Anzani and Walsh 2005).

The new "G" series was quite radically different from the legacy systems: it followed more closely a model of horizontal integration that IBM launched itself almost a decade before. For this reason, the S/370, which preceded the S/390, might be considered the last original line of mainframes.

4.5. A New Technological Trajectory in Computing: The Personal Computer

In this section, we first present a short account of the history of personal computing and second, we explain how its introduction and the open standard design that largely characterised the PC market has changed the structure of the entire sector.

4.5.1. From Hobby to Mass-Consumerism: a Brief Account of the PC's History

Similarly to the development of the commercial radio, a hobby-based community spun off the personal computer. The first electronic device that can be considered a PC, designed in 1975, was the Altair 8800: this computer was "personal" in the sense that it was relatively cheap ($397) and was affordable to the average individual. However, it still maintained the features of a hobbyist-based artefact, as it was sold by mail orders and buyers had to assemble it themselves (Campbell-Kelly and Aspray 2004).[39]

The second step on the technology path of the personal computer is represented by the introduction of the Apple II. This artefact, shaped by Steven Jobs' marketing ideas and Steve Wozniak's technical knowledge, both co-founders of Apple Computer Inc., started the technological trajectory that was later followed by the IBM compatible PC. In fact, Steve Jobs' driver was the idea that the microcomputer was ready to leave the hobbyists' sphere and become an electrical appliance for the average household. In order to fulfil this destiny the Apple II had to be a self-containing unit with a keyboard to enter the data, a monitor to display the results of the computation and a storage unit to hold data and software. This was the project that Wozniak materialised and introduced in 1976 (Campbell-Kelly and Aspray 2004).

However, this computer did not generate enough expectations and its distribution was limited when compared to the IBM PC. That said, the introduction of this computer and its less famous competitors, the Commodore PET and the Tandy TRS-80 created enough market to launch a software industry that was collaborating with computer manufacturers without being vertically integrated to them (Campbell-Kelly and Aspray 2004).

Therefore, by the beginning of the 80s, the first frontrunner PCs had been thrown into the market, microprocessors had become cheaper and more sophisticated, and applications for information processing were expanding (David 2000). It was in this context, and precisely in 1981 that IBM launched its version of the Personal Computer.

Three features of the IBM PC contributed to its success as the most popular machine of its kind. The first was that the IBM computer was modular. In fact, IBM assembled the computers from sub-systems that, in large proportion, were made by other companies: the 8088 microprocessor by Intel, the floppy disk drives by Tandon, the power supplies by Zenith, the printers from Epson, the MS-DOS operating system from Microsoft. Moreover, contracts with these suppliers

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[39] As its technology was open, this system became modular: some entrepreneurs or hobbyists tried to make a profit from their interest in this quickly expanding tool by selling compatible modules such as add-on cards or software (Campbell Kelly and Aspray 2004).

were not exclusive, so that these companies had the ability to market the same components to other manufacturers (Campbell-Kelly and Aspray 2004). According to Langlois (2002), although the IBM PC was not leading edge in terms of technical standards, and at one stage lagged behind some of the platforms already on the market, this approach led to a more rapid rate of innovation than integrated systems, which in turn quickly fell behind.

The second feature of the IBM PC was its open standard. In fact, the PC presented the following interfaces: "card slots", a parallel printer port, two serial ports and a video output port. These standards were either based on available-for-general-use industry standards or on standards that IBM initially made available. Therefore, any company could provide add-on devices and the software could be used in combination with these add-ons, in order to manage the flow of input and output data (Steinmueller 2005).

The third factor that made the IBM PC the most popular machine of its kind at that time was actually the IBM logo. IBM's tradition of supplying machinery for businesses somehow legitimised the PC's "utility" for both business applications and the household and promoted this tool from "hobby" to "productive" (Campbell-Kelly and Aspray 2004).

The open standard design was the factor that generated a sustained network effect: other PC manufacturers, the first ones being Tandy, Commodore, Victor and Zenith (Campbell-Kelly and Aspray 2004), switched their production and built IBM cloned machines (also with the faculty of assembling most of the same components that characterised the version IBM was distributing). The advantage of building IBM compatible machines was that these products could benefit from the existence of different add-ons which increased the value customers could attach to it, and do this without further investments in R&D from the computer manufacturer.

The IBM machine soon became very popular and in the first year of its existence gained 25% of the PC market. In the two years that followed, it became a *de facto* industry standard, as many other companies started to produce IBM PC compatible, totalling another 50% of the market (Usselman 1996).

However, this result does not seem to have been in IBM's plans: the choice of building a personal computer by assembling modules that were supplied by other companies was probably motivated, once IBM decided to enter the PC market, by the necessity to provide a quick alternative to the existing platforms and because building a PC completely in-house and almost from scratch would have taken many more years.

Moreover, a second factor explaining IBM's design of the business model that characterised the PC market, can be related to the 1956 consent decree and the requirement given to IBM at that time to unbundle some of its products and allow other companies to produce compatible parts. More importantly, however, is the fact that IBM invested in the PC market so that it was not seen to be "*losing ground*" to the competitors, but without any intention to make a mark. As reported by Usselman (1996), an executive close to the top management at that time said that IBM thought the PC was going to be a small market and that you could not make big mistakes in a small market.

Therefore, the choices IBM made, that shaped the PC business model, seem to have been motivated by "easy options", such as building assembled PCs to avoid investing important resources in R&D and adopting an open standard approach to avoid further, potential anti-trust persecutions. Moreover, these choices were made in a context (or because of this context) that did not give IBM too many incentives.

As explained above, technological progress of the PC platform was dependent on the development of multiple innovations, including the modular approach, and a key role seems to have been played by the software industry, in rapidly developing user-friendly applications programmes for both the home and the business users. Here, we argue that the relationship between computer hardware and software (as it is especially visible thanks to the modularisation of the PC platform as the two sectors are distinct) is a good illustration of the (neo-) Schumpeterian concept of "swarm of innovations", as technological progress in these two separate industries push each other forward, they are intertwined and their trajectories become interdependent. As an example, the VisiCalc application, which is the original calculation spreadsheet or the precursor of later applications such as Lotus 1-2-3 and Microsoft Excel (although some accounts have over-emphasized its role too much) has seemingly played the role of killer applications and increased the value of the PC and helped its diffusion (Campbell-Kelly and Aspray 2004).

Moreover, the evolution of the operating system and other applications is also a good example of interdependency of the technological trajectory between hardware and software: while the personal computer had to become smaller, cheaper and compact to become a household-friendly appliance, the operating system and other applications had to make the PC more user friendly, as computers were destined to be used by an increasing proportion of less technical people.

Although only relatively successful, the first affordable personal computer to be equipped with a Graphical User Interface (GUI) was Apple's Macintosh, released in 1984. After the release of the Macintosh, it became clear that the next big innovation in the computer industry was going to be a GUI for IBM compatible PCs: this materialised in 1985 with the release of the first version of Microsoft Windows (Campbell-Kelly and Aspray 2004).

This version of Windows, however, was too sophisticated for the current level of technology available: it is only towards the end of the 1980s, with the release of Intel's 386 and 486 processors, that using Windows became practical. Furthermore, the introduction of these new and more powerful engines for the PC platform, following a virtuous circle, enabled the development of more sophisticated operating systems, as demonstrated by the release of Windows 3.0 in 1990 and Windows 95 in 1995 (see Campbell-Kelly and Aspray 2004).

Evidence of additional synergies between hardware and software industries is pointed out by David (2000): the development of a multi-purpose computer replacing task-based minicomputers (used for desktop publishing or financial applications), which was completed during the 80s, contributed to the diffusion of general purpose (or multi-purpose) software packages.

Clearly, the combination of demand for multi-purpose software packages, coupled with the diffusion of a de facto standard (in the first years of its life already characterised over 75% of the PC market) enabled the transition from a software industry mainly producing customised products to a software industry mainly characterised by the production of (standardised) pre-packaged digital goods.

4.5.2. The PC Market and the New Business Model

Although several companies, including IBM, were buying some of the parts for their IT systems from affiliated companies already in the 1970s (see above, in the history of the mainframes) the dominant business model of the mainframe era was characterised by an oligopoly of vertically integrated companies (e.g. IBM, NCR, Fujitsu, Hitachi). Following the introduction of the PC, most of the computer industry was (and still is) defined by horizontally integrated segments, with thousands of companies competing at different levels of the value chain (Dedrick and Kraemer 1998). For example, Intel and Motorola were competing in microchips; Sharp, NEC and DTI in the matrix display field, and so on (Kodama 2004).

It was not just companies that were affected in the specialization of components: the IT value chains spread internationally and some countries specialized in producing specific parts: Korea specializes in PCs and monitors, Japan in notebook PCs and DRAM, Taiwan specializes in PCs, monitors and motherboards and Singapore in hard drives (Dedrick and Kraemer 1998).

4.5.3. The Platform Leadership: From the IBM to the WINTEL Platform

As mentioned above, IBM did not expect to see their product become the de facto standard of a significant new industry. Neither did IBM expect that its own product would start evolving independently from its originator company.

The role of the platform leader (or system architect) will be explained in more detail in the next chapter dedicated to the modularity literature. For the purpose of the historical account here, this role can be simply described as follows: a platform leader is a complementor (or module makers) producing key standards, which one necessary for the other complementors to produce their own parts (Cusumano and Gawer 2002).

In the case of the PC industry, the first key standard or interface is the system bus, which is the component that links most of the hardware parts together. By the end of the 1980s the original bus became the bottleneck of the system as it limited its performance. A new bus was needed and a war of standards was engaged: three bus architectures arose to solve this bottleneck (Chesbrough 2005). One of these standards was IBM’s micro-channel architecture, which unlike its predecessor a decade before, was proprietary (Steinmueller 2005). Almost a decade after first IBM PC, the company retraced its steps and tried to re-establish its influence on the technological trajectory of the product it originally helped to create.

However, this was too little, too late. In fact, the specific standard winning the battle was Intel’s Peripheral Component Interconnect (PCI) (Steinmueller 2005): this result was achieved by integrating the bus and card expansions’ slots onto PCs motherboards (Cusumano and Gawer 2002).

The other important key standard or interface is the operating system provided by Microsoft: as explained above, applications played an important role in adding value to the PC and any application that was going to be written for the PC had to be compatible and work in conjunction with the operating system.

As described by Cusumano and Gawer (2002), the platform leader has an influence on these three issues: first is the integrity of the system or the compatibility of its modules; second, its technological trajectory and third, how to maintain the leadership. Clearly, since the end of the 1980s IBM had lost control of all of these aspects of the platform; that is why technological progress has transformed the IBM compatible into the Windows-Intel (WINTEL) platform.

4.5.4. Innovation and Competition in the New Business Model

With the switch from a business model characterised by vertically integrated companies to horizontally integrated segments, the type of dominant form of competition between participants (especially in the case of the producers of the final product) changed from Schumpeterian to classical.

As explained above in the section about the mainframe industry, different machines were based on different technologies and market shares were gained by introducing new and disruptive technologies (e.g. the Complementary Metal–Oxide–Semiconductor (CMOS) processor instead of the bipolar one, which can be considered a disruptive technology, as its adoption required the development of a specific system and other new technologies).

The products that result from the new business model are a lot more homogenous (in fact, the majority of these follow the same standard) and competition generates incremental innovations. Therefore, given the existence of parallel competition and the specific contribution of each component to the platform, module makers try to ameliorate, through innovation, the characteristics of their product that would mostly increase their value added, and this within the platform leaders' pre-determined technological trajectory: for example, new microprocessors are developed into quicker and more reliable components, while hard-drives' technological progress consist of quicker access, increased storage and reduced physical space. Different generations of these two components, however, should still be able to exchange data using the current bus technology and to be managed by, and work in combination with, the current operating systems.

This shift from Schumpeterian to classical competition and the changes in the efforts to innovate that result from this shift, are best illustrated if we compare the innovative efforts of PC manufacturers, which are not platform leaders, with the innovative efforts of mainframe makers.

The innovative efforts of mainframe makers have been described above by presenting the case of a few generations of IBM's mainframes and they do not need to be re-stated here. We simply need to remind the reader that these where the result of intense and expensive R&D.

The innovative efforts of PC makers, on the contrary, are not based on new technologies: in fact, PC makers rely on module makers for technically improved components. Their competition is mainly based on price (as typical of a classical competition), marketing-related factors and organisational settings.

A good illustration of what innovation might mean nowadays for PC manufacturers, comes from Dell's success story. According to Kraemer et al. (2000) Dell completely removed the role of resellers, by selling directly to customers through its web sites. Moreover, this company implemented a built-to-order process, which gave it a competitive advantage vis-à-vis its direct competitors.

In fact, in a market where product cycles can be very short, some of the problems that Dell's competitors (e.g. IBM, Apple, Compaq) face are excess inventories of past products or shortages of hot new products or slow resellers. Dell's solution was to create an efficient information sharing-network between its procurement, logistics, production, services and support departments using of course, IT based information networks. These processes and new networks not only have allowed Dell to reduce its inventory, but also to speed up logistics and product cycles, as well as to better understand user markets, so that additional services to customers could be offered. Similar networks were used to share real time information with suppliers and achieve virtual integration; moreover, suppliers were, by contract, required to establish their warehouses at a maximum of 15 minutes distance from Dell's factories.

Therefore, Dell's acquisition of its market share is not the consequence of its ability to introduce on the market leading edge technology- products as a result of its own in-house R&D, following the typical scenario of the mainframe industry. Instead, Dell's success is based on its establishment of a new a complex production process, new organisational settings that best match the new production process and a new marketing strategy (as the company advertises the "online" selling) which allowed this company to supply products that are similar to the ones its competitors can supply, but at a reduced price.

4.6. The *Services-ation* of IT Industries

Another important milestone of the computer industry, although relatively recent and still evolving, is represented by what we call here *services-ation*. With this term, we indicate the change of strategy some of the largest IT manufacturers (such as IBM and HP/Compaq) are undertaking. This strategy focuses on the expansion and creation of new service activities as well as concentrating on an increasing share of innovative efforts to this objective. In fact, even hardware and its technological progress are increasingly subject to, and shaped by, the delivery of service activities.

In the rest of this chapter we provide a short account of the evolution of the IT industry from an activity mainly characterised by manufacturing to services, through the history of IBM. This company is certainly representative of this change: as reported by Waters (2004) of the specialist press, IBM was the quickest to realize that selling services was the biggest growth business in the IT industry. In 2003, IBM's service delivery accounted for 48% of its revenue and 41% of its profits (Waters 2004), making this company the largest IT service provider (Market Wire 2004).

4.6.1. A Brief History of IBM's Services: From Value Enhancing to Value Generating

As explained above, IBM delivered services before the 1990s; however, the type of services and their centrality to the business model changed quite consistently after that date.

At an industry level, the share of revenue generated by service activities in the IT industry was already 13% in 1963. This level of revenue, although following alternating trends, further expanded during the 1960s and 1970s reaching over 20% in 1978 (Usselman 2004).

As the history of IBM informs us, the type of service delivered in the years of the mainframe's dominance was shaped by this technology: in fact, the main service activity was data processing.

Another consequence of the 1956 consent decree and the "unbundling" measures imposed upon IBM was the creation of a new and independent entity, the Service Bureau Corporation (SBC), which offered data processing services in a potentially competitive environment, according to the wish of the Department of State. The share of revenue of this independent subsidiary grew to 4.6% in 1966, which, if summed to another 3.5% coming from other service activities, including software, equalled the average of the industry.

The start of the modern service delivery activities for IBM dates back to 1989 when the company, together with the Eastman Kodak Company signed an agreement by which the former designed, built and managed a data centre for Kodak, in Rochester, New York (IBM corporate archives 2002).

Following this first agreement, IBM started to shift its corporate strategy and increasingly focussed on service delivery. In 1991, when Louis V. Gernster became chairman, the company was going through its darkest period (IBM corporate archives 2002). As explained above, it was during the commodification and the twilight of mainframes and the raise of client-server technologies, while the PC market had increasingly taken an independent path and the company's role in the market was diminishing.

In this context, the new chairman and the management of the company faced two choices: breaking up the company (which was already run as a group of distinct activities) or find new synergies between the different departments and attempt a resurrection. It was during 1993 when IBM's management chose the second option and started to integrate its activities instead of breaking them up; two years later this choice lead to the foundation of IBM Global Services (IGS), which became the focal point of this model, bringing together hardware, software and services (IBM corporate archives 2002).

Moreover, the creation of IGS had a "standardization effect" of the service delivery process: as a matter of fact, by summing up the number of different service activities that could be offered by IBM worldwide, the total revealed 2500 different categories. The range of different services delivered following the introduction of IGS was consolidated into a portfolio of 100 globally consistent solution categories (IBM corporate archives 2002).

4.6.2. IBM and its Current Service Activities' Portfolio: Disseminating the Fruits of its Own Learning Experience

IGS today offers the following range of services: consulting, custom programming, systems integration (designing, building and installing complex information systems), systems operations (in which a vendor runs part or all of a company's information systems), business innovation services (such as supply chain management), strategic outsourcing, application management services, integrated technology services (such as business recovery), networking services, learning services, security services, storage services and wireless services (IBM corporate archives 2002 p2).

By using and adapting Gadrey's concept of service triangle, we can summarize IBM's range of service delivery activities as follows: a customer is the element B of the model while its business processe(s) and/or its business model are the C element. IBM, or the service provider A, is asked to modify and modernize C. In order to achieve this, IBM uses a combination of knowledge, hardware and software.

It is important to note here that the knowledge used to (re-)shape these service activities, comes from the adoption of new ICT tools and the development of new production processes in combination with these new tools. As explained in IBM's corporate archives (2002):

> "IBM converted its in-house experience in e-business into several commercial opportunities. For example, internal advances based on business intelligence and knowledge management tools were incorporated into many solutions, and IBM's expertise in using the intranet as its primary internal communications channel paid dividends when many customers asked IBM to build similar web environments for them." (p4)

This is particularly relevant for our analysis, as it clearly shows the *Carrier Branch*'s role of the IT industry in the fifth Kondratieff's cycle: in fact, this sector, which is highly innovative, makes intensive use of the key factor, semiconductors, in the production of new ICTs. Moreover, it provides the benchmark for the production / business processes that best match these new ICTs, and it is a disseminator of these processes.

4.6.3. Changing Innovation Patterns in the IT Industry

As IBM is evolving from an IT manufacturer towards an IT service firm, the main drivers of its innovative efforts changed. As expressed in the concepts of the service literature explained above, the key of understanding a service activity is about understanding the (changing) nature of the interaction between users and providers. The new innovative efforts of a company such as IBM are now more concentrated on studying and ameliorating, therefore innovating, service activities.

There are many examples of non-technical innovations that had an important impact on the strategy of the company; here we choose two that illustrate the importance of managerial changes.

With the changed focus on service activities following the establishment of IGS, a new customer segmentation was adopted. Before this new framework, IBM's management used to divide customers by the products they used: mainframe users versus AS400 users versus those who used workstations and PCs. In marketing strategies applications software was relegated to a secondary role. Following the introduction of a new strategy, IBM started to look at customers more closely, realized that most of them used a combination of its products and decided to concentrate on the solutions that they needed (Meyer et al. 2005).

Another innovation that clearly illustrates this change of strategy is IBM's "rent-a-researcher" program. As reported by Waters (2004) IBM's new strategy includes the assignment of researchers to consulting projects. The objective of this new program is twofold: first, to increase the effectiveness of consulting work by assigning the best "brains" to projects and the second is to bring back experience on the field and, more specifically, knowledge about customers, back to the IBM labs for generating new ideas and solutions.

4.7. Concluding Remarks

This account demonstrates how technical changes, coupled with other types of innovations, have contributed to the development of several IT markets. Moreover, it also highlights the evolutionary characteristic of IT technologies and markets. For example, the history of the PC market illustrates how some of the most important characteristics of the product were the result of a relatively "casual" process: they were the unexpected outcomes of decisions taken on the grounds of different expectations. In other words, one of the characteristics of the PC that made it successful is its modular design. This modular design, however, was chosen by IBM to reduce the time needed to introduce their own version of the PC to the market and to save capital and energies on a product whose chances of success were considered very marginal.

In this chapter we have also illustrated, with some detail, the organisational choices (i.e. open standards, modular design, etc…) that IT manufacturers have taken in order to realise significant products. In the next chapter, we use these as examples in order to illustrate the service-friendly concepts regarding innovation as found in the modularity literature.

Modularity is an important characteristic that has changed the business model in the computer market and related service industries. However, it is not necessarily considered as the most important characteristic. It is useful to compare our own viewpoint with Lazonick's (2005) – which also employs an historical account focussed on the IT sector. Such a comparison will better explain our choices. To begin with, the features we select in this section are not representative of what Lazonick refers to as the New Economy Business Model (NEBM). The main differences stem from the fact that we employ a neo-Schumpeterian hierarchy of sectors which is based on the type of products produced and service delivered. The neo-Schumpeterian framework helps define the characteristics of a long wave of economic development by establishing a blueprint that can be applied from the first wave to the most recent one. Lazonick, on the other hand, characterises "New Economy" activities as the most successful businesses established after 1955 which are not part of established corporate old economy activities. Therefore, according to Lazonick's viewpoint, the "New Economy" activities display distinguished features that did not exist before the New Economy.

Additionally, Lazonick focuses on specific aspects of the business model i.e. strategy, finance and the organisation. We would argue that these aspects, and what can be considered "new" about these aspects in the NEBM, are not a consequence of the multiplication of activities that followed the development of semiconductors. Secondly, Lazonick proposes that New Economy companies had facilitated access to funding through venture capitalists focussed on high-tech industry. In contrast, media corporations represent Old Economy Business Models (OEBMs) because, the majority of them were formed by entrepreneurs and latterly became public companies as they grew (see section 7.1.1). Lazonick (2005) also elaborates on how vertical integration and product specialisation are an important characteristic of the NEBM; media companies, on the other hand, although they are characterised by an increase of specialised activities, given the high level of risk involved in the production of media content, they also attempt to increase their vertical integration in order to diversify their production and to secure distribution of their products. Finally, Lazonick contends that another defining feature of the NEBM is the end of the "organization man", that is, workers are not employed by the same employer for their entire career, but change employment on a frequent basis. This characteristic has been evident in the production of audiovisual media content since the introduction of the blockbuster movie format in the 1960s (see section 7.2.1).

Chapter 5 - From Complex Systems to Multisided Platforms: Insights from the "Modularity Literature"

In this section, we are going to introduce concepts of what we call here "the modularity literature" which are directly inspired by the events, the production processes and the business models of the semiconductor and computer industries as we described in the previous chapter.

This modularity literature will help us to understand changes (technological, organisational, managerial, stylistic and regulatory) that have occurred in the other sub-sectors of the PIS, telecommunications and the media. Moreover, we will reflect on the importance of this literature for understanding the characteristics of the current wave of economic evolution.

5.1. The Choice of a Modularity Literature

Before describing the characteristics of the literature on modularity, it is useful to situate it in its context. In fact, the tradition of studies of Complex Evolving Systems (CES), of which the literature we consider here is a sub-set, is relatively recent but also very rich and rather heterogeneous.

The body of literature we consider here focuses on the technical characteristics, the organisational arrangements and the variety of business models of the IT sector; part of it, falls under the label of Complex Product Systems (CoPS).[40]

Writings about modularity can be divided into two categories and the first of these categories can be defined as the "*modular design of complex systems*". Writings that can be classified under this theme are developments of Simon's seminal work (1969, 1996) on the architecture of complexity, in which the author makes the fundamental suggestion that "hierarchical and decomposable systems tend to evolve faster and towards stable self-generating configurations" (Ethiraj and Levinthal 2004 p159). Ethiraj and Levinthal also find two main themes in this body of literature: the first analyses the scenarios where modularity should be preferred to an integrated design approach (and the examples provided are Alexander 1964, Baldwin and Clark

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[40] However, we think that the CoPS body of literature fails to capture the interesting "post-Fordist" aspects of modularity (as explained in more detail below) and this is because a very large majority of it focuses on the production of manufactured goods. Motivated by the intent of using this literature to understand change in different types of activities, we select writings of modularity that help to understand the IT sector and in particular service activities as they play a key role. Thus, we need to provide a framework which can accommodate service industries in the analysis. Therefore, we need to make a distinction between the writings selected here and the CoPS literature in general, although some of these writings are part of it.

2000, Langlois 2002, Simon 1962, Ulrich and Eppinger 1999), while the second investigates the advantages of using a modularity approach. In other words, the first theme provides an explanation of "when" modularity is preferred to an integrated design, while the second theme looks into the "why".

The second category, that we label here the "*Market Platforms*" literature, can complement the literature on modular design of complex system, as platforms *are* modular complex systems. However, if, on the one hand writings on the modular design of complex systems are inspired by the processes of designing products in the computer industry, on the other hand, the literature on platforms is inspired by the computer industry and its markets, the interactions between its stakeholders and other dynamics.

Market Platforms can be used as a framework to understand the sustainability or profitability of the market of a complex system, the effects of competition on the platform and on the definition of the interface standards or, more generally, on the relationship between the "leader" of the platform, the system integrator, and the suppliers. Moreover, within its framework one can debate about the advantages of modularity *in use*, describing the power delegated to the end-user to affect the form of the platform, over modularity *in design*, or, about the conditions for the emergence of mass customisation, a term that is used to describe the production of customised goods at mass production costs.

For simplicity, we adopt the terminology of all of these strands of literature in an interchangeable way: therefore, for example, the term *system* should be understood here as a synonym of *platform* or *complex product*; the term *subsystem* can be exchanged with the terms *module* or *platform component*, and the term *platform integrator* is assumed to be the *system designer* or the *architect*.

Before getting into the implications of the modularity literature, we are going to introduce its main concepts and principles in the next section. We do so by imagining a platform integrator about to design a new product (the S/360 or the IBM PC, for example) and list the choices a platform integrator might face, to describe different aspects of modularity.

5.2. Building a New System: Concepts and Choices of Modularity

Baldwin and Clark (1997) define modularity as the practice of "building a complex product or process from smaller subsystems that can be designed independently yet function together as a whole" (84).

Not all complex products, however, can be designed as a combination of modules: the necessary condition for modular design is, generally speaking, the capacity of the system to be divided into sub-systems. In Simon's (1982) original formulation this property of decomposability assumes the existence of no interactions between the sub-systems (in the case of full decomposability) or the existence of considerably weaker interactions between the sub-systems than within the sub-systems (in the more common case scenario of "near decomposability") (1982 pp212–213, cited in Ethiraj and Levinthal 2004 p161). Following these considerations, modules can be defined as units of a system whose elements are strongly connected with each other but weakly connected with elements of other units (Baldwin and Clark 2000, cited in Ethiraj and Levinthal 2004).

There are three main stakeholders or groups of stakeholders involved in the design, recomposition, production and delivery of a platform: a platform integrator, which could be composed of a group of individuals or companies, suppliers and end-users, however for simplicity we will refer to it here as a singular entity.

The platform integrator plays the leading role in the creation of the interfaces and on the standards defining the interoperability and compatibility of these interfaces. Suppliers are the makers and main designers of a platform's modules, while end-users are the main recipients of the platforms and, as Steinmueller explains (2005), are ultimately responsible for the platform's success.

The first step for a platform integrator (and architect) is to decide whether there is an advantage in designing and/or making a platform as a composition of modules or as an integrated system. As explained above, the choice of proceeding with the modularisation of the platform is taken if there is an expected low level of interdependency between modules.

The modularisation of platforms or more generally the decomposition of complex systems presents several advantages for producers as well as benefits for the consumers, when this is compared to the design and making of non-decomposable systems. The most important aspect is the existence of parallel research, the local or modular research, which is the research carried out to design and/to improve modules within the hidden design parameters (Baldwin and Clark 1997). This research leads to local or modular innovation, distinguishable from architectural innovation, which is a change to the relationship *between* the components (Brusoni and Prencipe 2001).

The existence of parallel local research is also susceptible to improve the quality of a product. This is because with parallel local research it means that competing approaches exist trying to solve the *same problem* leading to an improved quality of the product (Nelson 1982 cited in Holbrook 2000).

In theory, the existence of parallel local research is assumed to produce a "global" higher pace of innovation than in the case of non-decomposable systems.

The second step involves the process of encapsulation or the decomposition into modules and, at the same time, the establishment of visible design rules. In fact, as Baldwin and Clark (1997) explain the knowledge involved in the design of a platform or system can be divided into two: visible design rules and hidden design parameters. While the hidden design parameters refer to the knowledge put into the modules by their designers (i.e. the module makers), visible design rules can be divided into three parts: an architecture, interfaces and standards. [41] The *architecture* specifies which modules are going to be part of the platform as well as their specific functions; *interfaces* define how the modules interacts with the platform and with each other, while *standards* are used to test the module conformity to the design rules and are used to assess the module performance relative to other modules.

According to Ethiraj and Levinthal (2004), the process of encapsulation is carried out on a "trial and error" basis as designers face the challenging task of finding the optimal solution-combination of problems involving the choice of (1) the number of modules, (2) the mapping of design elements to the modules, (3) the interactions among the design elements within each module, and (4) the "appropriate" interfaces or interactions between the modules.

It is only after the integration or testing that the platform integrator might proceed to a recombination and try a different solution in the effort of looking for a more satisfactory result.

Following the technical decisions on interfaces, standards and the number of modules, the hypothetical platform creator faces other problems and challenges, this time of an economic nature. The platform integrator must decide whether to carry out the design and/or the production of all modules "in-house" or to outsource the design and/or production of some (or all) of the modules to suppliers. For simplicity, we label the first case scenario "captive architecture", and the second scenario "market architecture".

Along with these decisions, the platform integrator should decide the proprietary form of the standards and whether these should be open and released to the public, or protected by copyright and either for its own use or licensable. In the case of open standards, the knowledge embedded in the interfaces is given to the public to use, replicate and possibly to ameliorate (e.g. the case of the IBM PC); in the case of licensable standards, the knowledge embedded in the interfaces is sold to suppliers under the form of a fee that is proportional to the size of the suppliers (per

[41] Rather commonly in the literature (and therefore, in this text as well) the word "standards" is a synonym for "visible rules", therefore interfaces are included.

developer, for example) or as a share of the receipts of the modules sold (e.g. several generations of Windows Operating System). As Steinmueller (2005) explains:

> "licensable standards may allow the platform producer to capture the definition of the technological trajectory, the direction and, to some degree, the rate at which future technological progress is made" (p26).

More generally, we can say that the choice between open or copyrighted standards also translates the trade-off between prioritizing a network effect, which is more likely to take place with open standards, and prioritizing a control on the technological trajectory, which is tighter in the case of non-licensable than licensable standards.

Another important characteristic of platforms is the number of stakeholders involved in a market platform, as highlighted by Rochet and Tirole (2003) and writings inspired by their works (e.g. Evans, Hagiu, and Schmalensee 2004). According to the terminology used in this literature, the number of stakeholders decides the number of "sides" of the platform: therefore platform markets can be one-sided, a term that describes the classic case of a relation between the single producer of a platform and the end-user, or two, three or more generally multi-sided. Clearly, the choice of the proprietary form of the standards influences the possible number of sides of a platform.

An example of a three-sided platform is the Windows operating systems: its producer, Microsoft, deals with and generates a revenue from, (1) computer manufacturers to which the operating system is sold, to be installed on new computers in return of a fee per unit sold, (2) from applications developers to which development kits are sold for a fee and (3) from the end-users, the final purchasers of the platform (Evans, Hagiu, and Schmalensee 2004).

Therefore, one of the most important steps in the creation (or reformulation) of a platform is the determination of a price level, in the case of a single-sided platform, or of a price structure, in the case of a multi-sided platform, in order to make it economically sustainable and profitable.

As explained above, this list of stages is purely speculative and it is used to introduce the different characteristics of platforms and briefly explain the links between them. In reality, most platforms are dynamic products that are constantly reinvented and re-shaped. Therefore, a product might be divided and designed into a certain number of modules and is then recombined into more modules; the architecture might be "captive" in the beginning and can become "market" later; standards might then be changed so that suppliers can have more freedom to undertake local research and to sell their products to end-users or competitive platforms, up to a point where the original creators might loose the control over the technological trajectory.

Clearly, the account of the IBM PC compatible presented in the previous chapter is a good example of a rather complex and dynamic evolution of a modular product.

Moreover, the analytical viewpoint is also crucial, as platforms may themselves become modules of a bigger and more complex system. As Brusoni and Prencipe explain (2001)

> "[…]the degree of modularity depends on the level of analysis. Products can be decomposed at different levels: subsystems (e.g. control system), sub-subsystems (e.g. fuel metering unit), components (e.g. valve) and subcomponents (e.g. spring). Accordingly, modularity can be a characteristic of each or only some of these levels."(p183)

Going back to the computer industry, for example, as explained above many large IT manufacturers are becoming service providers. The product of their service delivery department can be thought of being composed of different modules: services (which can be also divided into more sub-units), hardware and software and each component can be considered a system itself.

Furthermore, in the case of platforms with licensed standards, the platform integrator gains from increased competition between modules designers and/or producers (Baldwin and Clark 1997), benefits that are also captured by the end-users, particularly so and to a larger extent, when the standards are opened.

5.3. The Microeconomic Aspects of Modularity: Combining These Theories With Neo-Schumpeterian Viewpoints

In this section, I would like to explain more extensively why the modularity literature briefly introduced above is useful in the context of this research.

The neo-Schumpeterian approach, which is the main approach chosen here, pays more attention to organisational and managerial changes. In general terms, as Perez (1986) suggests, when Schumpeter wrote about innovation, he meant "new ways of doing things": new tools and new processes and organisations. Furthermore, Freeman (1988) explains the difference between neo-Schumpeterian approach and neoclassical by suggesting that:

> "Our [neo-Schumpeterian] approach stresses the system's response to major changes in the price of new inputs, and new technologies which exploit their potential to reduce costs of both labour and capital, as a result of new total factor input combinations and organisational-managerial innovations." (p56)

In other words, according to neo-Schumpeterian theories, managerial and organisational changes are necessary, integrating parts of new innovative products, especially when these innovations represent new technological systems or a new techno-economic paradigm. Furthermore, as illustrated in various neo-Schumpeterian, historical analysis of long-term economic cycles (e.g. Freeman and Louçã 2001, Freeman and Soete 1997), every techno-economic paradigm is characterised by specific managerial and organisational changes that are linked (as they increase the value of their adoption) to the products of motive and carrier branches. More specifically, Freeman and Louçã (2001), describe the typical organisational structure of the fifth Kondratieff as more flat and less hierarchical and characterised by networks of firms: the same type of organisational structure we have described above that is characterising the new computer industry.

Therefore, at this stage, in order to emphasise our point and characterise modularity as a characteristic of the organisational model of the fifth Kondratieff cycle, it is necessary to establish a connection between technological progress and modularity of products; modularity of products and organisational and managerial changes, and finally, the novelty of modularity and its specific pertinence to the fifth Kondratieff cycle.

5.3.1. Technical Progress, Modularity and Organisational Change

Increased complexity is a "natural evolution" of technological progress, and modular architecture is the solution that enables goods producers or service deliverers to deal with this increased complexity. According to Pavitt (2005), as products increase in complexity, the number of sub-systems and components increase and, more importantly, so does the range of fields of specialized knowledge the production of system needs to draw from.

Moreover, modularity literature makes three strong predictions/assumptions, as argued by Brusoni and Prencipe (2001 p184). First, there exists a positive correlation between product, organisational and knowledge modularity; second, modular product architectures enable increasing specialization, both within and across companies; and third, modular product architectures allow for coordination to be achieved with minimum managerial effort.

In other words, increased complexity generates the option of adopting a modular design. A modular design is associated with a division of labour, whether this takes place in the case of a "market architecture" or a "captive architecture". The advantages of a modular design, from an organisational perspective, rely on the fact that coordination is achieved with minimum managerial efforts, otherwise the increase cost of coordination / communication that can be generated by the new division of labour can offset the benefits of adopting a modular approach. That is why, the standardisation process following the introduction of interfaces is key to realise these benefits.

After having explained how technical progress in general, is linked to modularity, it is necessary here to establish a link between technical progress in the ICT sector and the current trend towards modular design: in other words, how is it that ICT realises these economic advantages which justify a modular organisation (i.e. the flat hierarchical structure, whether within a company or as a network of companies) ?

The first set of arguments we report here is explained in Pavitt (2005): first, ICT has reduced the cost of the "search to identify standard components and subsubsystems to undertake a specified function within a product architecture" (p84) or in other words, ICT has reduced the costs of the encapsulation process as we have defined above. Second, ICT had increased the standardization of production through automation and the use of software tools; third, ICT technologies have increased the possibilities of "learning *before* doing" through the diffusion of simulation technologies and modelling; and fourth, ICT has given the option to the designer to monitor the production more closely.

Another set of arguments is provided by Brusoni (2003): this author explains (by building on Sanchez and Mahoney 1996 and Sturgeon 2002) that this "smooth" co-ordination between module markers is achieved by the codification and exchange of knowledge and, given the fact that interfaces are not permitted to change within a period of time, the modular architecture creates an "information structure" that acts as a compensation mechanism that holds the system together without the need to exert explicit managerial authority. Dell's organisational structure, that we have detailed above, can be thought of as an example of one of these information structures.

Therefore, *ICT enables modularisation*; however, up to this point, modularisation is not new or specific to the fifth Kondratieff wave. In fact, one of the consequences of modularisation is the need for specialized knowledge and the creation of interchangeable parts, which is a factor characterising the Fordist mode of production. Therefore, one more question needs to be answered here: "what is really new about modularisation as an organisational model?"

5.3.2. The Novelty of Modularity and its Post-Fordist Characteristics Explained

In order to explain this point, it is necessary to provide "post-Fordist" type of arguments and explain the difference in the past: first of all, modularisation can be applied to service activities. In fact, in the same way in which two components of the same system interact through the use of interfaces, which are built with visible rules or knowledge that they have in common, two service activities can become interconnected by establishing some common rules that determine the shape and the form of their relationship. In the rest of this research, we take into account two case scenarios explaining the relationship between two service activities: service activities are said to be interdependent modules, if their relationship or the *rules of the game*, to use an expression by Langlois (2003 p374, cited in Miozzo and Grimshaw 2005), are standardised.[42] What we mean by *standardised* is that these rules of the game establish a protocol that minimise the interaction (and the costs) between the modules. When services are modules of a system, the same characteristics observed from "manufacturing" types of systems apply to them, including the existence of parallel research.

In the second case scenario, interconnected service activities might be linked by a relationship that is not based on visible rules: this happens when the relationship is characterised by contingent negotiations, tacit knowledge or, in other words, rules that are not shared with the rest of the system's modules, but might be just defined between the activities in question. In this case, these activities are considered as integrated. This situation is typical of activities that are incorporated under the same ownership; however, other activities might be characterised by the same type of relationship even though they might be separate companies co-operating on a specific business project.

Miozzo and Grimshaw (2005) provide an interesting example of the standardisation of the *rules of the game*. In the case of IT service outsourcing, the interface is realised with the adoption of Service Level Agreements (SLAs): these define the parameters of the service including objectives, metrics, remedies and penalties for missing agreed levels of services provision. Although different versions of SLAs exist, typically these would also cover the scope of the work; performance, tracking and reporting; problem management; compensation; customer duties and responsibilities, and warranties and remedies.[43] Moreover, still in the case of the outsourcing of IT services, client companies contribute to the standardisation of these interfaces by benchmarking prices and services by acquiring the services of international consultancies such as Gartner, Compass, or Capital Procurement (Miozzo and Grimshaw 2005).

Secondly, modularity is a different type of division of labour than the one that has characterised the Fordist mode of production. In fact, in the Fordist mode of production, even if the production of sub-systems was delegated to other companies, the system architect had a tighter control on the specifications of these parts, as well as on the way they were produced. On the other hand, as Brusoni (2003) explains:

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[42] Langlois' concept of "rule of the games" is similar to the concept of *institutions* used in the systems of innovations' literature. As explained by Edquist and Johnson (1997 p46) institutions can be defined as "sets of common habits, routines, established practices, rules or laws that regulate relations and interactions between individuals, groups and organisations" (cited in Edquist 2004 p161).

[43] According to Miozzo and Grimshaw (2005 p1423), IT outsourcing are defined here as *"the use of a third party vendor to provide information products and services that were previously provided internally."*

> "[modularity] is proposed as an overarching business model that has profound implications not only on how firms do things, but also on how firms organise to change things." (p4)

We suggest that a good way of understanding the differences between Fordist division of labour and modularity is to think of the difference between offshoring (which can be easily associated with the Fordist mode of production) and outsourcing (which can be associated with a post-Fordist mode of production). Notably, in the case of the former, in order to place (part of) its production offshore, a company establishes a production plant in a country with cheaper (and/or more specialised) labour, bring in the new country investment and innovations and maintain the control (i.e. normally by bringing in the top-management from the mother branch) of the process.

In the case of the outsourcing of part of the production process, a company (or the "B" element in Gadrey's service triangle, as explained in Chapter Three) will bring a business problem to an outsourcing partner (the A element), and this partner's role is to provide a solution in exchange of a fee. The company requesting the service does not invest in the outsourcing partner and, although it might influence it through its requests, it is not responsible for its technological trajectory.[44] Moreover, although some elements might be included in the contract, generally the company requesting the service does not establish for example how the outsourced partner has to organise its workers in order to provide the service; the company requesting the service is mainly interested in the results, which are regularly measured and compared to the goals established by the contract.

5.4. Some Conclusions

We would like to restate some of the main points covered in this chapter: first, we have described various stages of the evolution of the IT industry. This tells us that throughout history, the design of the system determined the organisational structure of the company producing them: as an example, when IBM was producing different incompatible mainframes, the company was practically fragmented into *independent* small corporations. On the contrary, after the increase focus on service activities from the beginning of the 1990s, IBM started to find synergies between departments (sales, R&D, hardware, and software) by creating bridges between the different departments, as they all play a role in the delivery of the new products.

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[44] As an example, Miozzo and Grimshaw (2005) find that in the case of IT service outsourcing the cost base nature of the contract does not provide the outsourcing partner with incentives to innovate; furthermore, there is an asymmetry of objectives between the outsourcing partner and the company requesting the services, as the latter might be interested in new and customised solutions, while the former might be interested in implementing standard solutions that it can apply to different customers. This example also questions the innovation "friendliness" aspect of modularity.

Secondly, during the 1980s and especially around the time of the introduction of the IBM PC, the business model associated with this product soon became widespread and, as Freeman and Louçã (2001) explain, it determined the new and typical organisational structure of the fifth Kondratieff wave. The IT industry is not only responsible for introducing this business model, but also for spreading its use through consulting services as well as producing the tools that enable its adoption. Moreover, following the modularisation of this machine, the market of the PC has become increasingly characterised by neoclassical competition, more than Schumpeterian competition.

Finally, the changes in the computer industry and the relationship in this sector between technological progress and organisational change have given birth to a body of literature that can be used to better understand the changes in other sectors, which are also characterised by an intense adoption of new ICTs. Therefore, this literature, where useful, is going to be used to better understand changes in the telecommunication and media industries, which are the other two sub-sectors of the PIS that are the focus of this study.

Chapter 6 - The Evolution of the Wireline Telecommunication Industry

6.1. Introduction

This chapter describes the evolution of the wireline telecommunication sector in the United States, from the 1920s to the current days. As explained above, we want to demonstrate that we can understand this sector's current economic status, on the one hand, by describing its evolution as a succession of different innovations and, on the other hand, by employing concepts of the modularity literature just introduced.

Therefore, the wired telecommunications carriers' sector is compared here to a system allowing the transport of voice or data from one "host" or a piece of terminal equipment (whether a computer or a telephone) to another one. Although we mostly concentrate on technical, regulatory and organisational changes in this "*telecommunication system*", as we often rename this sector, we also consider stylistic and managerial ones. All these changes are intertwined and their relationship can be explained by the concepts of neo-Schumpeterian and modularity theories.

In particular, the evolution of the system can be best described as a process leading to the "encapsulation" or re-organisation of the system into modules. This process is also characterised by a dynamic of "trial and error".

The modularisation of the system includes the following steps: the identification of weak or of the weakest relationships between elements of this system, the assessment of the elements governing these particular relationships in order to make the necessary changes and transform their role from simple system components into interfaces; it is after these changes that the groups of elements between these interfaces can function as sub-systems or modules.

In other terms, here we tell the story of a communication system that from being integrated and managed by the American Telephone and Telegraph Corporation (AT&T), becomes a system made of several modules, that are interdependent but independently managed by different companies. Interfaces are put in place in order to allow these modules to interact and the system's stakeholder that has the power to design and change these interfaces is the considered the architect or integrator.

This system represents two specificities that are of interest here: the first is that it includes three layers. As Cannon (2003) explains, the FCC considers the network as composed of two layers which are the objective of specific and targeted regulations: a *physical network* (or the equivalent of layers one and two of the Open System Interconnection [OSI] reference model) and a *logical network* (the equivalent of layers three and four of the OSI reference model). On top of the logical network, one finds their natural collocation services, applications and content provided by application service providers, content providers and other players that are not the objective of communication regulations.

We define a third layer "*organisational*" as the one including the information exchange process and the agreements that need to be taken between two interconnecting modules and governing the coordination between the two when necessary.

The second specificity of the evolution of the system is the change of system integrator: from AT&T the design of the interfaces becomes a prerogative of the *regulator*.[45]

This represents an interesting case because, although the change of leadership of a system can be a rather common event as the history of the PC illustrates, in the case of the telecommunication system the new system integrator does not look for maximising profits but has the more "neutral" objective of maximising consumers' welfare. Therefore, regulatory changes are put into place in order to reap the benefits of technical progress for the consumer, but the rationale behind regulatory changes varies over time and depends on the understanding of current conditions and on the policy trends: as an example, the realisation of economies of scope and scale justified the creation of AT&T monopoly in the 1920s, while the same factors represented barriers to entry for potential newcomers and limits to the positive effects of competition in the successive phases of the evolution of this sector.

Therefore, our account includes a first phase or the phase of the integrated telecommunication system starting in 1921 and ending in 1968; a second phase or the phase of the separation of the terminal equipment starting in 1969 and ending in 1984; the third phase or phase of the AT&T divestiture and the liberalization of the long distance market, which spans from 1985 to 1997, and the fourth phase, the phase of the multisided telecommunication platforms starting in 1998 and still unfolding. Moreover, considerations on links between regulatory, technical, organisational changes and economic performance are presented at the end.

[45] As explained in the first chapter, "the regulator" is a term that we employ here to define all institutional bodies, state or federal, with regulatory power over the telecommunication (but also the information) sector, the most common being the Federal Communication Commission (FCC), the Government and in particular the Department of Justice, the Senate and District Courts.

6.2. Phase 1: The Integrated AT&T Telecommunication System (1921-1968)

Before the 1920s, many telephone companies coexisted: however, there was a general dissatisfaction with the service and a growing public sentiment that some type of reform was needed. The solution came from private and public efforts: Theodore Vail started to buy all existing telephone-related patents and then denied his competitors access to AT&T's long-distance network. Congress, on the other hand, wanted to achieve mass availability, a single efficient system, reasonable fee for service, protection of national interests, and protection of personal interests (life and property) and a monopoly of the telephone system was thought to be in a better position to provide these results. Therefore in 1921 the Willis-Graham Act granted the Interstate Commerce Committee (ICC) the power to consolidate local telephone systems. The overall result was a regulated (*de facto)* AT&T monopoly of the telephone system (Arden 2004).

In 1947 and as result of these changes, although more than a thousand independent telephone companies survived, those that were part of the AT&T brand together controlled 83% of US telephones, 91% of US telephone plants, and 98% of long distance lines (King and West 2002).

There was the shared belief that the telephony market was a natural monopoly: economies of scale, scope, density and the size and flexibility of investments were considered as limits to a profitable participation of other major carriers.[46] The regulator played its role of consumer advocate by having a direct influence on the level of prices. That said, the telephony market somehow also presented characteristics of being "contestable".

In a contestable market, a monopoly behaves as in a competitive market because of the threat of potential new entrants: however, even though AT&T was not under immediate threat of getting involved in a competitive market, the integrated vertical telecommunication system improved in terms of quality of service, efficiency, reliability and ease of access. In fact, AT&T was even allegedly "goldplating", i.e. over-investing in capital and labour in order to offer a service of high quality standards (Nordhaus 1980, cited in Phillips 2002).[47]

It is clear that, in light of the events that take place in the years that followed, at that time AT&T was trying to prevent a governmental intervention by keeping consumers satisfied and by undermining the argument of those that supported the benefits of market competition in this sector.

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[46] Economies of density reflects the fact that the cost per unit is inversely proportional to the density of connections (Falch 1997).

[47] AT&T's top stated priority was not to maximize returns on shareholder equity, but to improve the welfare of the United States through advanced communications technology (Fischer 1992, cited in King and West 2002).

However, many regulatory and technical changes took place between 1921 and 1968 that slowly transformed the relationship between the monopoly and the regulator, bringing the telecommunication system into a new phase.

AT&T as an integrated telecommunication company solved the market failure problem of financing R&D (Eckstein 1980, cited in Phillips 2002). In fact, it is in 1962 that AT&T managed to send the *first commercial communication satellite* (Telstar I) in orbit, to be used as an alternative communication bridge for international calls (Hochheiser 1989).

Moreover, a further alternative to wires for carrying signals over long distances in 1960s when *microwave technology* was improved and upgraded to be used for this purpose (Weber 2003).

Bell laboratories, the research branch of AT&T, also pioneered in creating telephone switches: in the mid-1950s, they launched the first electronic space-division switching research programme incorporating stored program control (SPC), which led to the first commercial Electronic Switching System, AT&T's Number 1 ESS, in 1965 (Fransman 2002).

Another invention that besides being relatively simple, fundamentally marked the history of the telecommunication system, was introduced during the AT&T monopoly phase. This invention only consists of a small, cup shape device marketed by the *Hush-a-phone Corporation*, which could be mounted on the phone, in order to reduce the risk of conversations being overheard and to increase sound fidelity for the listening party. At the time, the supply of telephone sets was bundled into the telephone service; AT&T therefore opposed the diffusion of this device by invoking the rights assigned to telephone companies by the Communications' Act of 1934. However, in 1948, this opposition led to the filing of a petition against AT&T's for interfering with the use, distribution, and interconnection of the Hush-a-phone device (Nall 1993). This petition contributed to the process leading to the separation between terminal equipment and telephone networks some years later.

Another regulatory change occurred in this period also played an important role for the future development of AT&T and the entire telecommunication market: following an anti-trust suit filed in 1949 leading to a consent decree signed in 1956 by AT&T and the Department of Justice, AT&T limited its activities only to the regulated business of the national telephone system and government work (Hochheiser 1989). These consent decrees heavily influenced future developments of the telecommunication system and of the AT&T company and it prevented this company for many years, from getting involved in the data transmission and the wireless communication markets, for which it had already a technological advantage (King and West 2002).

6.3. Phase 2: From Telephone System to Telecommunication Network (1969-1984)

In this second period, the telephone system started its transformation into a versatile communication network and experienced the first phase of its modularisation: the separation between the terminal equipment and the rest of the network.

6.3.1. Regulatory and Technical Changes Leading to the Unbundling of the Terminal Equipment

If the Hush-a-phone case was the prologue of the process which led to the first important modularization of the telecommunication system, the Carterfone case marked the beginning of this process. The Carterfone is a tool that allows talking to the phone from a radio through a base operated manually (Brooks 1976, cited in King and West 2002). Similarly to the Hush-a-phone case, AT&T opposed the use of this device in combination with its equipment and services. However, on the 27^{th} of June 1968 the FCC ruled against AT&T and allowed a customer wishing to attach an interconnecting device to the telephone system, in order to improve the utility to him of the telephone system or of the private radio system, to do so as long as the interconnection did not adversely affect the telephone company's operations (Melody 1997).

From the viewpoint of the telecommunication system, this decision marked a fundamental turning point: in fact, the Carterfone case started a process cantered on Customer Premises Equipment (CPE) or Terminal Equipment (TE), which, followed and then was completed by the Computer Enquiries, led to the separation of the telephone system into two modules. The key element is the definition of an interface which connects, on the one side, the terminal equipment and on the other side, the telecommunication network.

As mentioned here above, two other regulatory changes were decisive in this transformation process: the Computer Enquiries. Here is a short description of these enquiries, their rationale and their consequences on the telecommunication, but also on the computer markets.

6.3.1.1. The Computer Enquiry I

During the 1960s mainframe users started to use this equipment to send and receive messages through the public switched telephone network (PSTN). When these practices became commercial, two problems came to the attention of the regulator: the first, similarly to the Hush-a-phone and the Carterfone decisions, was to understand the implications of the use of these mainframes in combination with the public network; the second, and a relatively new one, was whether to regulate a practice, message switching, that directly competed with the regulated telegram services provided by Western Union. These two issues were the main drivers of the Computer Enquiry I (Cannon 2003).

This enquiry, ended in 1971, left two important legacies affecting the future development of computer networks and the Internet: the first was that in order to find an order between different types of activities, the FCC decided to divide "pure communications", which describes the transmission of a message over the network with no change in the content *or form* of the message, from "pure data processing", which describes the process which takes place at the end of the data transmission. Using this dichotomy of activities, the FCC decided that data processing, if some necessary precautions were taken, was not under the threat of being dominated by a monopoly and therefore this activity was not to be regulated (Cannon 2003).

The second legacy concerns the necessary precautions to be taken in order to avoid a monopolization of the data processing activities and specifically the role of telephone companies in this market. To achieve this goal, the FCC limited telephone carriers from benefiting from economies of scope by ruling out their involvement in commercial data processing activities. This concern was justified by the fact that telephone companies used mainframes to manage telephone networks and therefore these mainframes, financed with the revenue generated on the "pure communications services", could be used cheaply to provide "subsidized" data processing services at a reduced rate in comparison to pure (i.e. non-telephone) data processing providers (Cannon 2003).[48]

6.3.1.2. The Computer Enquiry II

Technical progress, however, soon caught up with regulatory changes and the decisions taken following the Computer Enquiry I became ambiguous soon after its implementation. In fact, as reported by the AT&T (2006) the first digital "class 4" Electronic Switching System (4 ESS), was lunched in Chicago in January 1976.[49] With the beginning of the digitalisation of the telephone network, the division between data processing and pure communication services became obsolete as an increasing number of data processing equipment were used to manage and provide *voice* services.

Therefore, after 1971, the FCC faced an important new hurdle: regulations that followed the Computer Enquiry I risked jeopardising technological development in the telephone services. To remedy to this situation in 1976 a new Computer Enquiry (II) was lunched; as a result of this

[48] However, the FCC rules on the Maximum Separation safeguards: the only condition upon which telephone carrier could enter the data processing market was by creating a separate and independent subsidiary, with separate accounts, personnel and fixed capital. The decision following the Computer Enquiry I, even though it left the door open to smaller, rural carriers, effectively, prevented AT&T in participating in the data processing market in virtue of the 1956 consent decree prohibiting the monopolist from taking part to any unregulated activity (Cannon 2003).

[49] In order to produce this first of digital switch, capable of handling over 500,000 calls per hour (or ten times the call volumes of the electro-mechanical switch it replaced), 400 million dollars had been spent over five years (AT&T 2006). Moreover, by the end of this second phase of the telecommunication system, a new generation or class 5 ESS (the most popular being the Northern Telecom's DMS lO) was already lunched (Phillips 2003).

enquiry telecommunication services were divided between basic and advanced. According to the new definitions, data processing used to facilitate the movement of information became part of the basic services.[50] On the contrary, the rest of the data processing, including email, voice mail, the World Wide Web, newsgroups, fax store-and forward, interactive voice response, gateway, audiotext information services and protocol processing, were considered enhanced services (Cannon 2003).

The Computer Enquiry II basically produced a new set of services to which "old" rules were applied. Therefore, the "pure communications services" became basic services and were still regulated, while the "pure data services" became enhanced services and they were left free to evolve in a competitive market and protected against potential monopolistic predators. In fact, as a result, even large telephone carriers were allowed to participate to the enhanced services markets, although only through sister companies complying with the maximum separation clause.[51]

Also AT&T was allowed to enter the unregulated market of the enhanced services. In fact, in 1983, the independent American Bell began its operations with two divisions: one producing and selling CPE and the other advanced information systems (Hochheiser 1998).

Furthermore, as mentioned above, the Computer Enquiry II represented the final step for separating Consumer Premises Equipment from the network by preventing the telephone carriers from bundling the provision of customer equipment to the services that they provided. This clause was only lifted much later, in 2001 (Cannon 2003).

6.3.2. The Interface Between CPE and Telephone Network

During and after the introduction of the regulatory changes explained above, the integrated telecommunication system is gradually and virtually transformed into a system composed of two modules: Customer Premises Equipment and the Telephone network. This separation is achieved by introducing an interface that in current times and since 1975-1976 takes the design specified in Part 68 of title 47 of the Code of Federal Rules (C.F.R; here thereafter, "Part 68").[52]

One of the main principles of Part 68 stems from the "no harm" general criteria introduced with the Carterfone decision. The commission identifies four types of harm against which the

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[50] Therefore protocol conversion, security and memory storage, when these are provided to the network for the benefit of the network were part of the basic services (Cannon 2003).

[51] See note 37 in this chapter for a definition of "maximum separation clause".

[52] Title 47 of the CFR can be found at the address http://www.washingtonwatchdog.org/documents/cfr/title47/part68.html

network needs to be protected; these types of harm are (FCC 2006): (1) electrical hazards to telephone company personnel; (2) damages to telephone company equipment; (3) malfunctions of telephone company billing equipment; and (4) the degradation of service to persons other than the user of the terminal equipment, his calling or called party.

However, Part 68 is not only a list of dangers that the PSTN can encounter, but it also contains all the information necessary to act as an interface between the telecommunication equipment suppliers and the carriers. In fact, in the absence of a regulated logical layer, Part 68 defines the properties of the physical connection between the two modules: in the Part 68 rules this is referred to as the "demarcation point" or the "point of interconnection" and consists of

> "(a)wire or a jack conforming to the technical criteria published by the Administrative Council for Terminal Attachments (47 C.F.R. §68.105).

Moreover, Part 68 can also be considered the main source of rules forming the *organisational layer* of the interface between the TE and the telecommunication network; in fact, the code specifies a simple procedure so that parties belonging to the different modules can agree on the connection. This is achieved by requiring, on the one hand, the telecommunication equipment provider to obtain a certification from a specific institution, and on the other hand, to force the telecommunication carrier to allow the connection of any equipment fulfilling this requirement.

The institution currently in charge of the terminal equipment technical criteria development process and the terminal equipment approval process is the Administrative Council for Terminal Attachments (ACTA). This institution was created under the joint sponsorship of the Alliance for Telecommunications Industry Solutions (ATIS) and the Telecommunications Industry Association (TIA) by the FCC in 2001, given the commission's difficulties in dealing with the high volume of certification requests and, at the same time, the rapid changes in the telecommunication technologies and standards (ACTA 2006).

6.4. Phase 3: AT&T divestiture and the creation of LATAs (1985-1997)

6.4.1. Regulatory and Technical Changes in the Current Phase

During the 1970s and the beginning of the 1980s, AT&T is not just accused of monopolizing the Terminal Equipment market, but also long distance communications. Technological progress has changed the conditions of those barriers to entry, once considered "natural", that justified the existence of a monopoly for the delivery of this service. As an example, microwave relay transmission considerably lowered the cost of the investment for long distance communication. The existence of an alternative long distance communication service, such as the Execunet provided by MCI, was the living proof that the monopoly was no longer natural.[53] Moreover, as explained in more detail below, the introduction of digital switches facilitated the introduction of the “equal access” mechanism, which allowed an easy and transparent users’ selection of a long distance carrier.

Therefore, the antitrust suit filed by the Department of Justice in 1974 against AT&T culminated in 1982 in a Consent Decree known as the Modification of Final Judgment (MFJ) which forced AT&T to make plans and break-up the corporation managing the old Bell system within 2 years (Hundt 1994).

The MFJ brought an important number of changes: the telephone network was divided into 161 Local Access and Transport Areas or “LATAs” (Hochheiser 1989); AT&T was allowed to provide inter-LATA communication services, while the regional Bell Operating Companies (RBOC), which became separate and independent entities from AT&T, maintained a respective monopoly of the intra-LATA communications (Hundt 1994).

What AT&T obtained from the process was the phasing out of the restrictions first introduced with the 1956 Consent Decree as well as by the Computer Enquiries: in fact, as Hochheiser reports (1989), following the divestiture AT&T was allowed to compete on the global scale as well as to merge its Communication and Information systems divisions into a single structure. Moreover, AT&T also assumed the ownership of the leased CPE (which is now unbundled from the provision of telecommunication services), while the RBOCs were forbidden to enter the terminal equipment market.

Following the divestiture, AT&T did not withdraw from the terminal equipment market and, contrary to some analysts’ expectations; it fought back with an aggressive marketing strategy highlighting the poor quality of non-AT&T made phones, and by designing new models and reducing the cost of producing the phones by opening a plant in Singapore in 1986 (Hochheiser 1989).

The AT&T divestiture shows how the modularisation of the telecommunication system can be characterised as a “trial and error” process, as regulations are introduced and later retuned or reversed without substantial changes in conditions. As an example, the regulator in this phase has to make a choice between two options. The first, involves letting the monopolist carrier benefit from economies of scale, scope and density, which can be boosted by the deployment of

[53] MCI offered an alternative long distance communication service using microwave technologies: in order to use this system, however, a customer had to dial MCI, then the number of the called party and then a PIN for billing purposes (Weber 2003).

new, cost saving technologies, and regulate this carrier so that the benefits from these economies are translated into lower prices instead of higher profits.

As explained in the previous chapters, arguments based on the realisation of economies of scale, scope and other synergies have been used in the computer industry as well as in the media industry to allow the creation of oligopolies. Bigger companies are understood to foster and make better use of innovation. In this case, however, regulation would have been put in place in order to avoid monopolistic behaviour in the fixing of prices and to allow consumers benefit from the changes introduced by the new technologies. The second option involved finding ways to introduce competition and let the consumer benefit from increased efficiency driven by the new market structure.

Notably, increased competition was the solution chosen; however, given the validity of arguments of both case scenarios, it is instructive to inquire into the drivers of this choice. In this case, the *Good Regulator* was not able to provide a solution based on "impartial" economic theory, therefore the viewpoint of regulatory capture theories and the neoliberal paradigm (see section 1.3.2.) seem to offer the only valid explanation. In fact, as explained above, the neoliberal doctrine characterised public policies in the United States starting from the early 1980s and during the Reagan presidency (Blevins and Brown 2007).[54]

Possibly, ideological belief also drove the choice taken, following the MFJ, to keep on preventing the RBOCs from participating directly in the enhanced services markets, and this, despite the fact that RBOCs kept their status as local monopolies and as regulated service. In fact, enhanced services could have been offered by the RBOCs (also at regulated rates); however the choice was made here to keep the delivery of these types of services competitive and to level the competition by avoiding bundling these services with the basic ones.[55]

It is the question of the participation of the RBOCs in the enhanced service market that provides the main rationale for the Computer Enquiry III. In fact, it is the Commission's will to eliminate the cost of the separate subsidiary, but at the same time, to promote a competitive environment. Following the Computer Enquiry III, the choice is taken to move from structural to non-structural safeguards: the solution advocated by the Commission is to promote Comparatively Efficient Interconnection (CEI) in the short run and Open Network Architecture (ONA) in the long run. In more detail, from 1985 separate subsidiaries providing enhanced services can be

[54] Although in 1981Reagan's Defence Department mounted a spirited objection to the break-up of AT&T on grounds of national security, the Justice Department pursued the anti-trust suit to its end (Temin 1987; Coy 1999 cited in King and West 2002)

[55] This ban was lifted by the court in 1991 (Hundt 1994).

integrated into RBOCs, which, however, are under the obligation to provide the commission with CEI plans. These plans detailed the agreement between the RBOCs and the subsidiaries and are used by the commission to verify that the RBOCs apply the same treatment to affiliate and non-affiliate enhanced service providers alike. In the longer run RBOCs are required to file ONA plans with the commission and this is independently of whether the RBOCs decide to participate in the enhanced service market or not (Cannon 2003).

Technical changes characterised also this period and prepared the conditions for regulatory changes in the following phase of modularisation. These include further steps into the digitalisation of the telephone network as well as the introduction of high speed data transfer technologies: the diffusion of SPC switches; the Signalling System 7 (SS7), capable of facilitating the bridge between the mobile and fixed telephony network, among other things, and the diffusion of the Integrated Systems Digital Network (ISDN), which followed, and was enabled by the implementation of SS7 (FCC 2005).[56]

The invention of another range of high speed data exchange technologies, the Digital Subscriber Line (DSL) allowing the high speed exchange of data using the PSTN and destined to replace ISDN, also dates to this period.

Moreover, the introduction and the diffusion among the final consumer of the tools, such as ISDN modems, allowing high speed data exchange took place at the same time, the late 1980s, as of a sequence of important upgrades of the National Science Foundation Network (NSFNet) backbone, at the time, the main carrier of the World Wide Web: in fact, this network was upgraded form 56K in 1985, to a T1 (1.5 million bits per second) in 1988 to a T3 (46.1 million bits per second) in 1991. Also, the introduction of the Domain Name Server (DNS), providing a map of Internet domain names and allowing users to connect to a web site using a simple acronym, instead of having to use the Internet Protocol (IP) address, dates to this period (1984) (Mowery and Simcoe 2002).

6.4.2. The Creation of a Local/Long Distance Communication Interfaces and the New Shape of the System

In the two years that follow the MFJ, AT&T organizes the separation of the long distance from the local telecom providers, as well as arranging some aspects of the interface between the newly created modules. At a physical layer level, the connection between local and long distance carrier takes place in the Central Offices now owned by AT&T: in fact, according to

[56] Notably, this new switched telephone network system, allows the digital transmission of voice and data over the ordinary copper wires, at higher speed and better quality that the old analog system. Moreover, ISDN also supports simultaneous connections also of different types, such as data, voice, video and fax.

the divestiture decree, RBOCs are prohibited from operating interexchange traffic routing for any interexchange carrier. Therefore, the separation of capital assets between a RBOC and AT&T was organized as follows: central offices housing mainly switches performing exchange and tandem functions (or class "5" functions) were assigned to RBOCs; Central Offices housing mainly switches performing interexchange functions (class 4,3,2 or 1) were assigned to AT&T (Brown 1982).[57]

In contrast to the interface between the terminal equipment and the (local) carrier, this interface requires a logical layer: in fact, in order to enforce fair competition between inter-LATA exchange carriers, not only are the RBOCs required to provide access by long distance carrier to their local loops on the same conditions; in addition, a method has to be established so that consumers can easily route their calls using the long distance carrier network of their choice and get billed by this carrier. Obviously, given the distance between the terminal equipment and the long distance carrier network entry point, the connection is routed using a command. All the elements that realize the "equal access" mechanism as ordered by the district court and whose implementation is overseen by the commission, are considered here as part of the logical layer of this interface.

In practice, consumers subscribe to a long distance carrier and access this carrier's network by dialling "1" and then the number they want to reach (Hundt 1994).[58]

Finally, the third layer of the interface connecting local loop to long distance carrier, or the organisational layer, includes all arrangements enforced by the architect, here the regulator, or taken by the parties involved under its supervision. In addition to the creation of the LATAs and more generally the geographical division of the network and the assignment of the different responsibilities, are parts of this layer the regulations on pricing determining how the revenue from costs incurred by consumers making long distance calls are split among the carriers.

Before the divestiture (and in the absence of competition), it was AT&T's practice to subsidize the local telephone service with the revenue generated on the long distance market (Nadiri and Nandi 1999; King and West 2002; Arden 2004). After 1984 a reform was then needed: the commission (in cooperation with a Federal-State Joint Board composed of both federal and state regulators) decided to implement a method of access charges (calculated per minute) in order to

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[57] After the divestiture, the number of long distance carriers grew rather quickly. As reported by Arden (2004), by 1987 there were 223 long-distance companies competing in the open market. That number increased to 621 in 1996 after the introduction of the Telecommunication Act.

[58] The conversion to "equal access lines" which started in 1984 following the MFJ, however, has only been finished in 1996 (FCC 2005).

determine the charges due by the long distance carrier (who is billing the customer) to the local carrier for accessing and terminating a long distance call. Moreover, in order to recoup the fixed cost of the local loop, a monthly, on a per line basis, fee charged to the customer was introduced (i.e. the subscriber line charges or "SLC") (FCC 2005).

From the viewpoint of the telecommunication system, the MFJ is responsible for two major changes: the first is the transformation of the regulator from representative of the consumers in the system, to veritable system architect or integrator. More interfaces were introduced and the design of these interfaces became the result of the regulator's decisions; as a consequence, the leadership of AT&T in controlling the entire network was radically reduced.[59]

The second change was the introduction of multisided platforms: after the MFJ, the stakeholders providing services composing the network have (more formally) increased the number of functions and roles they play in the system. As an example, local loops providers deal with end-users when they provide a service of connecting two terminal equipment within a LATA. However, these same providers deal with long distance carriers in the role of service providers for accessing or terminating calls.

Of course, considering these companies as multisided platforms provides a better viewpoint for understanding their business strategy. In fact, as an example, given that the multiple sources of revenue can allow for a more aggressive price behaviour on one market or side, when a constant stream of revenue is assured on another market or side and so on.

6.5. Phase 4: The 1996 Telecommunication Act and Multisided Telecommunication Platforms

6.5.1. The Regulatory Changes Enabling Multisided Telecommunication Platforms

The trend of liberalization of the telecommunication markets underwent an important acceleration with the introduction of the Telecommunication Act of 1996, whose main purpose was to break the last local monopoly in the wired telecommunication market, i.e. the provision of intra-LATA exchange.

The Telecommunication Act of 1996 foresees three different basic ways for competitors (the CLECs) to enter the market: the first is by reselling ILEC's services; the second is by leasing parts of the ILEC facilities, i.e. unbundled network elements, and the third, by building a complete set of own facilities. Furthermore, CLECs can enter the local communications market with a hybrid solution mixing any two or all three of these basic ways (FCC 2005).

[59] Also AT&T on the long distance network was facing the competition of MCI and Sprint (Fransman 2002; King and West 2002).

More specifically, this act imposed mandatory interconnection at any feasible technical point, unbundling, number portability and a non-discriminatory behaviour by the ILEC towards CLECs in defining the terms of the interconnection agreements (Loomis and Swann 2005).

This will of the Senate was translated in more practical terms by the FCC, which, following suggestions from the carriers themselves, defined these “feasible technical points” by identifying Unbundled Network Elements (UNEs). In the first place, the UNEs were: the loop, the sub-loop, the high frequency portion of the loop, the network interface device, local switching, interoffice transmission facilities, shared and dedicated; signalling network and call-related databases, operational support system and operator services and directory assistance. To these UNEs a special new element, named the UNE Platform or UNE-P, was later added. This UNE-P is a sort of bundled UNE (e.g. a combination of loop, switch and shared transport) sold as a single unit (Weber 2003).[60]

Another objective of the Telecommunication Act of 1996, as expressed in section 706 (and also pursued by increasing competition in the local exchange market) was to increase the diffusion of advanced telecommunication capability to all residents of the United States in a reasonable and timely manner. In the Telecommunication Act, these advanced telecommunication services refer to users’ capability to originate and receive high-quality voice, data, graphics and video telecommunications using any technology. In the more practical terms of the FCC, advanced telecommunication services required a level of transmission speed, both downstream and upstream, of at least 200 kilobits per second (Kbps) (Grubesic and Murray 2004).

The 1996 Telecommunication Act also changed the commercial relations between local and long distance carriers: in fact, as mentioned above, the FCC put in place a system where the cost of maintaining the local loop was partly recouped by the ILEC by charging long distance carriers access charges for accessing and terminating calls and partly by charging users with SLCs. In 1997 and following the Act, access charges were retired and a new type of charge was introduced, this time calculated on a per line basis, instead on a per minute basis: the Pre-subscribed Interexchange Carrier Charges (PICC). Moreover, in 2001, with the intention of merging into a single charge PICC and SLC in the long run, the toll service charges paid by the long distance carrier were reformed and they start being calculated on a fixed (the Incumbent’s) rate of return (FCC 2005).

[60] Once again, as a demonstration that the telecommunication system evolves following a process of “trial and error”, after February 2003, the FCC decides to retraced its steps and to consider the high frequency portion of the loop not as a an independent UNE, but as part of the local loop (OECD 2003).

6.5.2. The 1996 Telecommunication Act and the New Interfaces

Following the schema used above, we proceed here with the description of the telecommunication system following the latest and most important regulatory change of this phase: the 1996 Telecommunication Act. Following the introduction of this regulatory change, the local loop module becomes a subset of the system characterised by several multisided platforms.

Contrarily to the previous three phases, however, the 1996 Telecommunication Act leaves the field open to the generation of different case scenarios: therefore, it is difficult to fully describe all aspects of the different layers that might characterise the different interfaces. Therefore, here we attempt to illustrate the two most common cases: the reselling of ILEC's services and the leasing of local loops.

As explained above, CLECs can enter the market by reselling ILEC's services, by leasing part of their network or by building their own network. Even though the latter is seemingly the case scenario sought by the regulator as the "efficient" long term solution (at least at the time of writing), it does not seem to be popular as it requires important investments.

Naturally, in the case of the reselling of ILEC's services, the interface between incumbent and CLECs is only logical and organisational. On the contrary, in the case of leasing of UNEs there is the requirement for creating a "physical" bridge between the CLECs and the ILEC's networks.

In fact, in the most popular case scenario, the leasing of a local loop, the connection to the Main Distribution Frame (MDF), the cross-connecting frame that connects the outside plant cable to the central office switch, is rearranged so that this connects to the CLEC's switch (Weber 2003). This switch, like other CLEC equipment can be housed in the ILEC's central office itself or in a nearby facility (Itven, Olivier, Sepulveda 2000).

In a similar way in which technical arrangements allowing an "equal access" constitute the logical layer of the interface between the local and the long distance carrier in the third phase of the telecommunication system as described above, other technical arrangements, this time allowing "number porting" are considered here the basis of the logical layer of this latest phase.

Number porting defines the possibility users have to keep the same phone number in the case of a change of service provider. As described by the FCC, information about all ported numbers of old and new carriers reside in one of seven regional databases, currently maintained by an outsourced local number portability administrator, NeuStar Inc. (FCC 2005).

In the organisational layer of the interface defining the relationship with local carriers, we find many different regulations that have been introduced since 1997 and of which we mention here the most important ones.

First of all, even though ILECs cannot refuse interconnections to CLECs, standard rules are not in place and the companies involved have to negotiate the terms of the interconnection, with the regulator acting as a last resort negotiator or final decision taker if negotiations fail. The choice of leaving the power to ILECs to negotiate terms of conditions, besides its lack of incentive to reach a prompt and fair agreement that might favour a direct market competitor, was taken for more practical and technical terms and because of their superior knowledge of the network interoperability and costs (Itven, Olivier and Sepulveda 2000).

Moreover, interconnection arrangements can vary from operator to operator without being unjust (Itven, Olivier and Sepulveda 2000). These arrangements cover a wide range of subjects. As explained in a manual published by the Organisation for Economic Co-operation and Development (OECD 2003) about the status of liberalization of Telecommunication markets in its member countries, most, or all of the following exchange of information and actions, which are subject to prior formal agreements between the parties involved, take place in the local loop unbundling process.

Secondly, the CLEC must provide a forecast regarding the area, the collocation space needed in the ILEC's facilities and the number of local loop unbundled lines necessary during the forecast period. This represents a first hurdle as, on the one hand, the CLEC must provide the ILEC details of its business plan, while on the other hand, the ILEC is obliged to reserve resources for the CLEC, on a forecast that, for strategic reasons, is likely to be grounded on the most optimistic future expectations. Second, in response to the CLEC's pre-ordering, the ILEC must provide the CLEC business-sensitive information such as network information as well as line quality information and customers' records. Third, in case of a CLEC serving DSL services, the incumbent is normally required to proceed to line testing to check the suitability of the local loop for this technology. Fourth, the ILEC and CLEC must agree on a procedure for disconnecting users that switch provider by causing the shortest and the least inconvenient interruption possible. Fifth, in case of fault a procedure should be in place to determine in which "part" of the network the fault is originated and who is responsible to take action to solve the problem. Moreover, the parties need to agree on the type of collocation that is required, whether caged (the equipment is separated), not caged, mingled or virtual (in this last case the collocation is only paid by the CLEC, but operated by the ILEC) and on the collocation costs (which might include, for example, the preparation of the space, a rent, power usage and security) (OECD 2003).

6.6. The Consequences of the Modularisation of the Wired Telecommunication Carriers' System

The telecommunication system as it appears in its current form, shaped by the regulatory and technical changes, but also economic thinking and ideology, has radically changed from its "original" form in the first phase. First of all, the number of stakeholders has increased: most of the (large) companies which are part of the system today (such as Verizon, Quest and the new AT&T, this latter being recently formed by an agreement between SBC, AT&T and BellSouth) are all descendents of the original AT&T company that managed over than 80% of the telephone network in the United States, even though they are now independent and in competition for some of the same market segments.

Moreover, especially following the liberalization of local loop and the diffusion of high speed data transfer technologies, most companies have acquired different and multiple functions within the system. As an example, an ILEC, from being the "local" arm of an vertically integrated company offering one service, telephone communications, has become an element of the system covering all or some of these functions: accessing and terminating long distance calls, offering intra- and inter-LATA communications services to end-users, providing "wholesale" telecom services (the services used by telecom resellers or renting leased lines to customers), providing telecom companies with facilities, offering data transmission services to end-users (e.g. Broadband connection to the Internet) and reselling terminal equipment (network equipment and telephones).

One of the most important events of the history of this system, reiterated in this chapter several times, is the change of the system architect or integrator. As the modularity literature suggests the system architect is responsible for assigning and/or coordinating the roles to the modules and for the design of the interfaces. Because of these duties, the architect plays an important role in the general technical progress of the system. We have seen above that the regulator, by introducing changes over several years, broke the system into different modules and created numerous interfaces from elements of the system. In contrast to the cases discussed above about the IT sector, the system architect of the wireline telecommunication system has a different set of goals and, at least in theory, it is supposed to act based upon the best knowledge available and exercise its influence in a way that maximises benefits for the country and all its participants. Although different in some respects to integrators of other systems, the regulator establishes the general principles of the interconnection, and in this specific case, at the level of all the three layers identified: physical, logical and organisational.

Another concept suggested by the modularity literature that applies to the telecommunication system is the parallel evolution between the modularisation of the system and the property of *modularity in use* by consumers. Consumers formerly benefiting from the use of a telephone system, now have access to a range of services from which they can build their own customized "portfolios" and this essentially by using a network that for a consistent part (and especially the fundamental terminations of the network, the so-called "last mile(s)") is still based on copper pairs' wires.

In the paragraphs that follow, we concentrate on the characteristics and on the changes in innovation and economic trends between the phases described. We do so in order to investigate if the modularity literature helps to provide new insights into the explanations of these trends.

6.6.1. The Effects of The Sector's Modularisation on The Efforts to Innovate

As explained above, the modularity literature provides two different indications explaining the effects of the modularisation of a system on the innovation process: the first about its pace and the second about its quality. Firstly, according to this strand of literature, the rate of (global) innovation is assumed to increase because module providers are innovators and the more modules co-exist in a system, the more parallel research is carried out (Baldwin and Clark 1997). Secondly, modular innovation leads to changes that are in the interest of the modules, as opposed to the architectural innovation, which, on the contrary, affects the entire system but not necessarily the modules (Langlois 2002).

6.6.1.1. The Pace of Innovation in the Telecommunication System

First of all, we find evidence of the diffusion of parallel research from data released by the National Science Foundation (NSF): using this data we understand that R&D funds (as a percent of net sales) in *R&D-performing companies* in the telecommunication equipment manufacturing sector has increased steadily between phase 1 to phase 4, from 3.8% to 12.3%. This result is in contrast with the trend showed by the telecommunication service industries, as they experience a reduction from phase 3 (the first period that is covered by this dataset) to phase 4, from 2% to 0.5% (see table 15 in the appendices).

If on the one hand, this piece of information sustains the assumption of a multiplication of research efforts, it does not demonstrate an overall increase in the global rate of innovation; indicators built from data showing the trend of total funding spent on R&D are more appropriate for this purpose.[61] These indicators are compared to the trend of total funding invested in R&D in the entire economy, in order to try to separate general trends from specific characteristics of

[61] Data on total investment R&D is only available for the *communication equipment manufacturing* industry and not for the *telecommunication service* activities.

the telecommunication sector, and consequently to assess the influence of the modularisation process.

This data is relevant to the communication equipment industry and it reveals that in phase 1 R&D efforts were rather high and even up to 13% higher than the average of the economy; in phase 2 and alongside the beginning of the separation of activities in the telecommunication sector, although the level of investment in R&D was still sustained, it presented a much lower gap compared to the rest of the economy. Phase 3, on the other hand, is characterised by a negative average trend in the level of funding for R&D and much less than the almost 6% that characterises the economy; in phase 4 the share of investments in R&D in the sector starts to rise again and reaches the highest historical level (over 30% per year; see table 16 in the appendices).

These figures are also consistent when compared to the averages of fixed capital investments, which are ratios often used to try to understand the intention to innovate of a company or within a sector. The average yearly increase in fixed capital investment is equal to almost 9% in phase 1, 5.86% in phase 2, 5.64% in phase 3 and over 6% in phase 4. When compared to the rest of the economy, we find that in phase 1 the telecommunication sector was investing more rapidly than the average sector (almost 90% more); this gap between the telecommunication sector and the rest of the economy was much less wide during phase 2 and phase 3. Moreover, even if it appears that there was acceleration in the ratio of capital investment in phase 4, by placing the data into a more general context we notice that compared to the rest of the economy the speed of accumulation of capital had actually slowed down (see table 14 in the appendices).

Therefore, from these figures it appears that during the period of the integrated system efforts to innovate using R&D as an instrument were higher, at least until the current unfolding period which shows signs of positive growth; in order to fully understand the innovation routines of this sector we need to relate the pace of the investments in R&D to the types of changes introduced.

6.6.1.2. The Changing Quality and Characteristics of Innovations

Fransman's work on R&D and innovation in the telecommunication sector (2002, but also 1994a, 1994b) is particularly helpful in describing and explaining the changing characteristics of innovations.[62]

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[62] Fransman's work, other than being a detailed account of the different innovation trends in the sector, is particularly suited to explain the phases of the telecommunication systems as they have been outlined here: on the one hand, it divides the history of the telecommunication sector into four different periods which practically matches our own division; on the other hand, this account

Firstly, this author also shares a vision of the innovation process that is service-industry friendly, as he mentions that:

> "Firms with low R&D intensity may nevertheless be highly innovative, and their innovativeness may lead to competitiveness and high profitability." (Fransman 2002 p48)

This author also provides interesting examples of successful non-technical changes: in the field of marketing, for example, the introduction of a "family and friends" billing innovation offering preferential rates for frequently called numbers, gave MCI a prolonged advantage in sales over its direct competitors. Another example of a managerial change that we find in Fransman's writing (2002) and relevant to this section, is the new company structure introduced by AT&T's CEO Bob Allen in 1988, which divided the company into twenty business divisions in order to increase the focus, flexibility and incentive of the businesses.

Unfortunately, as explained above, most of these innovations are not the result of specific investments in targeted activities (such as the case of R&D), but they can be considered as "spin-offs" or consequences of normal operations and the outcome of informal R&D. As a result, quantifying the influence of several changes on a company output's growth *in isolation of other factors*, is practically impossible: therefore it is unrealistic to find *definite* empirical evidence confirming an increase in the global rate of innovation.

Secondly, from phase two and to the current time, with the separation between telecommunication manufacturers and operators, it is the non-technical changes that increasingly became more frequent and important (as opposed to the equipment manufacturers who heavily invest in applied R&D): in fact, Fransman describes the telecommunication sector's landscape (American, but also Japanese and British) as characterised by new entrants, which practically have not undertaken R&D and relied on specialized equipment suppliers (such as Cisco and Nortel) for acquiring new technologies; incumbents, on the other hand, undertook R&D, but their "R&D intensity" was lower than those of the classic "high-tech" industries and comparable to vehicles, leisure and hotel, building materials, and brewery industries.

Moreover, as nowadays new entrants rely on the same technology providers and therefore are unlikely to differentiate themselves by offering original or particular technologies, they attempt to gain bigger market shares by providing

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provides numerous examples and suggestions that help us characterizing modular and architectural innovation in the telecommunication system and its growth pace.

> "superior quality of service-such as quicker provisioning time and quicker restoration of disrupted service-and superior customer care, such as better understanding of customer needs and a greater ability to provide solutions" (Fransman 2002 p54).

Bigger market shares and, consequently, profits, clearly depend on the introduction of those changes which are the consequence of the informal R&D, as described above.

The incumbent AT&T also aligned itself to the same strategy of the other competitors: following the division of the company into twenty business divisions, the activities of the Bell laboratories were restructured and scientists and research projects were assigned an (internal) customer, which was identified as the main beneficiary of the research undertaken. This customer was a (or a group of) business division(s) of the company and this managerial change was introduced to make the Bell Labs more responsive to the immediate needs of the business.

The relationship between the main network operator and its research branch changed even more dramatically when the equipment business was separated from the main company in 1996 to become Lucent Technology, which includes the Bell-Labs (Lazonick 2005), and NCR, the computer company that AT&T bought in a hostile takeover in 1993 (Fransman 2002).

According to Fransman (2002) and in line with the figure about the pace of funding in R&D presented above, the evolution of the telecommunication industry was characterised by a slow decline of basic research resulting in a decline in the introduction of fundamental innovations, but to the benefit of applied and informal research, resulting in an increase of incremental technical innovations as well as managerial (and marketing and sales related) and organisational changes.[63]

This trend is explained by an increase of competition in the different markets of the telecommunication sector: the pace of innovation increases with competition (as the mainstream economic theory suggests) and the quality of the innovation changes because the stakeholder participating in the different markets becomes more focussed on the short term results that applied and informal research offer, than in the radical, long term, but also more uncertain outcomes, that basic research can deliver.

Fransman (2002), however, put forward other characteristics explaining the dynamics of the innovation process in the telecommunication sector: firstly, he suggests that in the last phase

[63] This is also in line with Lazonick's (2005) statement about the importance of product development in companies adopting a "New Economy Business Model"

“the innovation system is open in the sense that virtually anyone can create innovations within the industry” (Fransman 2002 p69).

It is in light of the many factors that have been introduced here to explain the evolution of the innovation process, that we understand the versatility and the advantages of considering the telecommunication sectors as a system. In fact, these advantages could be summarised into one concept: representing the telecommunication sector as a system allows the adoption of a holistic viewpoint to explain the changes that have taken place in the stakeholders’ approach to innovation.

First of all, the modularity literature suggests that the total rate of innovation in the sector increased: the empirical data presented here, together with the indications provided by mainstream economic theory lead to the same conclusion. In regard to the versatility of the concepts of modularity, we can affirm that this approach somehow represents an advantage over mainstream economics as it can coherently explain an increase in the efforts to innovate in the increasingly frequent scenario that sees companies collaborating and creating consortia (leading to the creation and diffusion of new standards, for example) instead of competing for market shares.

The quality and the characteristics of the changes introduced have also changed; by simplifying, we can assert that the main point is that basic research has been replaced by more applied and informal R&D. This can be explained, on the one hand, by the increase in importance of service activities within the sector at the expense of the manufacturing side, also given the fact that the production of telecommunication equipment is increasingly taken over by other sectors such as electronics and computing. On the other hand, network operators also became more “short-sighted” and depending on short term profits and equipment manufacturers, not only are under competitive pressure, but they have increased their pool of customers.

Thirdly, Fransman (2002) also explains that the choices regarding innovation trajectory are also shaped by a company’s vision, and (as it is the case of AT&T) its history. Therefore, if technical innovation might be in the DNA of incumbent operators as they are AT&T descendents, it is clear that (at least up to the latest regulatory changes) other local telecommunication providers had little incentive to invest in R&D aimed at generating fundamental innovations or creating new possible methods of communications (whether on their own or through possible consortia). In fact, their scope was purely limited to the local loop, and this, by virtue of restrictions imposed by the system architect that are *normative* and not technical.

Interestingly, considering the telecommunication sector as a system allows us to reformulate an old answer to a current problem: in fact, Eckstein states that at the time of the telecommunication monopoly, AT&T was in the position to solve the problem of market failure of financing R&D (1980, cited in Phillips 2002). As explained above, during the phase of the integrated system, AT&T was not only the biggest player in the telecommunication sector, but was also covering the role of system architect.

Therefore, if necessary, finding creative solutions and regenerating the conditions in order to find a remedy to the market failure of financing that basic R&D is part of the scope of the stakeholder that can have the most influence on the technological trajectory in this system; here, the regulator.

In conclusion, we make the following assumptions between the increasing modularisation of the telecommunication system and the introduction of new and different types of changes: first of all, in the case of the telecommunication system the modular innovation that is fostered by the separation of activities, as the literature suggests, in this case is mostly non-technical changes and the result of the informal R&D companies undertake to increase their efficiency (following managerial decisions, new marketing strategies, etc…). Unfortunately, it is impossible to quantify empirically the level of informal R&D efforts, even less so to assess its influence on a general innovation pace. However, we notice that since 1921 competition has intensified and numerous examples of non-technical innovations can be found in the accounts of the evolution of the telecommunication sector.

On the other hand, it appears that the pace of those innovations that are part of the visible design rules, the radical innovations or, in other words, the innovations that affect the entire system or the interoperability of the modules, is in decline.

Again, little evidence can be used to give this assumption consistency: however, on the one hand, we would like to point out that the conditions that enabled AT&T to solve the problem of market failure of financing R&D (e.g. vertical and horizontal integration and the economies of scale and scope that accompany the integration), as suggested by Eckstein (1980, cited in Phillips 2002) are no longer there. On the other hand, given the increased market segmentation, none of the current module makers, given limited influence on the entire system, has an interest or the capability of producing a radical innovative effort that can be compared to AT&T's launch of the Telstar satellite in 1962.

The effects of the system's modularisation on the innovation process are rather complex: the theory suggests an increase in the pace of innovation following a multiplication of efforts. If there is a positive outcome from the modularisation on the pace of innovation this is more concentrated in the type of innovation that results in informal R&D, while the more expensive, formal R&D is likely to suffer from the division of a system into several sub-systems and the loss of bigger, consolidated budgets destined for innovation purposes.

6.6.2. Modularisation and the Sector's Productivity

For this section, we have calculated average productivity levels for each of the phases described above. The modularity literature does not provide, however, a clear indication about the effects of a division of a system into sub-systems on the capacity of transforming a maximum of inputs using the minimum of inputs necessary. We assume here that this missing link between modularisation and productivity is inherent to the theory itself: the basic rationale of dividing a system into sub-systems is to deal with the complexity, to find a workable solution to the system, regardless, or at least with little consideration for the resources involved.

If, on the contrary, we include a market perspective, we can expect two opposing trends from the modularisation of a complex system: on the one hand, productivity might increase from the delegation of specific tasks to more specialized and more efficient (module) producers. This argument, of course, is the underpinning reason explaining the recent increase of companies' "delegations of tasks" or outsourcing. On the other hand, as explained in more detail below, modularisation can increase the costs of communication (e.g. the negotiation involved in the process of setting up the organisational layer of an interface), create duplicate tasks or more generally generate an opportunity costs deriving from the fact that telecommunications companies are no longer in position to benefit from one or more types of these economies: scale, scope and density.

Therefore, the influence of a modularisation of the system on the level of productivity is not clear-cut and the general result depends on the respective incidence of positive or negative factors. In the specific case of the telecommunication system under investigation, the level of productivity (i.e. output per hour) is compared to the average level in the economy.[64] As an example, the average productivity level calculated for each phase suggests that the telecommunication sector has known an average increase equal to 6.23% (or 1.5 times the average level of the economy) during phase 1, just over 6% (2.5 times) during phase 2, 5.10% (over 2) during phase 3 and finally 5.12% ("only" 60%), so far, during phase 4 (see table 13 in the appendices).[65]

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[64] Here the reference "general" level refers to the level of productivity of the non-farm business sector.

[65] Annual data are provided by the Bureau of Labour Statistics (BLS): averages are computed by the authors.

This sequence of data suggests that, for the period under investigation here, the wired telecommunication sector has known a productivity increase far higher than the average sector in the economy; a gap, however, that, at least during phase 4, has been diminishing. This is a rather surprising result considering that the years between 1996 and 2000 represent the heyday of the “New Economy” in which the telecommunication sector has seemingly played the fundamental role of carrier branch in the long-term economic upswing.

The economic literature suggests the following elements as the most important ones in characterising the past, sustained pace of productivity increase and the current slow-down.

A report published by the McKinsey Global Institute (2001), suggests that following the AT&T divestiture, the high productivity increase is mainly due to managerial changes: the local regional Bell monopolies cut back on underutilised labour by introducing measures such as creating pools of central office technicians, working on several sites or closing peripheral business offices.

Kennet and Uri (2001) suggest that the productivity increase, especially during phase 3, is due to reduction in switching costs and to the savings in the reductions in costs that are obtained by the introduction of new technologies. They observe that most of the productivity gains are realized in those portions of the network where the “fat pipes” are employed, i.e. the long distance network.

In this regard, it seems that the benefits of using these “fat pipes” are more difficult to realize with the unbundling of local network loop. In fact, Weber (2003) points out that telecommunication carriers have the option to use Subscriber Line Carriers Systems (SLC-Sys) in their loop plant. These systems allow, technically, to carry many telephone lines over two copper pairs or fibre optic strands, so that they can be connected to a switch as a single multiplexed signal representing all the lines in the system; economically, this allows to increase the capacity of the current network and to benefit from economies of scale. However, the more lines need to be unbundled, the smaller is the economic advantages of employing such a system.

Moreover, even though in a less spectacular fashion, productivity has increased in the aftermath of the 1996 Telecommunication Act, the McKinsey (2001) report suggests that this is the result of reduced employment coupled with steady growth. The reduction of employment had been made possible by managerial decisions and better organisation but also by a more extensive use of new technologies. Service Providers and third party vendors have developed operational support systems to automate key processes such as customer care and billing, service provisioning and network operations.

Moreover, this report also suggests some examples of how new technologies have made possible the reduction of jobs in customer-facing and back-office applications (especially, those used in call centres): among these technologies we find “self-service”, voice responsive units, as well as innovations such as the integration of computer and telephony that allows agents to use the information typed on the phone by the customer and software-based scripting that increases the number of calls an agent can handle in a given time (McKinsey 2001).

In conclusion, it is difficult to establish a clear link between modularity and productivity: not surprisingly, it is the more “traditional” and “basic” factors, such as technological change, that are accountable for the pace of productivity change. On the other hand, what the literature is seemingly leaving out of the analysis is the increasing share of service activities within this sector and the consequent slow down of the aggregate productivity levels in light of cost disease dynamics.

6.6.3. Other Shortcomings and Advantages from the Modularisation of the Telecommunication System

Additional indications from the modularity literature can be used to discuss benefits and shortcomings produced by the regulatory changes separating the system into (an increasing number of) modules. First of all, the modularisation can produce localized versions of the modules through the multiplication of design options (Baldwin and Clark 2000, cited in Ethiraj and Levinthal 2004). In the case of the telecommunication system, the “local adaptation” can be identified with the ability users’ have now to create their own “portfolio” of services and applications in combination with the PSTN: local calls, long distance calls, broadband, voice over IP, etc… Users can decide to subscribe to some services and not to others or buy packages of services: given the increase in choices, we argue that the increasing modularisation of the system has increased its adaptability to customized users’ needs, actually fulfilling the theory’s predictions.

However, as mentioned above, the modularisation of a system does not always engender positive changes, but it can also introduce weaknesses. In fact, modular systems are much more difficult to design and in comparison to interconnected systems they require more testing and integration time (Ethiraj and Levinthal 2004). We agree that the appearance of these shortcomings, the most interesting ones relating to the design of the module, more than the testing and the longer integration time, can be also observed in the evolution of the telecommunication system.

As Falch puts it (1997):

> "A single operator is in a better position to dimension and plan the construction of the network (technical efficiency) and to avoid duplications of investments and excess capacity. Thereby economies of scale can be fully utilised to the benefit of all customers. In addition a single network operator can better ensure compatibility of all parts of the network, and technical and administrative costs related to network integration and interconnection can be minimised." (p101).

Contrary to the benefits of the integrated system, the modular system presents the following shortcomings, which can be all considered as "design" problems since they derive from the changes in the relationship between different elements of the system: duplication of investments (resulting in a waste of resources), possible incompatibility of network parts and an increase in the costs of interconnection.

Moreover, the factors Falch refers to, can be found in the physical or logical layers of a network. Above, however, we have made the point that the design of interfaces between modules of the telecommunication system also requires changes in the organisational layer. Therefore we suggest that the negotiations necessary to shape the organisational layers of the interface between two or more modules should be added to the list of obstacles in the design of the system.

As an example, we would like to highlight one problem in particular that is still outstanding, which has been generated with the introduction of the last phase and involves the relationship between ILEC and CLECs. In general terms, the regulator faces the problem of creating a mechanism that, on the one hand, prevents (or at least, does not favour) strategic anti-competitive behaviour, and on the other hand, provides the right incentives to the ILEC so that it can fulfil its current role of arbitrator (or, in other words, of impartial lessor of network facilities) without interfering with its second role, the one of market competitor.

In more detail, the introduction of competition in the local carriers' market forces ILEC and CLECs to exchange information that can be a source of strategic and anti-competitive behaviour. First of all, a new entrant must provide the incumbent with details of the resources they require to establish their network; this information can be used by the incumbent to understand the competitor's business plans and take pre-emptive actions in order to preserve its market share, as explained in a report published by the OECD (2003). On the other hand, the ILEC must provide the CLEC with access to their customer database which includes billing information. This can be a rather important source of marketing information that the CLEC could use to try to gain market share: in fact, using the billing information the CLEC can target specific users that might have an incentive (e.g. an heavy consumption of a service the CLEC can sell cheaper than the ILEC) for switching provider.

Strategic behaviour does not only originate from the exchange of information between the ILEC and the CLECs. In fact, ILECs can benefit simply from the delaying the negotiations on interconnection issues (Mansell 1997) .

Therefore, several changes have been introduced to try to remedy to this situation: these changes have already been mentioned above and include publicity of the agreements, including the interconnection charges, when these are signed between large network operators, the planned rollout of an Open Network Architecture approach and the imposition, by regulation, on the incumbent to maintain a fair approach.

Alternatively, Itven, Olivier and Sepulveda, suggest a specific and practical solution to this problem, (2000):

> "A good approach to preventing abuse of competitive information is the establishment of an Interconnection Services Group (ISG). This is sometimes called a Carrier Services Group. The idea is to establish a separate organization within the incumbent operator, whose role it is to handle interconnection-related dealings between that operator and interconnecting operators (…) Safeguards will be put in place to ensure that information obtained by the ISG is not used for improper purposes.(…) Confidentiality safeguards should include codes of conduct with mandatory suspension or termination of employees who "leak information". Separate office space, locked filing cabinets, audits and other measures can help ensure confidentiality of ISG information." (p3/37)

However, this solution still presents some shortcomings: first of all, as we are going to demonstrate in Chapter Eight, interconnection between modules works when they are standardised: in this case contingent negotiations are still required. The second problem, is that this arrangement does not solve the problem of lack of incentives discussed above; in fact, it is legitimate to wonder what kinds of incentives (a part from some kind of administrative fees) can be given the incumbent to manage and maintain such a structure.

We believe that such a structure should be separated from the incumbent and reading the evolution of the telecommunication sector in terms of the modularisation of a system can help with providing arguments in this sense. Firstly, the successful stories of the previous phases suggest that critical aspects of the interfaces have been delegated in the end, to third party organizations. These include the Administrative Council for Terminal Attachments (ACTA), which is a collaborative association of industry representatives and deals with aspects of the logical and organisational layers of the interface between Terminal Equipment and the Network, and NeuStar Inc., which is the outsourced partner of the FCC, maintaining the necessary information for number portability, which is the main feature of the logical layer of the interface linking local and interexchange carriers.

Secondly, an independent or third party organisation could also be assigned, where possible, some of those tasks (e.g. the accounting of the compensation between carriers) that are duplicated in the modularisation of the system, so that from a “global” point of view, a more efficient management of resources could be realised.

Another shortcoming already discussed above, which comes from the separation of the system into modules, but seemingly specific to the telecom industry, is the opportunity cost of the loss of the benefits of economies of scale, density and scope.

6.7. Some Conclusions

This chapter demonstrates that the recent history of the wired telecommunication sector can be understood as the evolution of a complex communications system. Employing this perspective presents a number of advantages and leads to useful observations.

First of all, considering the wired telecommunication sector as a system, helps to understand the role that the different stakeholders play within the system, and what it is expected from these stakeholders and how their roles can change over time. In the story described in this chapter, the telecommunication system at the beginning is integrated (and for a large majority of it), owned and operated by a single private company, AT&T.

Among other things, this platform integrator is the stakeholder with most influence on the technological trajectory of the system: facts and figures demonstrate that AT&T has invested heavily in R&D and that from this research a number of important innovations are employed in the sector, such as the use of satellites as an alternative for long distance communications, and several generations of network switches.

Following several steps of regulatory changes, the system becomes modular and from the viewpoint of innovative efforts, the focus seemingly changes from formal to informal research and the innovations introduced are likely to be more “practical” than scientific, mainly focused on increasing efficiency and, by extension, on improving the financial performance and gaining market shares. As a result, consumers benefit from these types of innovative efforts which are fostered by increased competition, however, the reduction of innovative efforts in formal R&D can be the cause of a slow down in the long run. In the current form of the system as well as in the past, the ultimate responsibility for innovations that are likely to affect the entire system - here, the wireline telecommunication - is the system architect: therefore, the current architect, the regulator, is invested with the responsibility for finding a solution to solve the market failure of financing R&D.

Another interesting suggestion that derives from the comparison of the telecommunication sector to a system is that the architect is also ultimately responsible for the functioning of the interfaces separating the modules. As a result of the long “trial and error” process that has characterised the fine tuning of the different aspects of regulating the interfaces, external organizations (ACTA, NeuStar, Inc.) independently regulate and/or manage one or several layers of these interfaces. This story suggests that this same solution could be applied to the interfaces between ILECs and CLECs which have been created following the latest important regulatory change. This solution can solve the problems of, first, the lack of incentives the incumbent has to manage these interfaces, and second, of shielding the content of the information flow that is necessary for the establishment of these interfaces from becoming the source of anti-competitive and strategic behaviour. Moreover, if such an organisation would take responsibility for some of the tasks that have been duplicated with the modularisation (e.g. the accounting of the costs engendered by using peer networks), this could improve the efficiency of the overall system, resulting in increased benefits for its consumers.

Chapter 7 - The Evolution of the Audiovisual Media Services

In this chapter, we move on to review the most important technical, managerial, organisational, stylistic and regulatory changes that have characterised the history of the audiovisual media service industry, from the 1920s to the present days.

Here we take onboard the ideas introduced and used in the previous chapters and apply them to the audiovisual media service industry, the sub-sector chosen to "represent" the media. In explaining the evolution of this sub-sector, we identify interconnected activities or modules; furthermore, we demonstrate how technological progress, other types of innovations and regulatory changes are responsible for the increased complexity of this industry, resulting in the multiplication of modules.

In addition to our different types of innovations, we also carry on with the comparison between information services and a complex system: we draw a parallel between standardised *rules of the game* and modular "visible rules", which in this case comprises in this case arm's length market relationships and standard contracts. When this type of relationship links together two activities, these can be considered as interconnected and innovative modules; on the other hand, when two activities are connected by relational contracting (maybe as a result of contingent, bilateral negotiations) or the existence of an exclusive network, the relationship is thought to be governed by *hidden rules* and the two activities (or modules) are integrated.

The evolution of the audiovisual media services is divided here into three phases; the beginning of each one is marked by what we considered a major change affecting the industry. The first phase concerns the Golden Age of the Hollywood Studios and starts from the early 1920s and ends with the effects of the Paramount decisions and the beginning of the diffusion of television broadcasting in the beginning of the 1950s. The second phase is about the first "modularisation" of the audiovisual media services, the emergence of new modules and the multiplication of relationships between them (following the diffusion of television and the effects of the Paramount decisions); this phase spans from the 1950s to 1985. The third phase starts with the diffusion of home video systems and the "age of maturity" of the cable industry; as the complexity of the audiovisual content industry deepens, we characterise this phase as the customized audiovisual media experience.

7.1. The Golden Age of the Hollywood Studios: 1920s to 1940s

From Winston's (1996) detailed account of the history of audiovisual technologies, we learn that the modern cinema is the result of few radical and many incremental technical innovations, initially in the field of photography and consequently in the domain of cinematography. In order to give an idea of the extent of the timeline of the progressive technical advances leading to the modern cinema industry, here we simply list a few key development milestones. In 1553 Della Porta's version of the dark room ("camera obscura") which was equipped with a lens, was already used to project a spectacle for the view of a small audience; Edison's Kinetoscope, a tool capable of reproducing moving images, and used as a sort of private screen was dated 1880s; and finally the version of the projector that is considered the pioneering invention of the modern cinema, the Lumière brother's "*cinématographe*" or motion picture camera, was introduced in 1895.

Our own account of the audiovisual media service industry, however, starts from the early 1920s, after what is probably one of the first important regulatory acts: the anti-trust lawsuit involving the Department of Justice and the Motion Picture Patents Company. This was a trust between most of the owners of the most important motion pictures' patents, that could also count on a contract of exclusive distribution of the most used raw film or celluloid produced by the Eastman-Kodak company. This trust company was sued under the anti-trust Sherman Act and declared illegal in 1917 (Winston 1996).

7.1.1. The Hollywood Studios System

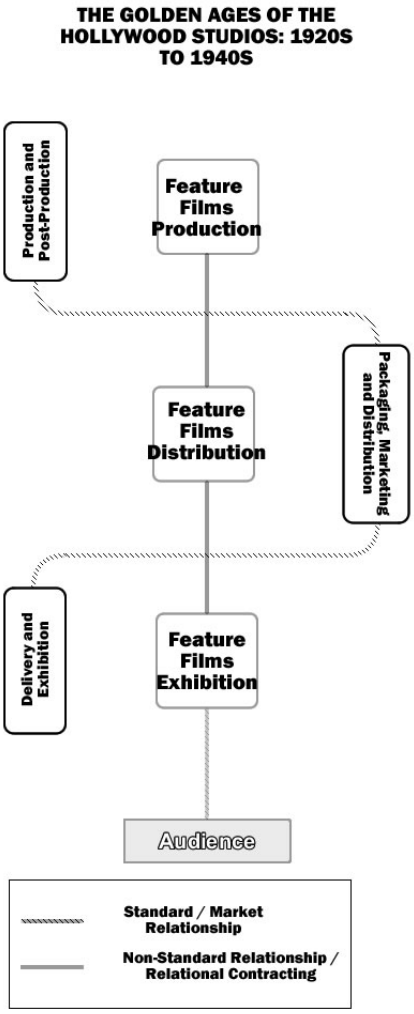
At that time, the cinema industry was already an important industrial and commercial reality. The period starting from the 1920s until the end of the 1940s is in fact often referred to as the Golden Age of the Hollywood studios' system. Notably, in this period, the cinema theatres were the only outlets for audiovisual media products and a large majority of films was produced by a few production companies. These Hollywood major Studios, or "the Majors", were initially conceived, owned and run by innovators and entrepreneurs who shaped and influenced the early history of this sector (e.g. Marcus Loew or the Warner brothers).

These media companies were responsible for the production and distribution of movies and partly for their exhibition as most of these companies owned a sizeable portion of cinema theatres. The Majors who did not own theatres were able to secure the exhibition of their products by block booking exhibition outlets and/or by other types of tight commercial agreements with theatres' owners. By the late 1940s the major companies that owned cinema theatres were *Metro-Goldwyn-Meyers* (Loews), *RKO*, *20th Century-Fox*, *Warner Brothers*, and *Paramount*; instead, *United Artists*, *Columbia* and *Universal*, did not own theatres (De Vany and Mc Millian 2004). All these companies were “Fordist”-type of organisations where routinization, task fragmentation and mass production characterised the production process (Storper 1989). Actors, writers as well as other employees with less creative tasks were employed by the studios and involved in the production of several movies (DeFillippi and Arthur 1998).

Moreover, before the introduction of sound in movies, the Hollywood Majors could count on healthy revenues generated from their movies’ sales on deregulated international markets. Already in the 1920s, as Bjork (1995) explains, American movies were very popular in Sweden, a neutral country whose international trade was relatively affected by the restrictions imposed by the First World War. According to the Swedish press, as this author reports, American films were the only ones which truly transcended national borders. They were more successful than European movies because more entertaining and because of their superior technique. These characteristics compensated for the fact that, at times, plots that were found repetitive.

However, the sale of movies overseas (and particularly in Europe) was severely affected in the 1930s and the 1940s, by two factors. The first was the introduction of sound in movies; clearly, the use of different languages became an obstacle for the American movies and an advantage for local products. Paramount made an attempt to localise its products by re-shooting movies with indigenous actors (Bjork 1996). An attempt that failed because of the high costs involved. The second factor was the insurgence of nationalist governments in some countries and the raise of trading barriers in others (Miskell 2006).

Figure 5: A representation of the Audiovisual Content Industry, 1920s-1940s



Source: the author

A Fordist-type of organisation, as explained above, typically aims at maximising profits by producing the largest amount of output with the lowest possible level of investment, by benefiting from economies of scale and scope. As a result, each major studio was then producing a larger amount of movies than any production company does today. For example, Universal produced more than 250 films in a single year. Moreover, characteristic of a standard mode of production is the fact that in the early days, films could even be sold by the foot (Hampton 1970 cited in Rifkin 2005).

Notably, the closer is an organisation to the Fordist model, the more standard the output. Therefore, this organisational structure was as peculiar for a cultural industry sector, as it was short-lived. Two factors marked the end of the Golden Age of the Hollywood studios as described above: the first is the introduction and the diffusion of television broadcasting; the second, is the anti-trust regulation known as the Paramount litigation, which attempted to liberalise the audiovisual content market by freeing exhibition outlets from their strong tight with the Majors.

7.1.2. The Introduction of Television

As was the case of the cinema projector and of many other technical innovations described in previous chapters, television was the result of decades of research leading to a few radical and many incremental innovations. Moreover, its relatively slow implementation but successful diffusion was also heavily influenced by public intervention.

Although some successful experiments on the transmission of images by electronic means were conducted as early as 1911 by Rozing, the first system deemed to have established some of the basic concepts of modern television was introduced by Zworykin. The patent of the essential component of this system, the "iconoscope", a camera tube capable or scanning images was granted in 1923. In 1927 an alternative system to the iconoscope, the image dissector, was introduced and patented by Philo Farnsworth. These innovators were backed up by the electrical appliances and radio manufacturers: Zworykin by Radio Corporation of America (RCA) and Farnsworth initially by the Philadelphia Battery Company (Philco) and later by his own company, the Farnsworth manufacturing company. The two systems were improved over the years and competed to become the standard. Both inventors were somehow successful as a result of this competition: while Zworykin's latest version of the iconoscope was technically superior and destined to be part of the new standard, it included some of Farnsworth's principles and therefore it infringed his patent. A licensing agreement was then negotiated and signed between Farnsworth and RCA (Winston 1998).

Many years passed between the invention of the television system and its diffusion. In short, in 1940 the National Television System Committee (NTSC) was formed to decide on the standards for the new medium; critical for the determination of the standard was the definition of the image via radio signal. The NTSC decided in favour of a suggestion made by the Radio Manufacturers Association (RMA) which in turn was heavily influenced by RCA. This saw RMA initially proposing a 441 line standard, later increased to 525 lines; Frequency Modulation (FM) radio was chosen for the audio and a band of the Very High Frequency (VHF) spectrum was secured (Winston 1998).

The allocation of some frequencies for experimental purposes started as early as 1936; yet, the allocation of frequencies for commercial television only started in 1941. Moreover, the war played a major role in the development of the new medium. First it slowed down its diffusion as most radio and television manufacturers turned to build equipment for the military. The end of the war accelerated its diffusion as the extra capacity of the radio industry generated by military spending was channelled to build components for the new medium. However, in 1946 the FCC had to deal with two issues: the first was that this infant industry was already ready for a new and superior standard, such as colour television; the second, was that the 150 mile-distance-rule imposed on television stations using the same channel turned out to be inadequate as even stations strictly adhering to the rules interfered with each other's signals (Winston 1998).

In order to resolve the frequency problem, the FCC halted the allocation of new portions of the radio spectrum between 1948 and 1952. During this period, the contentious deliberation on colour television standards was resolved. Two standards were competing: the first was produced by RCA in 1949 and it was compatible with the Black and White 1941 NTSC standards. The second was produced by Columbia Broadcasting System (CBS), and it was compatible with RCA monochrome receivers when tuning brackets were added to them. A commission from the Senate evaluated the two standards and found the RCA superior. However, regardless of these considerations and in light of the possible creation of a monopoly in the supply of television receivers, the FCC promoted the CBS colour television system as the new standard. Sales of colour television sets, however, did not take off until the 1970s (Winston 1998).

7.1.3. The Paramount Litigation and its Effects

The second factor contributing to the Golden Age of the Hollywood Studios' sunset was the Paramount litigation. This case, which started as an antitrust case between the Department of Justice and Paramount, led to a flow of consent decrees and decisions, issued and taken between 1949 and 1952, and aimed at breaking the vertical integration between film distribution and exhibition. As a result of this litigation the Majors who owned cinema theatres were forced to divest: Paramount lost some 1,395 theatres and a further 993 that it owned jointly with other operators; Fox was forced to divest 636 of its own theatres plus about 20 jointly owned; MGM (Loews) lost 135 and 20 jointly owned; Warner Brothers 501, and RKO 109 of its own theatres and 187 jointly owned (De Vany and Mc Millian 2004).

Moreover, franchises and master contracts governing general terms were dissolved; some forms of contractual arrangements between exhibitors and film distributors were made illegal, including block booking and forms of "forward contracting", such as "blind selling" (exhibition deals signed before the movie was produced) and season contracts (the purchase by an exhibitor of a studio's entire production of a season). In place of these contractual arrangements which restricted competition in the movie industry, standard spot contracts or single licenses for each individual film, theatre, and play date, became the only admissible form (De Vany and Mc Millian 2004).

Part of the rationale for the Paramount litigation was also to preserve and expand the parallel and smaller independent film industry, which was already present in the Golden Age of the Hollywood studios and differentiated itself from the majors in many respects. Already at the time, for example, independent production companies used to create temporary associations and contract employees on a short term/ project basis (DeFillippi and Arthur 1998). A sign of the organisations' flexibility is the fact that workers in independent productions unlike the employees of major studios, were not unionized (Blair, Culkin, and Randle 2003). Moreover, using data referring to feature films distributed between 1946 and 1965, James Robins (1993) shows how independent productions were delivering "hit or miss" –type of projects: on average, independent producers used to spend more on a movie than a major studio; however, their revenue and profit margins, although more volatile, were also higher.

7.2. The Modularisation of the Audiovisual Media Service Industries: 1950s to 1985.

The most important changes occurred between 1950 and the middle of the 1980s in the audiovisual media service industry illustrate a fundamental concept of the modularity literature: technical progress increases the complexity of the system and leads to the creation of new modules. In the specifics of the audiovisual media service industry, many technical changes took place in this period, the most important being those leading to the introduction of television, first, and then of cable and satellite transmission technologies.

During this phase, and subsequent to these technical changes, the following new modules (that we describe here as "tasks"), were created: (1) the production of audiovisual content (or programmes) that are not destined for cinema theatres, but for other exhibition outlets, notably *broadcast television channels/ networks* (a term we use to define television channels that are licensed to distribute programming by radio signals, but also via any other technology) and *nonbroadcast television channels/ networks* (a term we generally use here to define television channels distributed only via cable and/or satellite technologies and the Internet); (2) the packaging of audiovisual content into a programme schedule providing the basis of a (broadcast and/or nonbroadcast) television channel; (3) the packaging of different television channels in order to generate a multichannel video distribution service; (4) the delivery of broadcast television channels via radio signals to consumers; and (5) the delivery of multichannel video content to consumers using cable technologies.

Moreover, during this period the audiovisual media service industry shifts from being run by owners-entrepreneurs to being managed by corporate professionals (Louw 2001). This follows a general trend in the media sector. In fact, the 1960s were characterised by a new interest of financial and business corporations in media companies and they mark the beginning of the complex professional era, characterised by the rise of large public companies led by corporate managers. Furthermore, this period witnesses new methods of management, new organisational structures and the appearance of new, small and medium size companies and of a complex web of inter-firm networking and strategic alliances (Hesmondhalgh 2000). The audiovisual media service industry, of course, followed this trend: for example, the Hollywood studios which were heavily dependent on the guidance of their founders and owners moved on to become public companies in this period.[66]

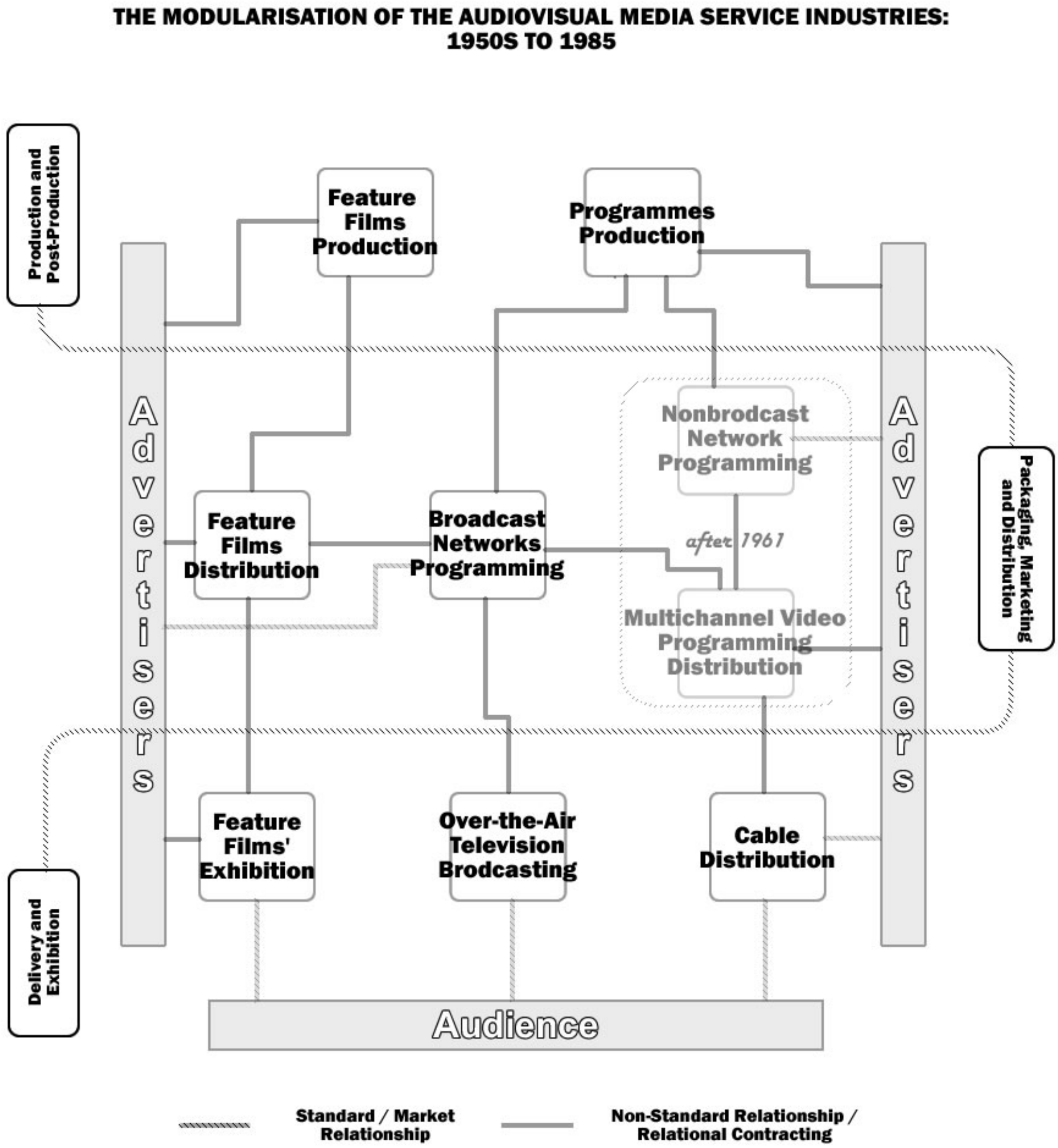
In the following section, we adhere to the approach that privileges technological change as the source of other types of innovations including organisational changes. Moreover, we present here a short account of the evolution of the audiovisual media service industry by dividing it into three horizontal sections: (1) production and post-production services; (2) packaging, marketing and distribution services and (3) delivery and exhibition services. At the same time, we also explain the evolution of three types of audiovisual media services industries that have characterised this period: the Hollywood major studios (the Majors), the broadcast television channels (the Networks) and the cable industry. Each one of these industries, because of the nature of its core activities, can be used to detail and explain the main changes taking place in each one of the three horizontal/value chain sections.

We consider here the production of audiovisual media content as the core activity of the Majors in the Golden Age of the Hollywood studios, as most of their resources and efforts to innovate are concentrated in this activity. Certainly, however, distribution although less significant in terms of the share of revenue and employment, is one of the most strategic activities undertaken by Major conglomerates as it represents the central activity of the audiovisual media services value chain. Distribution becomes the core activity of the Majors in this second period described here as a consequence of the increase number of media outlets and the more frequent collaborations with independent productions.

On the other hand, the main activity of the Networks is the packaging of audiovisual programming, while the cable industries' initial focus was the delivery of the Networks and local stations' televisions signals.

[66] In the same way, the first cable companies, as specified below, were founded and run by innovative entrepreneurs: Milton Jerrold Shapp (Jerrold Electronics), and Henry Griffin and Bob Magness (cofounder of TCI), to mention just a few. Then, relatively early in the history of this industry (i.e. by 1966) the industry started moving out of the entrepreneurial phase, mergers and consolidations took place and the cable industry landscape became dominated by a growing number of national corporations with cable television holdings, such as H&B, RKO/Vumore, TelePrompTer, and American Cablevision (Parsons 2003 p30) According to Picard (1982), this trend in the cable industry was characterised by the capital intensive nature of this particular industry and by its rapid development

Figure 6: A representation of the Audiovisual Content Industry, 1950s-1985



Source: the author

7.2.1. Changes in the Production and Post Production Services and the Evolution of the Majors

As explained above, the period under consideration here starts in the aftermath of the Paramount litigations and its effects.

7.2.1.1. Breaking Monopolies and Fostering Diversity: From the Paramount Litigation to the Financial Syndication Rules

In the period following World War II up to the 1960s, several factors, including improved transportation, the baby boom and the advent of television, contributed to reduce demand for films and to increase audience selectivity (Robins 1993). Majors and independent productions, however, were hit by this decrease in demand in different ways: production costs and revenues both fell significantly over time for the former, while both rose significantly for the latter. Thus, contrary to what happened before the war (and the effects of the Paramount litigation), some of the movies produced did not recoup their costs.

Given the reduced demand for movies, the demand for commodity-like (and more "standardised") films collapsed, while "hit" films became the primary source of revenue for the studios (Balio 1976 cited in Robins 1993).[67]

Between the 1950s and the 1970s and as a consequence of these market trends, the Majors made several attempts to find a new way forward for popular cinema, a way that had to be comprehensive of combinations of aesthetics and economic solutions (Scott 2004). As a result of this changed environment and in order to provide a viable alternative to the entertainment value of television programmes, the Majors drastically decreased their output and began to invest larger amounts on fewer productions. These "blockbuster" movies became their staple products, while the more standardised shorts and newsreels were eliminated from production (Aksoy and Robins 1992, Brown 1996).

The Majors undertook two main changes in order to adjust to the new production strategy: the first was a change in the organisational structure and the second was a shift of their core activity.

Here I wish to draw on insights from contributors to the modularity literature. Following the introduction of innovations, organisational structures adapt to better suit the delivery of new products and or services. This applies to the case of the Majors following the choice of the

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[67] Confirming Balio's observations is the data collected by Robins (2003), as it shows an increased concentration of revenue per film.

blockbuster movie strategy. In fact, as the cost of keeping star actors and other personnel under contract on a long term basis became too high, the Majors progressively turned to the model of increased flexibility provided by the independent producers (DeFillippi and Arthur 1998). This organisational innovation was adopted not only with the intention of increasing their efficiency, but also and more importantly, to be in a better position to produce new and more distinctive movies that could generate profits in a increasingly volatile and uncertain blockbuster movie market.

The vertical disintegration of the Hollywood Studios and the related organisational changes in the production process however, presented a critical downside. As the modularity literature suggests at a theoretical level, the coordination process between separated modules can be more difficult than in the case of a vertically integrated structure unless a standardised procedure is put in place. In the movie industry, however, film making is a characterised by a rich and strongly tacit process (therefore, difficult to standardise) and even the "simple" procedure of bringing together writers, directors, stars, and support crew became more difficult by several orders of magnitude (Lampel and Shamsie 2003).

Despite the more costly practices at the pre-production level, the organisation of the production process as a project was more sustainable and became the way forward. We might note that this is because the logic behind the blockbuster movie market is very different from the logic of a "regular" competitive market of manufactured goods, for example, where reducing the cost of production can lower the price paid by end-users, increase demand and the producer's profits.

In the case of the production of a blockbuster movie, cost reduction is not the primary objective. As Aksoy and Robins (1992) affirm, cost rationalisation strategies are meaningful mainly as a way of cutting down the investment levels required at each round of a new film production, and in that sense they are useful to producers. Theatrical runs (i.e. several "episodes" of blockbuster movies), for example, which according to Gomery (2004) were initiated with the movie *Jaws* in 1975, certainly present the most concrete possibility for realising economies of scale. As movies are similar in theatrical runs, the knowledge accumulated in the production of the first movie can help to increase the quality and reduce costs for successive episodes. Moreover, the popularity of the theatrical run is also explained by the fact that production companies can estimate the demand for a new movie based on the previous releases.

However, and more generally, films do not compete for audiences on the basis of the price they can offer to consumers and the cost of producing them. However, if there is a relationship between the cost of a movie and its box office receipts, in the blockbuster movie market this is likely to be positive. Although new and original ideas in the fields of storyline, screenplay or casting brought relatively cheap productions enormous successes, in most blockbuster movies, success is positively correlated, for example, with the size and the quality of the casting, the investments in distribution and marketing, the professionalism and experience of the staff, which are all factors positively correlated with their total costs.[68]

This organisational change we have discussed so far applies whether the modularisation of the production process is made in-house or outsourced to a third party (i.e. whether a movie is produced by a Major or distributed and partially financed by a Major, but produced by an independent company). Therefore, as Robins (1993) explains, the main rationale for the Majors to start co-financing or co-producing movies with independent producers or simply distributing movies for them, as well as the strategy of vertically disintegrating the in-house production process, are to be found in the necessity of diversifying and delivering distinctively and qualitatively superior products.

This viewpoint, however, is not universally shared. According to Aksoy and Robins (1992), these new types of arrangements between Majors and independent producers are better explained by the increased average cost per movie, the consequent reduction of output, and the Majors' goal of compensating their reduced production with the work of independents in the distribution end of their business. Besides the new organisational structure, the power of the Majors was not lessened, but on the contrary, extended (Aksoy and Robins 1992).

7.2.1.2. The Adoption of the Financial Syndication Rules and the Audiovisual Media Content Production of the 1970s

Whether or not these new organisational arrangements constitute an important novelty and the beginning of a new post-Fordist production process is a matter to be discussed in the next chapter. What we intend to highlight here is that from the beginning of the 1970s, audiovisual media *distribution* became the core activity of the complex networks of business that the Majors led. Drawing on the concepts of the modularity literature, distribution companies represent the platform integrators of the system called Majors, as they control the interfaces: they draw up the agreements with movie production companies and all the activities situated vertically above, and with the delivery and exhibition channels (e.g. movie theatres and broadcast networks) and all other activities situated vertically below.

Moreover, by the 1970s, Hollywood studios were not only producing feature films for cinema theatres, but they were also involved with providing content for the new medium of television.

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[68] Moreover, as Caves (2003) explains there is complementarity among high-quality inputs: a better leading actress produces a better performance from the leading actor.

Television programming started by following the example of the radio with the first prime time programmes being talk and variety shows broadcast live from New York. In the years that followed the frequency allocation freeze, with the increased availability of television channels, the influence of the Majors on this medium also increased (Winston 1998). Furthermore, the production of prime time programming increasingly moved to Hollywood, although secondary programming such as news, sports, documentaries, variety and daytime soaps were still produced from New York by the Networks. Although many production houses were involved including the new studio facilities owned by some of the Networks (CBS and NBC among others), most of the production was coming from the Majors and their subsidiaries. By 1955 telefilm raw stock consumption was already ten times greater than that of the feature side of the industry, and by 1956, starting with RKO, the Majors started to sell their libraries (Winston 1998).

In the early 1970s other important changes in regulation were introduced. These aimed at increasing competition at the production and the distribution end of the audiovisual service industries, and went on to affect the sector's organisational structure for the next thirty years. It was 1970 when financial syndication (fin-syn) rules were adopted to become effective a year later. These rules forced the Networks to purchase all their prime time programming, with the exception of news and sports, from a third party, instead of producing it themselves (Bielby and Bielby 2003; Christopherson 2006).

As a result of the fin-syn rules, the demand for media entertainment products was reinvigorated, to the benefit of the Majors' television subsidiaries and of new, medium size and independent production companies. Two other consequences resulting from the fin-syn rules and the increased demand for audiovisual services are worth noting here as they influenced the sector throughout the 1980s: the first is that, besides a homogenisation of production strategies, variety between individual products increased (Christopherson 2006). The second is that given this increased search for diversity and distinction, with the application of television production methods and technologies, film shooting was becoming more mobile and independent productions started to look outside Los Angeles for their production phase. The rationale behind what have been called "*Runaway Productions*" was twofold: artistic and economic. From an artistic viewpoint, "shooting on location" led to more distinctive and original productions, while from an economic viewpoint, moving productions away from Hollywood helped reduce production costs.

7.2.2. The Packaging, Marketing and Distribution of Audiovisual Media Services

Between 1950 and 1985, three types of activities may be identified as the most important in the vertical stage of the audiovisual media services that is the focus of this section: the distribution of feature films, the packaging and distribution of television schedules (the broadcast channels) and, only towards the end of the period in question, the Multichannel Video Programming Distribution (MVPD).

As briefly mentioned above, the distribution of the feature films turned out to be the key activity in the Majors' value chain: after the vertical separation between production and distribution, a distribution deal became the essential tool to pass a project from the pre-production to the production phase (Cones 1996 cited in Lampel and Shamsie 2003).

Indeed a distribution deal normally provides a production with part of the funding. It covers the marketing of a movie which is carried out by the distribution company, and it guarantees the production company's access to one or (as is increasingly common) more media outlets. Moreover, it is reasonable to assume that the practice called "windowing", which is the timely distribution of feature films (but also television programmes) to the different media exhibition outlets, was initiated with the release of the Majors' libraries to television channels. This innovation further strengthened the role of distribution companies.[69]

In the case of television networks and local stations, the most important aspect of their activity is the composition of a programme schedule. Here we would like to present a brief account of how the Networks have evolved between 1950 and 1985, and how institutional changes have shaped new innovations in this particular section of the audiovisual media service industry. First of all, given the extent of its role, we consider that the activities comprising the distribution phase of audiovisual media content industry are the most influential in determining the diversity of the movies and programmes that are offered to viewers. Moreover, we consider new formats and genres as new stylistic innovations and that is why we refer to studies of diversity to estimate the intensity of the innovation process and relate this intensity to the changes in the organisational structure.

In the 1950s and in the early 1960s, as Mara Einstein (2004) explains, the dominant genre broadcast during prime time by the Networks was the action / adventure and Westerns. The FCC at the time was worried about the level of violence in the audiovisual productions. As a consequence of this the first important change to the dominant television format was directly imposed by the FCC. Therefore, by 1973, there were no adventure programs and only 2 hours of western programming, whereas there had been 14 hours per week and more than 13 hours of each respectively, only 6 years earlier. Instead, the milder crime genre conquered prime time television (Einstein 2004 p150).

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[69] See Doyle 2002 for a more detailed definition of the practice called "windowing"

Another important change, this time of an organisational and structural nature, was the consequence of the Quiz scandal in the late 1950s, as well as of the increased cost of programming. Up to this point, most of advertising came in the form of sponsorship and sponsors played an active part in the selection of programming. In the years that followed the Quiz show scandals, spot participation became more common. As a result, between 1957 and 1964, single sponsorship of prime time programming declined from 39.5% to 10.3%. This dropped to less than 4% in 1968 (Einstein 2004 p149).[70]

This was the first step towards a changed relationship, and yet again, the move towards a more standardised, arm's length-type of agreement, in this case between advertisers and television broadcasters. Before this change, advertisers were involved in the choice of programmes and provided input on different aspects of the programming commissioned. Following this change, television broadcasters offered advertisers airtime and audience generated through programming, for a price that is proportional to the audience generated, instead of to the programming itself.

The fin-syn rules narrowed the focus of television broadcasters, and following their introduction, the distinctiveness and originality of the programmes themselves was not a primary prerogative of the Networks or of the other local television stations (with the exception of News and sports programmes); programming became the main playing field where they could be innovative. We claim, that the innovations that we describe below, demonstrate how vertical disintegration had changed the nature of modular innovation (i.e., in this case, of the packaging of television programmes).

First, it was in the 1970s and following the introduction of the fin-syn rules that television broadcasters started to compete for audiences as demographic targets. This innovation contributed to a decline of diversity in the programming: this because all three Networks went after the largest group of buyers (i.e. adults between 18 to 49 years) in order to maximize the revenue generated on the audience market (Einstein 2004).

The second example of modular innovation is provided by the successful attempt made by ABC in the late 1970s to become the first broadcaster scaling up from a third position. This Network achieved distinctiveness and originality by changing the main format of its programming and introducing nostalgia, sex appeal, and double entendre comedy. Overall, diversity as a result

[70] The Quiz Show Scandal refers to the debates following the discovery that the most popular quiz shows were actually staged. In fact, Participants were given the answers and taught to follow instructions and act in order to make the programme more entertaining. These proceedings came to light after a quiz show contestant, James Snodgrass ,mailed himself registered letters containing the pre-arranged results of an episode before it took place (Doherty 2007).

increased although it was short-lived, as, since ABC became the first Network following this move, the other Networks followed and aligned themselves to the same prime time formats (Einstein 2004).

The third and last example of modular change following the introduction of the fin-syn rules concerns the change in the role of news broadcasting, one form of prime time programming that Networks and local television were still allowed to produce in-house and for which they retained full responsibility for the content. As reported by Champlin and Knoedler (2002), from the 1970s news divisions changed from being loss-leaders and a mark of network prestige, to a source of profit. In order to attract the largest possible audience and maximize advertising revenues, many news programmes gradually and increasingly moved away from the hard news, such as risky and costly investigative work, to increase the share of sensationalist and soft-news.

The third most important module in the distribution, marketing and packaging of the audiovisual media service industry mentioned above, is the Multichannel Video Programming Distribution (MVPD). As this is a service that is a characteristic of cable companies, who introduced it first, its role and evolution are described in the next section.

7.2.3. The Delivery and Exhibition Stage: the Rise of OTA Television and CATV

During the period between 1950 and 1985, two new delivery methods of audiovisual media services were created: terrestrial/over-the-air (OTA) radio television and cable television.

In the case of local television broadcast channels, programming and delivery are normally vertically integrated. Local broadcast channels own the licences and the equipment to broadcast their programmes in a particular area, sometimes labelled (by Nielsen Consulting) as the Designated Market Area (DMA). This equipment, which requires relatively less capital investment than more modern delivery methods such as cable and satellite transmission, normally consists of a radio transmitter, used to broadcast the channels' radio signal, and possibly boosters and transmission stations to rebroadcast and improve the reception of the signals within the area covered by the licence. National Networks broadcast their programming using the terrestrial/OTA signal through their affiliated local stations. Local televisions that are not affiliated to any Network are referred to as "independents".

Cable Television was born in the early 1950s as an ancillary service to terrestrial television. The first form of cable television was the Community Antenna Television (CATV), whose main business purpose was to capture local televisions signals using reception facilities and re-distribute them to households using recently developed wideband amplifiers and coaxial cable technologies (Maule 2003; Parsons 2003; Bates and Chambers 2004). Therefore, CATV services exploited television stations' inability to provide the entire community they serviced with good reception, by re-broadcasting their signals without paying any rights to the programmes' packagers and distributors, and collecting monthly fees from their users.

This industry was partly regulated by municipalities and local governments: in fact, similarly to other utilities, such as the telephone and electricity, the cable industry must lay cable in the ground, use municipal poles and buy rights of way. Therefore, cable companies negotiate franchises with municipalities in exchange for fees (Strover 2005).

Furthermore, local broadcast stations were in favour of cable diffusion despite the fact that CATV did not pay the Networks any copyright fees, as they benefited from the extra audience it generated for their programming and the extra revenue they collected from advertisers.

From the 1960s, the cable industry market entered a new phase. In fact, it was 1961 when a San Diego-based cable company started to distribute, additionally to the three local VHF stations, the signals of other four stations in the Los Angeles area, otherwise unavailable in the market (Corn-Revere and Carveth 2004). Gradually and following the introduction of this innovation, the cable industry moved on to become a main media outlet with the ability to create value added from content by selecting which channels were to be delivered to its users; MPVD services had been created.

At least initially, this change was not welcomed by the FCC as it clearly altered the competition in the television industry and it undermined the Commission's role in distributing the licenses that gave the privilege to use the radio spectrum for television broadcasting.

Following the retransmission of distant signals, the commission started to regulate the cable industry, mostly indirectly and through the involvement of the district courts as it did not have the authority to regulate an industry which did not use the airwaves to broadcast radio signals, nor could it be classified as a telephone service. This situation only changed in 1984 with the Cable Act, when the Senate invested the FCC with this authority over this industry (Bates and Chambers 2004).

However, the FCC asserted its right to regulate the cable industry in its First Report and Order of 1965 by issuing a regulation stating that cable companies could not import programming which duplicated that of local stations, and this for a period of time that was initially set to 30 days and later reduced to just one day (known as the Syndicated Exclusivity Rules or "syndex" rules). Moreover, the commission limited the number of distant signals that cable companies could carry (Winston 1998).

Pushed by the television industry, the Commission issued a set of rules in 1969 aimed at keeping the cable industry as a local and rural business (Strover 2005). However throughout the

1970s as a result of the introduction of technical changes, the cable industry increased its potential and prepared itself to play a much bigger role in the audiovisual media service industry for decades to come. According to Strover (2005), the set of rules issued in 1969 included prohibitions or limitations on television and telephone companies owning cable companies in the same local area, and the prevention of cable television from entering the top 100 markets. Moreover, limitations were also placed on the programming cable companies were allowed to deliver, as for example, the FCC created a prohibition on showing movies less than 10 years old and sporting events that had been on broadcast television within the previous five years.

Additionally, in 1972, the Commission issued the "must-carry" rule and mandated cable companies to carry and distribute the signal of the local television stations in the area (defined as a 50 miles radius) where they operated (Kassel 2005).

On the other hand, one of the most influential technical changes came from the development of satellite technologies. As the transmission of television signals through satellite technologies became cheaper, some media entrepreneurs saw an opportunity to launch new and innovative television stations. These television stations presented two advantages: first, they did not require a license from the FCC to use the radio spectrum, which was limited in capacity and already allocated. Second, these stations could reach virtually any household in the national territory that was using a (rapidly expanding) cable service. In other words, satellite technologies opened up possibilities for the development of a new module of the audiovisual service industry that we have labelled (following the FCC) *Nonbroadcast channels or Networks.*

Home Box Office (HBO) is believed to have been the first of these types of network. It was conceived by the Sterling Manhattan Cable owner, Charles Dolan, who launched this service in 1972 (Winston 1998). For three years and before being distributed by satellite communication in 1975, HBO was distributed to cable companies by using the AT&T long distance network (Strover 2005). Moreover, this project was launched with the help of a financial partner Time Life Inc., who a few years later gained control of the new network. Another pioneer in the creation of nonbroadcast channels was Ted Turner, who started leasing satellite time in 1977 to transmit thematic channels for cable companies (Winston 1998).

As HBO expanded and was distributed to many hundreds of cable systems in the national territory, restrictions that were jeopardizing its future and the future of other nonbroadcast channels were still in place; notably, new movies and sporting events were still exclusive to broadcast channels. As a result, in 1977, HBO brought the Commission to court claiming that the latter had exceeded its jurisdiction in limiting programming options. The District of Columbia Court of Appeals recognizing the cable company editorial role, finally supported

HBO's position by asserting that cable television deserved greater First Amendment protections (Strover 2005).

Subsequent technical and regulatory changes led to new channels that represented new formats for television. Cable television, for example, increased the demand for cultural products overall and for different types of content (Feigenbaum 2004). These included infomercials, 24-hour news and weather services, music video services, home shopping channels, arts channels, and a host of other narrowly targeted programming (Strover 2005; Maule 2003).

With the increasing number of channels and the expanding cable systems, the number of bilateral negotiations and agreements between content providers and deliverers grew exponentially. Therefore, as noticed several times in this study, when a system increases in complexity it also evolves towards a standardisation of the relationship between its interconnected modules. In this case, the Cable Compulsory License Provisions of the 1976 Copyright Act fulfilled the need for standardisation of the *rules of the game*.

This act eliminated the need for bilateral negotiations as it provided a simplified procedure to allow the transaction between the parties involved and it invested the Copyright Office and the Copyright Royalty Tribunal with the function of acting as the interface. As Dobal (1998) explains, this law (effective from 1978) allowed cable systems to retransmit television broadcast signals containing copyrighted programs without the express consent of the copyright owners, upon the payment of a statutorily fixed royalty fee. The Copyright Office and the Copyright Royalties Tribunal collect, distribute, and adjust the royalty fees paid by cable systems, while the courts supervise collection, distribution, and adjustment decisions. [71]

Moreover, with the increasing number of channels to choose from and besides the limitations on the content and on the number of distant signals that cable companies could deliver to their customers, a new form of market segmentation, which is still in use today, was introduced: cable systems started to use "tiers". In 1979, the basic tier (or package of channels) was composed of the local television stations, while the advanced tier, for which customers were charged an extra fee, included distant television channels (Dobal 1998).

[71] However, although the Cable Compulsory License Provisions certainly simplified the majority of relationships between Programmes' packagers and distributors, it did not apply to all. In fact, we find at least three exceptions to this rule: First, in virtue of the must-carry rules and before the introduction of the Cable Television Consumer Protection and Competition Act of 1992, cable operators did not remunerate local stations for the retransmission of their signal (Strover 2005). Secondly, cable operators did not pay royalties to retransmit "significantly viewed stations" in a particular community. The list of the significantly viewed stations is published by the FCC. It was first edited in 1972 and it is updated on a regular basis; moreover, it is mainly determined by measurements of OTA viewing of the signal in the community (Carson 2004). Third, small nonbroadcast networks, in order to reach a certain audience target, already at the time, but also nowadays, might pay to be carried and delivered by large cable systems (Bates and Chambers 2004).

On the regulatory front, the 1980s marked the reversal of a trend that had lasted for decades. Although district courts have overruled some of the FCC interventions, regulatory changes that came from the Commission up to that moment were mainly in favour of the broadcast networks and somehow sought to limit the role of cable companies and nonbroadcast networks.

The Reagan-appointed Chairman of the FCC from 1981 to 1987, Mark Fowler, on the other hand, supported a marketplace approach to media regulation that would essentially put cable on a more equal footing with broadcasting (Strover 2005). As a result, in those years the commission eliminated syndicated exclusivity and network non-duplication rules (Corn-Revere and Carveth 2004).

The 1984 Cable Act also represented a step towards the de-regulation of the industry: firstly, as already mentioned, the FCC became the main authority with regulatory power over the industry (Bates and Chambers 2004); secondly, its major provisions created a standard procedure for renewing franchises that gave operators relatively certain renewal; thirdly, the act legalized signal scrambling. More importantly, the act also deregulated rates so that operators could charge what they wanted for different service tiers as long as there was "effective competition" to the service. This “effective competition” was defined not in relation to other cable system (as they were basically local monopolies) but as the presence of three or more OTA signals. As a result of this definition, over 90% of all cable markets could fix their own prices (Strover 2005).

The last major restriction imposed on cable companies, however, was again removed as a consequence of a court decision. Following the Quincy Cable TV v. FCC case (1985), the court established that the Commission had failed for twenty years to produce evidence that the presence of cable companies was causing economic harm to the network and therefore the “must-carry” rule was overturned (Corn-Revere & Carveth 2004; Strover 2005).

Therefore, at the beginning of what we have marked here as a new phase, the cable industry, which was in full expansion, found itself re-designed by a wave of regulatory changes that in fact increased its independence. Moreover, these recent changes renewed the interest of large media conglomerates in this maturing industry.

7.2.4. Infant Innovations of the Customisation of the Audiovisual Media Experience

Here, we end the second phase of the development of the audiovisual media service industry, where television broadcasting is reaching a new stage of development with the maturity of its relatively new delivery method, namely the cable industry. On the other hand, we mark the beginning of the third phase with the diffusion of the home entertainment industry. However, as reiterated several times in this study, the diffusion of a new technology is accompanied by regulatory changes that facilitate or even provide a rationale for its expansion. Chronologically, most of these come before the diffusion of a new technology and the appearance of the consequences it generates, therefore they are part of the second phase and therefore briefly explained in this section.

Key innovations responsible for enabling the creation of a home entertainment industry are the Video Cassette Recorder (VCR) and the Digital Versatile Discs (DVD). In Winston's account (1998) of the development of audiovisual technologies, the VCR is the spin off invention of a cassette recorder system used by broadcasters in the mid-1950s. By the 1960s, the cassette record system was in competition with a disk recorder system, which at the beginning, however, was capable of recording only few frames. The advantage of this tool was the quick selection of images; in fact, this type of system was used for the first time commercially in the August 1965 by CBS as a "replay" device, in the transmission of a football game. RCA marketed a version to consumers from 1969 (Winston 1998).

The first VCR, on the other hand, was available to home consumers in 1974; however, sales did not really take off until 1979. Moreover, sales decidedly grew from 1981 after a US court held that taping a broadcast television signal did not constitute an infringement of copyright law. Famously, the establishment of a VCR standard was the result of fierce competition in the 1980s, between Sony's Beta and JVC's VHS systems. In the end, although the Beta system was available earlier and it was superior in quality, it did not come with tapes that could record over an hour of television. This technical shortcoming prevented users from recording a full feature movie without having to change the tape. The VHS, which on the contrary had tapes that could record more minutes, became the most popular (Winston 1998).

The second "pillar" of the home entertainment industry is the Video Tape and Disc Rental industry, which, as explained below, flourished from the end of the 1980s and throughout the 1990s. However, a regulatory innovation is at the origin of the simplification (or, as we often repeat in this text, the standardisation) of the relationship between the rental industry and movie distributors. This regulatory change is the "First Sale Doctrine" of the U.S. Copyright Act of 1976 which applies to all copyright protected products and allows for legal markets in video rentals, used books, records/CDs, paintings, and other creative works, and invokes copyright jurisdiction upon the first sale of a copyright-protected product only. As a consequence, the subsequent use of copyrighted material, including resale and rental, does not generate income to the copyright holder (Mortimer 2005).

7.3. Increased Complexity and the Customization of Audiovisual Services' Consumption (1986-2006).

The third period in the evolution of the media service industry is characterised by two types of trends: the first trend is the further increase in complexity of the industry, leading to the multiplication of modules particularly in the delivery and exhibition phase and the proliferation of relationships between the modules. Audiovisual media content is also influenced by the increasing number of delivery methods: its form and the quantity produced are two dimensions that are affected by this change. The increasing number of delivery methods also helps the American industry in exploiting foreign markets.

The second trend is an increased liberalisation: most barriers that restricted the accumulation of different (vertical) activities under the same ownership were lifted, and the rules limiting mergers between companies providing the same type of service were relaxed. These developments were facilitated by prior policy and regulatory changes as noted above.

7.3.1. The Diversity Effect of Technical Change Versus the Concentration Effect of Regulatory Change

As anticipated above, the new activities that constitute the main "architectural changes" of the audiovisual media services industry and that characterise this new phase, include: (1) the packaging and distribution of home video products, (2) the delivery of audiovisual media products through Internet Protocol (IP)-based communication systems – using the Internet or mobile phones private networks, and (3) the delivery of audiovisual media products directly to households using analogue and digital signals routed by satellite technologies.

According to the modularity literature, as explained above, the organisational form of an industry changes following the introduction of innovations and this is because it adapts to better suit the production of a new good or the delivery of a new service. Below, we are going to illustrate with many historical examples how this rule also applied to the specific case of the audiovisual content media markets. First of all, here, we will comment on how this is affecting the final consumer.

The trend traced by the appearance of the new services is that of an increasingly private or personal consumption of the audiovisual media experience. Viewers are increasingly able to customize their experience of audiovisual products: first of all, compared to the previous periods, viewers have more choices of outlets; second, new technologies increasingly allow final-users to experience videos at their chosen time and in the place of their choice. As a matter of fact, instead of being dependent on one or few "windows", viewers have more control over the timing of consumption; nonbroadcast networks (cable and satellite), can offer several television programmes on a staggered-start basis using several channels (notably, the system called Nearly Video On Demand or NVOD); Digital Video Recorders (DVRs) and DVDs, on the other hand, have completely freed viewers from the restrictions of television schedules. At the same time, viewers are also more independent in respect of the choice of the format and place for audiovisual media consumption, as new forms of video display are increasingly portable, from DVD players to cell phones.

Still at the organisational level, if, on the one hand, the emergence of new activities opened up more possibilities to *increase* the number of establishments in the industry, on the other hand, the wave of de-regulatory changes undertaken since the end of the 1980s led to the opposite effect, as it produced several mergers, consolidations and takeovers.

If the effects of the Paramount decisions were cancelled in the early 1980s (Christopherson 2006) and feature film distributors have been allowed since then to own cinema theatres, the fin-syn rules survived for another decade. In fact, it was 1991 when the fin-syn rules were changed for the first time: a change that the Commission was prompted to take due to three factors, as Tamber (1995) explains. These include the results of a National Institute of Statistical Sciences (NISS) study concluding that despite twenty years of fin-syn rules, diversity or competition in the program supply market had not increased; the remarks of the Justice Department and the Federal Trade Commission stating that there was no evidence that the rules were limiting the Networks' market power, and finally, as the same FCC chairman was suggesting, the video marketplace of the early 1990 was very different from the time when the rules were originally adopted.

The FCC chairman's suggestion referred to, and fed into, a more general and diffused opinion about the video marketplace and the appearance of new technologies. As Louw also observed (2001), new media technologies made deregulation possible: the increased number of media outlets, reduced the importance of the scarcity of airwaves and reduced the need for an intervention from the central authority.[72] Alternatively, political economy of communications scholars consider the increasing popularity of a neoliberal agenda as the most determining factor, although they might also accept the argument that technologies help to realize economies of scale favouring mergers and acquisition in the sector. For example, Blevins and Brown (2007) argue that the neoliberal philosophy is guiding the FCC decisions since the arrival of Mark Fowler, who served as a chairman during the Regan presidency in the 1980s.

[72] Louw also explains that however, other and new forms of interventions were needed to allow the expansion of the new technologies, such as regulations regarding satellite orbital spots (Louw 2001).

Despite the opinions of communications scholars and in light of the increase in the number of media outlets, the FCC thought that the capability that networks had to monopolise production was reduced and therefore the rationale for the fyn-sin rules was dismissed. Thus, these rules were further relaxed in 1993 and finally eliminated with the changes brought about by the comprehensive revisions of the regulations governing the information sector that were imposed by the 1996 Telecommunication Act.[73]

Figure 7: The Time Warner Media Conglomerate (Time Inc., AOL, Warner Bros. Entertainment Turner Broadcasting System)

<table>
<tr><th colspan="3">Production and Post- Production</th></tr>
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Source: several companies' web sites

If, on the one hand, the fin-syn rules had failed to foster competition in the production marketplace, on the other hand, they had at least reduced the rationale for horizontal integration and concentration in the packaging and distribution phase of the audiovisual media service industry. In fact, it is more profitable to own than to buy television programme syndication rights, and as pointed out by Fergusson (2004), the Networks have a competitive advantage over local stations as they can afford and fully exploit expensive studios and afford to buy the most expensive programming. As explained in more detail below, the difference characterising the

[73] In 1993 the FCC had to re-defined the rules to include the following points: 1) Network Acquisition of Back-End Rights; 2) Network Syndication of Off-Network Programming; 3) Network Participation in the First-Run Programming Market; 4) Entities that Qualify as a Network; and 5) Reporting Requirements Imposed on Networks (Tamber 1995).

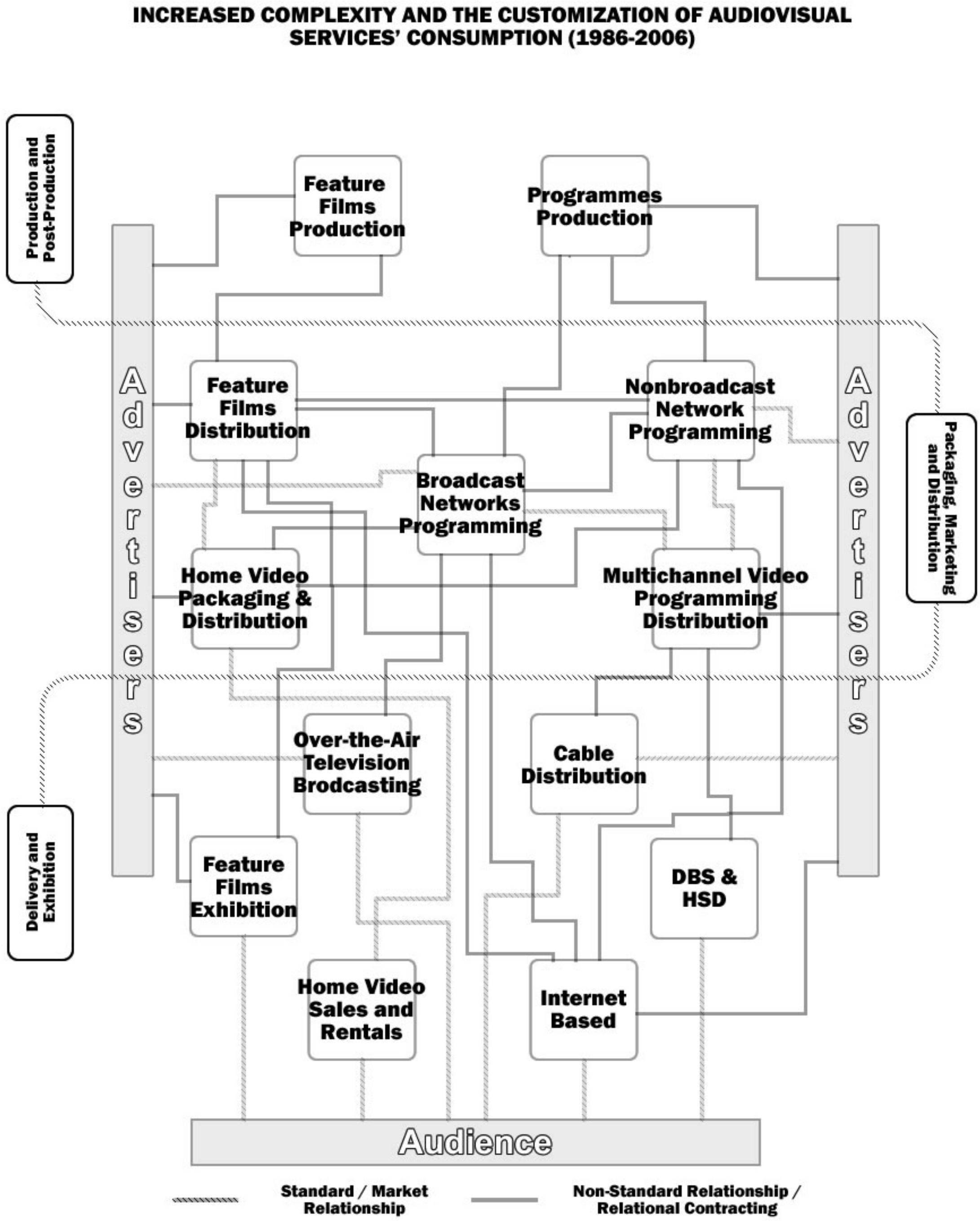
relationship between Hollywood and the Networks in the 1960s and in the 1990s is in the structure; indeed, in the latter period this association became a matter of ownership.

Liberalisation as a consequence of the multiplication of media outlets, did not only interest OTA television broadcasting, but also the cable industry. In 1985, or one year after Congress officially invested the FCC with regulatory power over the cable industry, the Commission adopted, as part of its Cable Act, a "three-signal standard". According to this rule, any cable television company delivering its products in an area serviced by at least three OTA television signals (and such was the case of the very large majority of them) was considered to be in "effective competition", as well as constituting a local monopoly of the specific service of cable television provision. As a consequence of the existence of effective competition as defined by the Act, a cable company was freed from any regulation regarding the price of its basic tier (Corn-Revere & Carveth 2004).

As the fin-syn rules did not apply to cable companies, some of them had invested in programming in the 1980s. According to cable operators, these investments justified a rise in rates, which, as they were no longer under restrictions, grew by 25% to 30%, on average, from 1986 to 1988 alone. However, this liberalisation brought with it consumer dissatisfaction and their opposition led to a redefinition of effective competition and the consequent re-regulation of the rate as imposed by the Cable Television Consumer Protection and Competition Act of 1992 (Strover 2005).

Moreover, as the cable industry moved towards saturation and the availability of new markets shrank, cable companies tried to exploit economies of scale by investing in horizontal integration. As Parsons explains (2003), cable companies started to look into regional consolidation or "clustering". By this process, companies would buy out or exchange systems in order to group them and take advantage of scale economies, not only in areas such as personnel, marketing and advertising sales, but also in emerging technologies such as fibre ring topologies and digital servers. As a result, the total number of cable systems in the United States fell between 1994 and 1999 from about 11,200 to about 10,500 (National Cable Telecommunications Association 2001, cited in Parsons 2003).

Figure 8: A representation of the Audiovisual Content Industry, 1986-2006



Source: the Author

This new trend of regulatory changes, which was further fostered by the 1996 Telecommunication Act, facilitated not only vertical but also horizontal integration in the audiovisual media service industries. It relied on the assumption that because of the *convergence to digital formats and the interoperability of the networks*, more systems could provide substitute services and compete against each other. Therefore, with this Act, Congress established the basis for an enlargement of the audiovisual content media services by establishing the Open Video System (OVS) framework. This allowed ILECs to benefit from a different regime than cable providers and to provide video services in their own area (FCC Media Bureau 2006). In addition, it modified the current media concentration rules and allowed any single company or network to own TV stations that reached as many as 35% (against the previous 25%) of the nation's television households (Corn-Revere & Carveth 2004).

As a result of the many regulatory changes favouring the integration of the different activities (not only audiovisual, but media in general) the once-family-run, film production companies that evolved and survived the changes of the media marketplace, to finally gain the title of Hollywood Majors, are now part of larger media conglomerates.

At the time of writing, there are six major conglomerates: (1) Viacom/CBS, (2) Time Warner, (3) NBC/Universal, owned by General Electric, (4) Sony, (5) Fox, and (6) Disney. These conglomerates own and run companies carrying out activities in most of the modules we have identified as part of the audiovisual media service industry (see figure 7, for an example). Moreover, according to Christopherson (2006), together they control 98% of the programs that carry commercial advertising during prime time television (broadcast and nonbroadcast networks) and 96% of total US Film rentals. They control 75% of commercial television in non-prime-time slots, 80% of subscribers to Pay TV, and 65% of advertising revenues in commercial radio (Epstein 2005 p83, cited in Christopherson 2006).

In a few words, the story of this third phase as described so far suggests that technical innovation combined with certain form of regulatory changes have increased the number of activities carried out in the audiovisual content industry. This increase in the number of modules, coupled with the convergence to digital formats, is what others describe as the *new market conditions* of the audiovisual media service industry. According to the regulator, which still declares that it values and attempts to maximize consumer welfare (mainly fostered through increased market competition) and media diversity, the increased concentration in some of these activities, leading to reduced diversity, is offset by the increase in diversity fostered by the multiplication of media outlets. The presumed benefits of the increased concentration within the modules are to be found in classical explanations such as the realization of economies of scale and scope (as explained more in detail in the next chapter). Although we have used only the most common cases as examples, the concentration trend involves the entire audiovisual media service industry.

Following the schema used in the previous sections, we now proceed to describe the main changes, regulatory and technical, that have characterised this period and that are specific to one or more vertical sections of the audiovisual media service industry: production and post production; packaging, marketing and distribution, and exhibition and delivery.

7.3.2. Technological and Organisational Change in the Production Stage: Digitalisation and "Runaway Post-production"

At the level of production of audiovisual media content, we can identify key trends taking place between 1985 to today: the first, is the increasing use of computers and software in the production and post-production phases of feature films; the second, is the increase of investment in television programmes.

7.3.2.1. Feature Films: the Leading Edge Audiovisual Products

Given the combined effects of the many mergers between the film studios and the Networks and the dismissal of the fin-syn rules, the levels of television production taking place in the Majors Hollywood studios in Los Angeles strengthened over this period. As Scott (2004) reports, since the mid-1980s and mainly due to the expansion of cable television, the production of television programmes has outpaced the production of feature films.

Hollywood and Los Angeles are still the main centres of production of feature film and television programmes. This is demonstrated by two facts: first, the majority of new productions are still undertaken in this area, and second, employment related to this specific set of activities has increased in the last decade (Christopherson 2006).

If the decisions issued after the Paramount litigation and the effects of the fin-syn rules had favoured the introduction of new styles and genres, the effects of the dismissal of the fin-syn rules are evident in the decrease in diversity of television programmes. Gomery (2004) talks about an homogenization of content and style due to the emergence of the Big Six. More specifically, Einstein (2004) observes that in 1997 there were a record 40 situation comedies (equal to 30% of the total) in prime time programming, and explains that historically, this type of programme has always been the most lucrative type of shows in syndication. More recently, game shows and reality series are the new cost-effective and successful formats for television.

Although overall the share of production in terms of volume and cost has changed in favour of television programmes, the role of feature films in the audiovisual media service industry has not changed with the emergence of new media outlets. Feature films still represent the leading-edge audiovisual content, experimenting with new techniques and technologies that are later applied and developed by similar television programmes.

This supremacy of feature films can be understood by examining their average cost and comparing it to television programmes. With a rough calculation based on a sample of 1215 movies produced between 2000 and 2006, we estimate that the average cost of producing a blockbuster movie is about 35 million dollars. This average provides only a purely theoretical indication as the variance within the sample is very high.[74]

Although even to up to a half of the cost of a blockbuster movie might be going into its marketing instead of its production, on average it still represents the most expensive audiovisual product by several orders of magnitude. From the data provided by Ferguson (2004), we can see that the cost of a sitcom episode (the most expensive of the "fictional" production for television) varies from less than a million for the average production, to seven million for the most popular ones. Live events, on the other hand, are more expensive: these go from the 500 millions for a networks news division to the two billion invested by Fox to acquire privileged rights to broadcast football games (Ferguson 2004). These costs, however, contribute to the generation of many hours of programming in a year, therefore assuming that blockbusters movies are the most expensive product to produce is rather realistic.

7.3.2.2. The Digitalisation of Feature Films and the "Runaway Post-productions"

In this third phase (1986-2006), two related trends have influenced the production of feature films: the first is the pervasive "digitalisation" that progressively characterises their production processes, while the second, is the increased modularisation, relocation and outsourcing of the activities that are part of the production stage, resulting in a movement that we define as "Runaway Post-productions".

Digital technologies have influenced various stages of film production: for a start, a scene or an entire movie can be shot using the traditional cellulose-based film, then scanned and transformed into a digital format for computerised editing and then exported back to film for conventional exhibition. Alternatively, given the flawless means of transforming and transporting content from digital to cellulose and vice-versa, digital cameras are increasingly used for shooting scenes and/or movies are also released in digital formats (and high definition)

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[74] In fact, the data varies from the 207 million spent on producing the 2003 version of "King Kong", the 7,000 dollars spent on the production of "El Mariachi", which is the cheapest movie distributed by a Hollywood Major (Columbia) and the 218 dollars spent in 2000 on the production the movie "Tarnation", which is the cheapest movie (distributed by an independent) produced over the period in question.The sample data is pulled from the online database "The Numbers", available at http://www.the-numbers.com (retrieved on March 2007).

for exhibition on digital screens (see Prince 2003). Digital cameras include many more features and allow cameramen to make many changes during film shooting, once exclusively confined to the post-production process (Geuens 2002).[75] Despite the increasing number of features available to cameramen, the digitalisation of film making has not reduced the importance of film editing, or more generally, of the post-production phase. In reality, it has greatly enhanced it.

Prince (2003) presents a very interesting account about the possibilities that are available to film directors at a post-production phase, which, as he states, offer them "greatly enhanced artistic powers" (2003 p27). He explains that the cinema industry is moving on from using digital tools and processes mainly for the generation of artificial effects, the creation of "illusions" or fantasy elements in a movie. The digital generation or modification of images can be used to represent reality (although possibly embellished) and to substitute the actual filming when there is an advantage in doing so. According to Prince (2003), the movie "*O Brother, Where Art Thou?*" directed by the Cohen brothers and released in the year 2000, represents a milestone in this sense. First of all, this movie was the first to be entirely subjected to digital colour correction: the purpose of this change was that the authors wanted to visualise a movie with a sort of dustbowl look. However, when the shooting location was moved from Texas to the green areas of Mississippi, the idea of the dustbowl look was maintained and applied to the images by a digital process. Moreover, in this movie some of the characters are digitally created with the intention of looking real instead of creating an illusion: for example, the authors decided to re-create the gunning down of a cow, instead of staging the scene.

Another author, Geuens (2004), using Star Wars as an example, provides an account that explains the extent of the changes that through digital processes can be made to the content of the movie during the post-production phase. These include morphing actors' facial expressions to modify dialogues in the post-production scenes (without the need of re-shooting) and composing scenes that were shot separately in order to accommodate the actors' needs.

As technology has increased the number of options available, or, in another words, the complexity of tasks, specialized equipment and a trained workforce are also required. In sum, the modularisation of the production processes, also within the specific context of the

[75] As Geuens explains, for example: "*the exposure can be immediately adjusted to any light level, brightening up even the darkest areas. The colors can be programmed to match whatever light sources are being used or can be extravagantly tweaked for all sorts of expressionistic effects. Tone, grain, contrast, and density can be altered to provide a specific look. Shutter adjustments can be refined to produce stunning visual effects in any movement. Fades and dissolves can be adjusted on the spot for maximum impact.*" (Geuens 2002 pp19-20).

production and post-production phases of the audiovisual media service industry, becomes the "natural" organizational response to the increased use of technology.

Already in the early 1990s, as Aksoy and Robins (1992) were suggesting, post-production was increasingly outsourced to small specialized companies. This process is seemingly easier nowadays and thanks to the use of ICTs, as many tasks involved in the production and post-production can be performed simultaneously (instead of one after the other) by using remote collaboration systems (Palmer et al. 2001). More recently, as Christopherson (2006) pointed out, this division of tasks assumed the characteristics of an international trade, creating the basis for a "Runaway Post-production" trend, as post-production processes are outsourced to companies based abroad.

This movement of outsourcing of the post-production phase, also works in combination with the trend of proliferation of production companies that started at the end of the Golden Age of the Hollywood studios, as described above. Although many production companies work effectively as units of the Big Six, more often than not they are independent companies formed by a star, director, or producer through his or her agent (Gomery 2004).

These examples are listed here to illustrate how digital technologies are affecting the production of films and to better demonstrate a point made above: contrary to what Baumol claimed in the 1980s about television production, the application of the latest technologies in the audiovisual media industry is not only changing the form of the media product, but it also modifies what he perceived as an extension of the "live performance". Indeed, actors' performances may now be finely tuned and modified or also substituted by digitally generated characters; in some cases, entire movies are generated by computer graphics and the role that can be identified as the extension of the "live performance" is limited to the reading of the dialogues. As Prince explains (2003), a relatively new style that is proliferating is the reproduction of comic books onto the cinema screen (as recent movies such as *Spider-Man 2, Blade: Trinity, Catwoman,* and *X Men 3* testifies).

As explained above, however, Baumol is right when he argues that in the creative sector, new technologies do not necessarily lead to productivity increases in the long run. In most cases new technologies are employed to enhance the quality of a movie and to better respond to the creative input of its makers. The effect is an increase in cost and therefore they are clearly not employed with the primary purpose of conserving resources. As a result of this trend, blockbuster movies, besides being the most innovative, technology-using productions in the audiovisual media marketplace, are equally the most expensive to produce.

7.3.3. The Big Six and the Concentration of the Distribution, Marketing and Packaging of Audiovisual Media Content

The evolution of the distribution, marketing and packaging of audiovisual media content in this last phase also demonstrates that interdependent activities converge towards a standardisation of their relationships (such as the case here between Networks and advertisers), while activities that have non-standard relationships put in place (and this because of many characteristics, e.g. the importance of tacit knowledge and relational contracting) tend to concentrating (e.g. movies producers and distributors).

7.3.3.1. The Concentration of Feature Films Distribution Activities

The most important trend characterising the feature film-side of the packaging, marketing and distribution phase is the increased concentration of ownership. As mentioned above, the distribution activities have certainly become the most important and strategic activities included under the umbrella of tasks performed by the Hollywood Majors. The multiplication of the audiovisual media industry's activities and outlets has further increased their importance and, in the absence of regulations limiting the size of these distribution companies, facilitated their concentration.

Moreover, as the figures published by the last two US Census surveys indicate, the number of establishments whose primary activity is the distribution of motion pictures and videos (feature films and television combined) has decreased from 756 in 1997 to 484 in 2002. This change has also been accompanied by an important reduction of revenue (from over twelve to just over one billion dollars, also between 1997 and 2002)[76] (U.S. Census Bureau 1997 and 2002). Furthermore, in terms of employment, the average size of a distribution company is shrinking: in 1998, for example, over 80 percent of the companies involved in audiovisual media distribution activities had 500 or more employees, while in 2004 only 21% of these companies equalled or exceeded that level (U.S. Census Bureau 2004).

Although these figures refer to a rather short timeframe, they clearly highlight two trends: the first is that the sector is concentrating and the second is that its revenue is shrinking. Although the direct contribution of distribution companies in term of cash flow might have decreased, this does not mean that indirectly - and at least in the case of the Big Six - distribution activities are less profitable. The Big Six have most likely shifted their profit towards other activities of their conglomerates as the increase of revenue in the production end of the business testifies (e.g. the

[76] The data refer to the NAICS 51212 category.

revenue of production companies has increased from 20 to almost 47 billion dollars between 1997 and 2002; U.S. Census Bureau 1997 and 2002).

Besides the direct contribution in terms of revenue, distribution activities play a key role in the vertical integration of audiovisual media service sector, as documented here. Typically, distribution companies might have different types of contracts with production companies, from the ones where they participate financially in the production and share part of the risk, to the ones where they are simply using their circuit to market and distribute an independent movie. As explained above, nowadays the typical case scenario is the one where they distribute movies for a consortium composed of an affiliated producer company and another small company composed of the star of the movie and/or the movie director.

The typical timeline for feature movie distribution is the following: first, the movie is released into theatres. Generally, movies produced in the U.S are first released in the home market, while the timing or releasing of a movie in a foreign country depends on other factors (for example, the competition of locally produced movies, or differences in holiday calendars).[77] The theatrical run of a movie typically ranges from one to four months. Following the theatrical run, the movie can only be seen in the travel industry in airlines or in hotel rooms, for a period of about 2 months. Then distributors negotiate street dates to video retailers, and after hearing the retailers' reactions and the potential release dates of other movies, the date of the movie's home video release is announced (Waterman and Lee 2003, cited in Chiou 2006). After the home video release, movies are shown first on pay-per-view nonbroadcast networks and weeks or months later on broadcast networks (Gomery 2004).

The procedure for re-distributing revenue and profit of a theatrical release to the different contributors is *not standardised* and the centrality of the distributor in coordinating this system is evident. As a matter of fact, when the film's theatrical revenues begin to flow, cinema owners take a cut directly from the gross box-office receipts, known as the "house nuts" to cover the costs of running the venue. According to Scott (2004), a high degree of familiarity or relational contracting better describes the relationship between exhibitors and distributors, then a pure arm's length type of relationship.

The remainder of the receipts is divided between exhibitor and the distributor. A 90:10 split in favour of the distributor is not unusual, but the exact terms on which net box-office receipts are shared between the cinema and the distributor vary according to the film, the duration of the

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[77] In this respect, Christopherson (2006) suggests that some of the Big Six companies might coordinate their efforts and co-finance some big hit movies that are destined for the global market, in order to co-ordinate the release of their movies in foreign countries in a way that is mutually convenient.

theatrical run and other circumstances. The distributor's share forms the "distributor's gross" from which commissions and costs, including advertising and other promotions, are subtracted (Doyles 2002). The rest is profit that is first distributed to institutional investors (which charges a premium for a risk), and then to the other financiers (the same distributors, main actors, the producers) following the agreements taken at the pre-production phase.

7.3.3.2. Television Broadcasting

The television broadcasting-side of the packaging, marketing and distribution phase of the audiovisual media industry has seen more changes in this last period, than the feature films-side of the industry. Although with the end of the fin-syn rules, the Networks' revenue from programme syndication has increased, advertising still represents a consistent revenue stream. As reported by the FCC, for example, the cumulative revenue for television advertising in 2004 was just over 47 billion dollars. Of this, almost 53% is collected by the (now 7) broadcast networks, while the rest is earned by the nonbroadcast networks, with cable channels responsible for a 35% of the total.

Getting a (bigger) share of advertising money, securing old and new channels of distribution and exhibition for their products, realising economies of scale and finding other synergies between feature films and television programmes production - these are the reasons that have pushed the Majors to heavily invest in television. Ironically, if the fin-syn rules were issued to prevent the Networks from monopolising the creation of content, after these rules were no longer in effect, it was the main content makers that bought the distribution channels.

In fact, all three of the original, national broadcast networks are part of one of the Big Six conglomerates: ABC is part of Disney, CBS is part of Viacom (and so is the new upstart network United Paramount Network - UPN) and NBC is affiliated with Vivendi Universal studios. From the mid 1980s, the FOX network was added to the three original national Networks. Notably, this new division of the parent company News Corporation is affiliated with the 20th Century Fox audiovisual production company. To these four national networks, another three very large networks have been added: the ION Media Networks (formerly known as PAX), WB (Warner Bros) and, as mentioned above, UPN.

Moreover, the ownership concentration among broadcasters is clearly a transnational phenomenon. Using data drawn from the Thomson Reuters SDC Platinum database, Jin (2008) illustrates that between 1983 and 2005, 10,233 mergers and acquisition were completed *worldwide*. Almost 54% of these involved American companies buying other companies in the U.S. or abroad. Furthermore, this author also argue that this concentration process was intensified between 1996 and 2005.

As explained above, from the growth of the television industry and following the scandal linked to the fixing of quiz shows of the late 1950s, the television audience market changed from the product placements and programme sponsorship to the more standardised sale of spot times for advertising.

This trend could be reversed, as given the increased viewers' independency from the television schedules (thanks to DVD, VCR, DVR, etc…) and the ability to select the content (and to avoid exposure to advertising), a return to programme sponsorships could be justified. However, if on the one hand, a return to the diffusion of advertising in the content of audiovisual products is still not much more than a general assumption, on the other hand, it appears clear that the trend initiated in the 1960s towards targeting specific audience has intensified. Given this trend, the following changes are taking place: first of all, advertisers nowadays always prepare campaigns that will use several media to diffuse their content and reach their audience market; secondly, the standardisation of the *rules of the game* of the audience market is becoming more refined. As Fergusson (2004) explains, the new Cost Per Point (CPP) system is diffusing and replacing the "Cost per Mille" (CPM), the price paid by advertisers per thousand of viewers. Instead, the CPP is based on the share of audience a programme manages to achieve in a specific market, while this share of audience is sold to advertisers as Gross Rating Points (GRPs).

On the other hand, nowadays it is more likely that advertisers charge their customers flat rates based on the actual work entailed by the job: this is because with the traditional system (a percentage of the advertising budget) agencies had an incentive to propose the most expensive medium (Shaver 2004).

7.3.4. The Digitalisation and Multiplication of Delivery and Exhibition Outlets

The delivery and exhibition-end is the vertical stage of the audiovisual content industry that has changed the most following, on the one hand, the adoption of new ICTs in the sector, and on the other hand, the modification of the existing and the introduction of new rules governing the sector. The most interesting cases illustrating the effects of (modular) changes that are organisational and managerial and not only technical, are provided by the exhibition cinema theatre activities and the home video entertainment services.

Most of the regulatory changes that have led to an increased vertical and horizontal concentration in the audiovisual content media service industry have been described above in section 7.3.1.

7.3.4.1. The Growth and Consolidation of Exhibition Cinema Theatres

As Gomery reports (2004), at the beginning of the 1980s the multinational consulting firm Arthur D. Little, Inc. studied the film industry and came to the conclusion that cinema screens were going to disappear by 1990. Their conclusions, which a number of authorities in the field agreed with, were based on the observed growth of alternative audiovisual media services such as pay TV, home video, and DVD.

As explained above, we think that such an analysis is based on the dominant viewpoint of an economy based on the exchange of goods. In reality, home video rental services and cinema exhibition theatres are two different services that share the same content: however, a number of different factors, such as the time of release of these movies or the conditions in which viewers see them, make these services quite distinct and far from being close substitutes.

Since 1985, the year we chose to mark the beginning of this third period, cinema exhibition activities have changed, but these adjustments are associated with the growth of other activities within the audiovisual media service industry, such as the growth of the home video market (as they are related to regulatory changes) and the general trend of the sector. Firstly, the number of screens has increased: as figures published by the National Association of Theatres Owners (NATO) suggests, the number of cinema (indoor) screens has increased by over 80% between 1987 and 2005. Secondly, the number of cinema sites has decreased by 20%, between 1995 (the first year for which this type of data is available from this source) and 2005.[78] Moreover, the number of digital screens is also increasing quite rapidly: in the early months of 2007, they already represented 10% of the total (Giardina 2007).

This data testifies to the diffusion of multiplex cinemas, which is taking place at the same time as a concentration of ownership in the industry. As reported by Vogel (2001, cited in Chiou 2006) at the end of the 1990s, a handful of theatre chains owned 65% of the screens in the U.S. and collected at least 80% of total, domestic, box office revenue. These companies were United Artists and Regal (or Regal Entertainment Group), Loews Cineplex, the General Cinema Companies, AMC Entertainment (now owner of Loews Cineplex and General Cinema Companies), Carmike Cinemas, Redstone, Cinemark USA, and Marcus Corporation.

Contrary to what has happened in the television business, however, the increased concentration is not strictly linked to the expansion of the Big Six. In fact, only two of these companies were or are affiliated to these media conglomerates: Loews Cineplex was owned by Sony, while

[78] The number of sites has decreased from 7000 to a bit more than 5700 (see http://www.natoonline.org).

National Amusements Inc (or, more specifically, the mother company Redstone) is part of the Vivendi group (Gomery 2004).

As with other audiovisual media exhibition outlets, the main reason that explains the increased concentration in the cinema theatre business is achieving operational economies of scale. In the specific case of cinema theatres, a large share of revenue comes from the sale of items inside the premises (e.g. popcorn, etc) and large theatre chains are in a better position to negotiate better deals with the suppliers (Gomery 2004). Moreover, as the relationship between distributors and exhibitors of feature films is said to be better described as "relational" contracting (Scott 2004), certainly bigger theatre chains obtain better deals from movie distributors than the small ones.

This industry, therefore, despite the forecast of film industry experts at the beginning of the 1980s, seems now quite healthy. With a rough calculation based on the data published by the NATO, we determine that first, in 2005 each cinema site had an average of (almost) 6.5 screens compared to not even 4 in 1995, and second, the gross revenue per screen (in 2005 prices)[79] has increased from 135 million to over 241 million, which corresponds to an increase in productivity of the average screen of almost 80%.

Moreover, the inevitable computerization of the tools supporting the daily operations of cinema theatres, has certainly contributed to the foundation of what Gomery (2004) defines as one of the key innovations of the final quarter of the 20th century in the film business: overnight audience attendance data generation. This data is collected by A.C. Nielsen's Entertainment Data, Inc., which creates daily reports about box office trends that are fed to distributors and producers and on which many important business decisions (for example, about the length of the different media windows) are taken.

7.3.4.2. Old and New *Rules of the Game* and the Growth of Home Video and DVD Rentals and Sales

As explained above, by the mid 1980s the main technical innovations and regulatory norms providing the basis for the future growth of the home video industry were already in place. Therefore, following the 1981 court decision on copyright that legitimized the use of VCRs, the use of this new tool spread very quickly: as reported by Winston (1998), by 1995 almost 90% of all households with a television had one and they were renting a video nearly every week. In 1998 when the diffusion of DVD took off, the rental and sale of audiovisual media home

[79] The index used for the calculation is the Producer Price Indexes (PPI), All commodities, published by the BLS, on http://www.bls.gov [Accessed, April 2007]

entertainment was already a working and profitable business and the DVD (more or less rapidly) provided the market with a new, alternative and superior form.

However, it is not only technical innovations related to VCRs, VHS tapes and DVD players and discs that are responsible for the success of this industry in the last few years; new *rules of the game* or contractual agreements between rental outlets and distributors, are responsible for the improvements of the service and the increase of revenue. Moreover, the main enabling factor of the diffusion of these new contractual arrangements, as explained below, is the diffusion of ICT tools.

According to the “old” rules of the game, distributors were applying price discrimination and they would initially issue pre-recorded VHS tapes at the wholesale price of around 60 to 70 dollars. The buyers of pre-recorded tapes at this price were “institutional”, i.e. the rental shops and chains. After a period of generally five months in which the pre-recorded tapes were rented, distributors used to start selling pre-recorded tapes at a “sell-through re-pricing” that was equivalent to 10 to 15 dollars. At this stage, pre-recorded tapes were not only rented but also sold by the same or other media distributors to individuals (Mortimer 2005).

The main problem of this old system was that rental shops were exposed to a risk: over-stocking of pre-recorded tapes. Therefore, instead of buying extra pre-recorded tapes that were not rented enough times to cover the initial cost and generate a profit, rental shops would safely underestimate demand and found themselves often “stocked-out” of new releases, giving up some opportunities to make extra business.

As the cost of producing pre-recorded cassettes and DVDs shrank, it made more sense to promote a new system based on revenue sharing. According to Dana and Spier (2001) the home video and DVD distributor that is credited with the introduction of this system (in 1986) is Rentrak. Rentrak’s system of revenue sharing, however, became famous only after 1998 when one of the major chains of Video and DVD rentals, namely Blockbusters, became a customer.

Nowadays, this system requires rental and sales stores to use an electronic database to keep track of the rental and sales of pre-recorded tapes and DVDs. This database also provides the vital statistics the distributor uses in order to calculate the income of rentals that is divided between the movie distributor, the rental and sales’ outlet and itself.

Moreover, under this new system, videos are purchased by rental and sales outlets for a price that ranges from 0 up to 8 dollars each and the rental revenue is typically shared as follows: the video retailer keeps 45% of the revenue, the movie studio gets 45%, and the remaining 10% goes to Rentrak. Nowadays, this system is no longer exclusively used by Rentrak, as other distributors also offer revenue sharing, while the main chains of home and DVD rentals and sales are signing revenue sharing contracts directly with the major movie producers (Dana and Spier 2001; Chiou 2006). The "fixed" cost of buying extra copies is reduced and so is the risk involved in the acquisition of large amounts of pre-recorded discs.

The introduction of revenue sharing is likely to be responsible for other changes in the industry. In fact, other than "physical" sales and rental shops, now it is more common to find their "virtual" counterparts. These types of business take orders online and deliver DVDs by the post. DVDs are also returned by free post by their users and they can be rented for an unlimited time. The frequency of deliveries of a new DVD depends on the type of subscription service (e.g. a maximum of 2 DVDs per week) and on the return of the previously rented discs. Clearly, this system would have not been possible without the cheap and virtually unlimited supply of pre-recorded disk a dealer can have access to, as is the case under the revenue sharing regime.

Another change that has been created by the new *rules of the game* is the variance in the length of movies' "rental windows". In fact, this is now more likely to be determined by market conditions. According to Mortimer (2005), approximately two-thirds of a movie's rentals occur during the first two months and at least 85 percent of all rentals occur in the first five months. Moreover, approximately 50% of the rental revenues over a five month period are earned in the first 3 weeks (Chiou 2006*)*. Therefore, during the first two months, shops rent most of their copies of that movie and sell a few, while as soon as the demand weakens, more pre-recorded discs are up for sale.

As the FCC reports, the sales and rentals of DVDs have grown to account for 60 percent of entertainment companies' profits over the past eight years (FCC Media Bureau 2006) and certainly the diffusion of the revenue sharing system is likely to have played a major role in this growth.

7.3.4.3. The Delivery of Audiovisual Media Services Thorough Satellite Technologies

As explained above, satellite technologies have been used to transmit television signals since the early days of the cable industry: in fact, a few years after the introduction of nonbroadcast networks in the mid 1970s, satellite communication became the primary method for cable companies to pick up long distance signals that were retransmitted to cable customers using coaxial cable technologies.

Certainly, non-institutional, individual viewers equipped with satellite dishes existed before 1988, but satellite television transmission to end-users "officially" started its service in that year when it was first regulated by Congress when it passed the Satellite Home Viewer Act and created the satellite carrier statutory license with section 119 of the Title 17 of the United States Code (here thereafter, section 119; Carson 2004).

The evolution of this industry was clearly marked by relatively frequent regulatory changes in a relatively short period of time, mainly to safeguard the existing and regulated OTA and television cable industries. At the time section 119 was enacted, satellite carriers lacked the technical ability to deliver to subscribers their own local television stations. This of course posed a problem as, on the other hand, OTA television stations paid licenses to use the frequencies in their DMA and cable carriers were obliged to deliver the local television station signals to their customers. Therefore, the delivery of the local signal was not covered by section 119, which, on the other hand, divided the types of OTA television signals into two: "superstation" signals (i.e., commercial independent over-the-air television broadcast stations) and network signals (i.e., commercial television network stations and noncommercial educational stations). [80] This division, first of all, was made for the calculation of royalties that satellite MVPDs were due to pay to television stations for re-producing their signal. As it turned out, different rates were paid to the different types of stations: as Congress decided, at that time the rate for a superstation was fixed at 12 cents per subscriber per month and the rate for a network station at 3 cents per subscriber per month. Secondly, while satellite carriers were allowed by section 119 to retransmit superstation signals to subscribers located anywhere in the United States, they were allowed to retransmit network channel signals only to subscribers who reside in "*unserved households*", defined as ones that cannot receive an OTA signal of Grade B intensity of a network station using a conventional rooftop antenna (Carson 2004).

In other words, as the FCC and Congress could not oblige Satellite signal providers to retransmit the local stations to the subscribers residing in that area because of the technical limits of their delivery method, they excluded these providers from effectively generating other competition from the stations using OTA delivery method by forcing them not to delivery *any* of the local stations.

Besides these limits, between 1988 and 1999 the number of subscribers to satellite providers grew considerably: however, if on the one hand, the period between 1988 and 1994 was marked by relative calm for the industry, after 1994 broadcasters started to bring lawsuits and successfully forced the service termination of those customers found in violation of the unserved households rule. Moreover, the Library of congress conducted a Copyright Arbitration Royalty Panel (CARP) proceeding to adjust the royalty rates paid by satellite carriers and by

[80] In the year 2000, the list of nationally independent TV superstations included: KTLA-TV (Los Angeles); KWGN-TV (Denver); WPIX-TV (New York); WWOR-TV (New York); WGN-TV (Chicago); and WSBK-TV (Boston) (FCC 2000).

applying the new marketplace value standard as it was required to do, rates rose considerably (to 27 cents per subscriber per month for each signal) up to a point where they became more expensive than the rights paid by cable services providers (Carson 2004).

Following the protest of many customers, congress issued the Satellite Home Viewer Improvement Act of 1999 (SHIVA). Within this Act, section 122, which allows satellite providers to retransmit local stations to subscribers within the DMA of the local station, also establishes that the retransmission of these signals is royalty free and conditional on a satellite carrier carrying *all* local over-the-air television stations within a given market. In other words, a satellite carrier may not pick and choose which stations in a given local market it wishes to provide to its subscribers residing in that market. Moreover, the SHIVA also reviewed the fair market value rates determined by the CARP and reduced them by 45 percent for network stations and 30 percent for superstations.

Currently, there are still two types of television to satellite delivery services: the home satellite dish (HSD), or large dish, which was the original satellite-to-home service that was offered to end-users. It involves the home reception of analogue signals transmitted by satellites operating in the C- and Ku-band frequencies (generally referred to here as C-band). The satellites in the C-band frequency, however, are used primarily to transmit programming to cable operators. To be authorized to receive one or more scrambled channels, an HSD owner must purchase an integrated receiver-decoder from an equipment dealer and then pay a monthly or annual subscription fee to a MVSP. This service should account for the current affiliation of 270.000 subscribers or less (FCC Media Bureau 2006). [81]

Similarly, the more common, modern and digital system called Direct Broadcast Satellite (DBS) requires a satellite dish (which is smaller than the one required for the HSD), a set-up box and a subscription to a MVSP. This type of service, of which EchoStar and DIRECTV are the two main providers in the United States, has grown to a point where it services now almost 30% of all MVPD subscribers (FCC Media Bureau 2006).

7.3.4.4. Innovations in Other Exhibition Media Outlets

The most diffused method of viewing audiovisual programmes, OTA television is also undertaking some important technical changes: in 1997, the FCC announced the rules governing the mandatory transition from analogue to digital broadcasting or DTV (Corn-Revere & Carveth 2004). Every technical change bears some costs, but also some advantages: other than High

[81] As declared by the two main providers Superstar/Netlink and National Programming Service (NPS), LLC (FCC Media Bureau 2006).

Definition Television (HDTV) for viewers, the most important of these advantages for the service deliverers is probably the capacity of "multicasting". Multicasting allows television service suppliers to broadcast multiple streams of digital television programming using one channel, partially offsetting the traditional problem of frequency shortage. As reported by the FCC, in 2005 already 50% of broadcasters were using multicasting, and 80% of the rest of broadcasters were considering using it (FCC Media Bureau 2006).

Many changes also occurred in the cable distribution industry in this period: a new regulatory framework allowed "overbuilders" to establish a new and alternative network. According to the FCC (FCC Media Bureau 2006), the competition offered by overbuilt networks to the incumbent monopolies is efficient as it drives down the rates and increases the quality of the services.

However, if increased competition is likely to reduce individual cable companies' revenues, the digitalisation of audiovisual media products provided a chance for increasing it: in fact, thanks to digitalisation cable companies were able to enlarge their portfolio of services and increase market segmentation and price discrimination. These services include interactive services such as Video On Demand (VOD), Subscriber VOD (SVOD), Nearly VOD (NVOD) and Digital Video Recorders (DVR) and the less interactive services, which are different ways in which users can access media content independently from televisions schedules.[82] (FCC Media Bureau 2006).

Other than services allowing users to better manage the media content they want to experience, cable distributors offer High-definition television (HDTV) and broadband Internet. The latter of these services has been the main source of revenue growth also by virtue of the many products that can be bundled with it (multiple e-mail accounts, integrated security suites with anti-virus and anti-spyware among others, but also telephony technologies by providing voice-over-Internet protocol [VoIP] services) (FCC Media Bureau 2006).

The last of the changes affecting the cable distribution industry is managerial and marketing-based: these companies have expanded their market segmentation based on "tiers" or packages of channels. From the early division between basic and expanded tiers or channel packages, now there are four distinct services: the basic package, the expanded package, premium cable network services (giving access to nonbroadcast channels such as HBO, Showtime and Starz!)

[82] VOD subscribers can order and have access (for a given period of time, which is generally 24 hours) to video programs that are downloaded from a central server, at any time of day. With Subscription video-on-demand (SVOD) in exchange of a monthly fee, users access an entire library of movies. With NVOD programmes and events are offered on a staggered-start basis (e.g., every 15 to 30 minutes) using several channels. DVR service allows subscribers to record programmes onto a hard drive located in a set-top box (FCC Media Bureau 2006).

and a per-channel service (i.e. pay-per-view channels) . As explained above, feature films and television programmes are normally released in a series of windows: the supplemental fees users pay for the advanced services give access to the nonbroadcast channels that air some of the programmes first and months or even years in advance of the OTA television networks (FCC Media Bureau 2006).[83]

The last strand of innovations we review here concerns the use of the Internet as delivery method for audiovisual media products. The delivery of video through the Internet has been made possible thanks to the advances in compression and decompression software technologies. In fact, in order to download and view a video of a certain quality standard, at the moment defined by the MPEG-2 standard, a connection of minimum 1.5 Mbps is required. This kind of connection speed is relatively common for a broadband service.

Internet based delivery systems present a lot of potential, as they can be used to display the same videos from different platforms, for example, personal computers, handheld devices or mobile phones. Although, these systems are relatively new (the diffusion of broadband access is an enabling factor for their diffusion), they are also the cheapest of all the delivery systems: given the plethora of video producers and packagers that have access to it, here we are only going to briefly outline some of the main uses.

First of all, it is necessary to make a distinction between how professionals and non-professionals of the audiovisual media content industry use these systems. On the professional side, feature film distributors use the Internet as a marketing tool and to diffuse their movies' trailers.

On the other hand, as reported in the annual report by the FCC's Media Bureau (2006), channels such as CBS News, CNN, Comedy Central, and Nickelodeon offer 24-hour web access to some regularly featured television programming. The purpose of offering streaming video on their websites is to increase access to and supplement their regular television programming content.

On the non-professional side of audiovisual content supply, the popular, Google-provided "YouTube" portal demonstrates how virtually anyone that is (although, possibly above the average) computer literate, can create their own video broadcasting programmes. The rationale for producers to post videos on this portal is mainly and simply file-sharing.

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[83] Digital cable services' users can also choose among theme tiers, such as a movie tier, a sports tier, and a non-English-language tier (FCC Media Bureau 2006).

Probably, the fastest growing and at the same time least known area of development, resides in the delivery of audiovisual content for the semi- or small professional (small television network or production companies) video producers. Online distribution interfaces such as DaveTV, Brightcove, and Wi-FiTV can be considered part of this category (see FCC, Media Bureau 2006).

7.3.5. Regulatory Changes and the Consequences on Diversity

So far, we have analysed the changes occurred in the audiovisual media service industry in a way that will allow us to understand what is really changing in this sector from an organisational perspective and to propose an alternative standpoint about the effects of mergers and acquisitions in the information sector on the consumer. However, the recent wave of regulatory changes has been particularly criticised by those scholars mainly concerned with the consequences of these changes for the citizen. We find interesting to summarise some of their arguments in order to highlight the fact that different approaches can lead to a different set of suggestions.

Interestingly, both the Good Regulator and its main critics stress the importance of widening media content *diversity*. These two approaches, however, diverge on the principal meaning of diversity, on the consequences of promoting this value and on the existing ways that exist to promote it. The FCC evaluates different types of diversity: viewpoint diversity, program diversity, source diversity, outlet diversity and minority and female ownership of media facilities. Viewpoint diversity contributes to policy goals by contributing to the democratic process, while program diversity improves consumer welfare as it increases the range of products available. Outlet diversity contributes to policy goals only indirectly by influencing viewpoint, source and program diversities (Wildman 2008). Apart from the issue of ethnic and female media ownership (which is under consideration by a specific working group) the FCC (2003) maintains that the last round of regulatory changes of which the 1996 Telecommunication Act is the most important milestone, is improving diversity by increasing competition in media markets.

The main principles of the current *Good Regulator*'s argument can be summarised as follows: digital convergence transformed the media landscape and allowed different systems (e.g. cable, satellite and wireline signal providers) to compete in the same markets (e.g. MVPD, broadband internet) and the 1996 Telecommunication Act and subsequent regulatory changes promoted competition *between* these systems.[84] Moreover, although restrictions to concentrations were partially relaxed - especially between companies serving different markets in the "pre-convergence-era", such as between AOL and Time Warner Inc.- these changes, it can be argued, are still in the public interest because the benefits from this concentration (e.g. economies of scale, scope and increased potential for innovation) outweigh the shortcomings (i.e. reduced source and viewpoint diversities).[85]

Commentators from the political economy of communications' literature have proven critical of this regulatory justification. As explained above, these scholars are more interested in the consequences for the citizen as opposed to those for the consumer. Although there does not seem to be a unified theory defining what exactly are the citizen's basic communication needs, which can be affected by media regulations, McQuail's social normative approach certainly provides an excellent synthesis of the existing different concepts. McQuail (1992) finds that the public interest can be considered to be composed of three "composite"-pillar values: (1) Freedom, (2) Order/Solidarity and (3) Justice/Equality.

Freedom is a value that concerns three main aspects of communication: the first is related to content delivery, the second to citizens' access to communication channels and the third to the variety of communication channels that are accessible. Moreover, justice and equality are considered together as they are closely related: in the field of communications, the various channels play a fundamental role in publicising processes of justice and expressions of grievances. In order to accomplish this role, content and access to communication channels should be equal. Moreover, equality in terms of media content is subject to two main conditions: equality of access, as in "absence of discrimination" and a proportional distribution of audience demand and interests, and objectivity. The values of Order and Solidarity refer to the role of the media in creating and maintaining social harmony and cohesion in society (McQuail 1992). Changes that favour diversity (as defined above by the FCC, for example) are in the public interest and represent an improvement for the citizen, because they serve these values: for

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[84] As explained by the FCC (2003 p19): "The 1996 Act reinforces the link between competitive markets and the public interest. One of the central aims of the 1996 Act was to introduce competition to communications industries that traditionally have been thought of as natural monopolies."

[85] As explained by Horwitz (2003) the widespread assumption underpinning the 1996 Telecommunication Act was that constructing competitive communications networks would be high-risk, capital intensive endeavours requiring the resources of large and flexible corporations. Moreover, as the FCC states (2001 p4): "The balancing of potential harms and benefits to the public interest is particularly appropriate in the context of reviewing license transfer applications that are associated with significant mergers because such mergers are likely to create potential for both good and ill. For example, the same concentration of assets that may support technological innovation by providing sufficient capital to take the necessary risks or by reducing transaction costs may also allow the merged entity to create or enhance barriers to entry by its competitors. As a result of this ambiguity, the outcome most favorable to the public interest, in terms of the policies and objectives of the Communications Act, is often best achieved by allowing the transfers, and thus the associated merger, to proceed (thus obtaining the positive benefits of the combination), but only subject to certain conditions, either voluntarily agreed to or imposed by the Commission under its statutory authority, designed to minimize the potential harms or increase the potential benefits."

example, freedom of access fosters viewpoint and source diversities, while equality can be promoted by minority and gender ownership diversity.

Seemingly, the most important divergence of opinions between the Good Regulator and communications scholars concerns the *inter-platform* concentration of ownership. For example, the Good Regulator standpoint seems to be in line with findings provided by Milyo (2007 cited by Connolly and Kwerel 2007) published by the FCC itself, which argue that there is no proof that inter-platforms concentration of ownership affects diversity. This author demonstrates his point by using the coverage of the elections and by showing that there is no difference between television stations that are cross-owned with a newspaper relative to television stations in the same market that are not cross-owned. Wildman (2007), on the other hand, criticises the results provided by this type of empirical analysis by explaining that frequency of viewpoints should not be sought only in news and current affairs program, but in all types of programming.

The potential of the World Wide Web to promote viewpoint and source diversities and the effect of relaxed concentration of ownership rules affecting this potential is also the subject of an intense debate. Some communications scholars denounce the fact that, although the Internet provide an opportunity to increase the range of media contributors and therefore to foster viewpoint and source diversity, because of the enormity of information available to users, the role of gatekeepers such as ISPs and search engines is key to direct audience to the available content. Therefore, the vertical integration between content providers with internet providers is likely to limit the diversity potential effect of this medium (see Blevins 2002, Hargittai 2003 and Hindman and Cukier 2003).

Our findings provide further insights to this debate. In the next chapter and in Chapter Ten, we will argue that vertical integrations in the information industries do not necessarily increase the innovation potential of a conglomerate; on the contrary, in virtue of the existence of technological trajectories and as demonstrated by the poor results of the merger between AOL and Time Warner, especially in periods characterised by rapid innovation patterns mergers between different media outlets can reduce the rate of innovation. Therefore, given that the Good Regulator considers the loss of diversity caused by the relaxation of concentration rules, as a price to be paid to obtain more innovative and efficient information conglomerates, we signal that alternative economic theory may lead to the conclusions that this price is even dearer then commonly thought.

7.4. Some Conclusions and Interpretations

We present some conclusions about the dynamics of the audiovisual media services throughout these three phases; a more in depth analysis of the evolution of this media sub-sector, however, is going to be the subject of the next chapter.

First of all, we have briefly represented the "neo-Schumpeterian characteristics" of technical innovations in this sub-sector: influential technical changes are the result of a gradual process, and the more important the innovation, the longer the process leading to it; the time lag between their invention and their diffusion is relatively long (generally, ten to twenty years). Moreover, as the many examples provided in this chapter demonstrate, regulatory changes and institutions more generally play an influential role in the selection process and the diffusion of a new technology.

Secondly, we have tried to provide a "sense of direction" of these innovations. As the neo-Schumpeterian literature illustrates, among all the inventions, only a few become innovations and this because of the "social" or demand side of technical progress: here we have mentioned that audiovisual media services are developing a diversity of delivery methods resulting in the viewer's ability to differentiate between audiovisual products and (better) choose the conditions of their consumption. We named this situation, the customization of audiovisual product to draw a parallel between the trend in this sub-sector and the same trend that is affecting other industries (e.g. the computer industry).

Thirdly, as was the case in the other chapters, we have paid much attention to non-technical innovations, whether stylistic, managerial, regulatory or organisational. Clearly, as explained above in the previous chapter, it is important to understand and catalogue these innovations: some industries/modules are not in a position to generate technical innovations (e.g. OTA television packagers) and therefore other types of innovations (e.g. genres and formats) should be understood in order to grasp an industry's inclination to innovate, and if this increases or decreases following other changes, such as the introduction of new regulations.

Moreover, the role of non-technical innovations should not be underestimated as they can be responsible for important "architectural changes": for example, the new revenue sharing regime in the Home video industry changed the relationships between modules participating to this market and revolutionised this business.

Chapter 8 - Technical and Social Changes and the Economics of the Audiovisual Media Services

Many economists would agree that of the three sectors included in this study, the computer industry, telecommunication and the media, the latter is certainly the most *peculiar* in terms of sectorally distinctive characteristics. For obvious reasons, it is possible to make such a statement when there is a common understanding on what constitutes the *norm*. As explained above, this norm, we think more implicitly than explicitly, is a type of industry that is more closely matching the assumptions or key concepts of mainstream economic thinking.

Neoclassical theories are certainly very useful, when they are applied to specific environments and in order to answer specific questions and to forecast short term economic trends. These theories are focussed on the offer/ production side of activities. However, most of the activities that are considered part of audiovisual media services nowadays present many characteristics that make them significantly different from the Fordist type of production activities, from which mainstream economics theories are derived.

In this chapter, we summarize and present some of the economic dynamics that we have described in the evolutionary account of the previous chapter. We discuss these dynamics and we can compare our analysis to the neoclassical viewpoint. As a result, we comment on some of the features that makes this sector *peculiar* and we try to do this in a way that is “compatible” with mainstream economics. These features include a notion of “quality”, the impact of new technologies on the economic performance and on the organisational structure of the sector. In light of our findings, we also discuss the fitness of the current regulatory framework affecting this sector.

8.1. The Audiovisual Content Industry: Activities’ Categorisation and Beyond

Given the evolution and the current setting of the audiovisual media services as described above, we realize that there are several important differences between home entertainment rental and retail services than the one that is most obvious when these two types of services are compared; i.e. in the case of the former, the provider gives the user access to a prerecorded DVD (or other formats) for a *limited* amount of time, while in the case of the latter, the users gain access for an *unlimited* amount of time as the property of the disc is transferred to him or her.

Alternatively, we could take a different viewpoint and go beyond the "primary task" of the provider/producer, to look more closely at the relationship between providers and users, and talk about *primary* and *secondary* home video services, both being services that provide feature films to be used in combination with home entertainment systems. Primary video services benefit from an "exclusivity window" as they are allowed to release feature films for home entertainment systems before any other types of services and this exclusively for a limited timeframe. Moreover, the service is offered only by a (relatively) more limited number of specialized shops, and generally the length of the consumption timeframe is limited. Recent innovations (the diffusion of ICTs and the revenue sharing agreements between the rental shops and distributors) have led to new forms of these services and therefore modified their characteristics. In sum, they (1) facilitated the access to these specialized shops (as many can be reached now online), (2) extended the average length of the consumption timeframe (as most of the online rental shop do not pose strict time limits), (3) further standardised the relationship\agreement between provider and the users (and in the case of online shops, fines for returning late movie copies are not contemplated) but (4) reduced the length of the "exclusivity window", as DVDs go on sale faster than they used to before the diffusion of the revenue sharing agreements.

Secondary home video services are available from more retail shops and they provide unlimited views. Although they release movies later than the primary services, they still have the privilege of being able to release them before other audiovisual content delivery systems (e.g. OTA television networks). With this example we are trying to explain the relationship and characterise the exchange between users and providers; more specifically, we are seeking to grasp the entirety (the different forms) of this relationship.

The recent changes from the SIC accounting system to the NAICS accounting system in 1997, and its subsequent revision in 2002, aim to better address the increased share of service activities in the U.S. economy. However, the main viewpoint informed by this system is still the one of the production (and therefore it is more suited for an economy based on manufacturing activity): activities making goods are grouped together and so are wholesale retailers, and so on.[86]

I wish to argue that a *service activity* should not be identified with one characteristic or with its main output, as the NAICS implies, or be stripped down to a list of products to look for links

[86] Another approach that has been recently developed and focused more on the demand side, is the North American Product Classification System (NAPCS). According to the Economic Classification Policy Committee (ECPC) "NAPCS will develop a demand-based, hierarchical aggregation system, in which products are grouped according to how they are principally used and according to how they are used in relationship to each other in satisfying that principal use." (U.S. ECPC 2003 p2). See the North American Product Classification System http://www.census.gov/eos/www/napcs/napcsproductlists.htm

between these products, as articulated in the new North American Product Classification System (NAPCS), instead of being understood as a combination of different options with different characteristics. What we propose here is a perspective that totally embraces a service activity viewpoint, to better understand the evolution of the audiovisual content industry. This includes overturning the general understanding about manufacturing and service activities: instead of service activities being everything that is not part of good-producing activities, good-producing activities should be understood as a subset of the service industries.[87]
For example, as indicated in Chapter Three, we can use Gadrey's (2000) definition of a service activity (*An operation aimed at the transformation of a reality C, owned or used by B*) without the "exclusion clause", and focus on the relationship between user (B) and provider (A), instead of the shape and form of the product (C) and classify manufacturing activities (at the highest level) as those activities where the "transformation" involves the change of ownership by the simplest and most standardised of the procedures: trade.[88] What is seemingly proposed by the NAICS and the NAPCS, on the other hand, is to describe and classify the provider and the reality used, or, in other words, the A and the C elements of the service triangle.[89]

In the specific case of the audiovisual media services, the activities that we have described in this part of the study, at some aggregation level should be categorized following the same "value chain" categories we have used above: (1) production and post-production activities, (2) packaging, marketing and distribution, and (3) exhibition and delivery of audiovisual content.

Moreover, looking at the audiovisual content industry in its entirety, as a service industry including the audiovisual input, the form and the conditions attached to the use of this reality "C", helps us understand what features viewers appreciate and are willing to pay what we will refer to here as a *premium price*. In other words, we can rationally define some "objective" qualitative criteria for the service, as this is shaped by different stages and finally delivered to the users. Very simply, in the case of the service delivered by this industry, price can be understood as *the value every user gives to each experience generated by the single viewing of an audiovisual product.*[90] Some of the prices of the services offered in this industry as they are indicated, strictly adhere to this definition: cinema tickets or pay-per-view shows and programmes on encrypted cable channels, for example. In the case of other services, this

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[87] This definition of a service activity as "not a good producing activity" is referred to as the "broad definition of a service", as explained in U.S. ECPC 1994

[88] The purpose of the exclusion clause, "the output of which cannot circulate in the economy independently of C", is in fact to exclude manufacturing activities from the definition (see Gadrey 2000 p376).

[89] Although we do not have many details on future use of the NAPCS.

[90] We choose a single experience as a unit of measure, in order to be able to compare prices.

definition of price would need to be computed because the actual price paid might give rights to more "experiences": e.g. DVD rental or sale. In both these last cases, one can establish an average number of "experiences" viewers benefit from this service and compute a price per unit. In the case of some other audiovisual media services, the price is not directly paid by the viewers but by third parties (advertisers or airline companies), but the value per view / per users, can still be estimated.

So, with this in mind, we assume that companies try to maximize the revenue from their expensive "original", partly by financial (and profit maximization) calculations, and partly by a more evolutionary trial and error process (i.e. various reactions by the industry to signals from the market). As a result of this process, the highest price users pay for their viewing experience is attached to the first release window of an audiovisual input, the cinema theatre, which presents some specific characteristics, and the lowest price is attached to the last one, OTA television, which presents other specificities. Therefore, we ask ourselves: "what features enrich the viewers' experience and increase their utility, so that to justify the difference between the (let's say) five cents paid to watch a feature movie on OTA television (although, these five cents are subsidized by advertisers) and the seven dollars paid to experience the same feature movie in a cinema theatre?"

We refer to the increase in price between the different windows as the price premium (as it is a premium for the producer, who creates the conditions for the viewers' experience) and by answering this question and keeping in mind the characteristics of the service offered by the different windows, we can interpret the user's value of these characteristics.

We can summarize these characteristics under three headings. (1) The *novelty* of the experience: according to this characteristic, viewers are willing to pay a price premium that is inversely proportional to the duration of content's circulation in the market, but also associated with the assumed innovative style of the product and/or experience. According to this last characteristic, the most original ideas are rewarded with larger audiences and revenues. (2)The second heading we identify is the *definition* of the experience. Under this heading we include two main characteristics; how the technical features of the form shapes viewers' experience in the exhibition phase and the completeness and accuracy involved in the production of the input. According to this characteristic, viewers pay a price premium to be more "immersed" in the experience (a higher premium for bigger screens and high definition), and to see feature films produced with larger capital, with more and better (most famous) actors, more digital effects, attention to details, the best original music, and so on.

The last of the three headings is (3) *User's customization*: the more a user is able to customize the audiovisual experience (the independence in terms of time and place of the consumption of the experience), the higher is the premium s/he is willing to pay.[91]

We believe that it is possible to establish (at least) ordinal measures for the different characteristics and provide an empirical dimension to this definition of quality, although this is a task that cannot be performed in this research.

8.2. The Creative Input and the Economic Performance of the Audiovisual Industries

In this study, we have analysed, explained and re-evaluated Baumol's intuition about the economic dynamics of the cultural industries. We take on board the side of the intuition implying that there are aspects of human contribution to economic activities that are irreplaceable by technologies and that these affect the economic performance (as framed by mainstream economic theories) of activities that are more or less dependent on this type of contribution.

Moreover, we have redefined and reworded this type of human contribution into the notion of *creative input,* or *labour's originality of ideas, concepts and actions and the capacity of troubleshooting and finding solutions*; this includes the generation of creative content and ideas, what Baumol defines as the extension of the live performance (the contribution of actors and musicians to which we also add those of sport performers), as well as personal services.

We have demonstrated in Chapter Three with two empirical exercises that, generally speaking, the more activity outputs are dependent on the use of the creative input, the more stagnant they are. This implies that the productivity of the labour employed does not increase in the long run and that its cost increases in relation to the cost of products made or delivered by progressive industries. Moreover, the share of labour employed in stagnant activities increases and so does the total cost of their labour.

In light of the evolution of the audiovisual media services as we have outlined it in the previous chapters and of the existence of a creative input and its consequences for the economic dynamics, we would like to discuss and provide some conclusions here about our analysis of the economic consequences of technical change in this media sub-sector.

As we have indicated several times in this text, there are different viewpoints from which we can explain the trends of the audiovisual media services: if we consider the mere production of

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[91] As demonstrated by the price premiums paid by users in order to benefit from a larger degree of customisation: Broadcast television is cheaper than NVOD, which is cheaper (per movie) than Disc Rentals, etc…

video content, we can certainly affirm that technology has decreased its costs. It is easy to illustrate such an affirmation: in fact, in the Golden Age of the Hollywood studios, a few hundred movies per year were shown in cinema theatres and they were the only audiovisual media product available. Less than a hundred years later, however, thousands of videos are made available each day from the YouTube portal, which is one of many exhibition outlets.

However, the cost (or the budget) of making blockbuster movies or professional-standard television programmes, on average, has not decreased following the introduction of new technologies. We could argue with a neoclassical viewpoint affirming that the conditions of the market are not perfect and therefore the theoretical economic dynamics as mainstream theories predict might not be at work. However, it is more useful to think along the lines that the audiovisual content industry and its products are not directly comparable with neoclassical-types of industries and its goods. Instead of the search for standardisation, the search for originality (in some forms) and diversity is the intrinsic characteristic; in most cases and especially in the case of the leading edge audiovisual products, investments in technologies are made to increase their quality not to increase the productivity of the factors of production; finally, profits, which are the main driver for production, are not sought by trying to increase the quantity of production nor by competing on the pricing.

Therefore, an economic analysis of the effects of technological change on the production of the audiovisual content industry cannot be fully understood if considered separate from aspects of demand, or more generally, from the "service" aspects of the industry and the different forms that its products assumes.

The evolution of this media sub-sector as we have outlined above shows that the audiovisual content industry is confronted with the issue of the stagnancy of its content-input, and that this issue has been dealt with the constant introduction of innovations. In Chapter Seven, we have seen that the major Hollywood studios had to change their organisational setting and switch to a project-basis type of organisation (copying independent productions) because having performers on their payroll on a constant basis was becoming financially unsustainable (also given the changed regulatory and market circumstances). Moreover, in the years that followed the diffusion of television, the increase in the cost of producing blockbuster movies and television programmes was possible thanks to the increase in the number of media outlets and the extra revenue generated from the different windows. In other words, for much of its history, the audiovisual content industry in its entirety presents the characteristic of what the theory refers to as an asymptotically stagnant sector.

On the other hand, it is difficult to predict the future evolution of this industry: the cost / budgets of content production might continue to increase, unless media markets experience a trend towards saturation. This trend towards saturation of a media market could be a situation in which, for example, there are too many broadcast and nonbroadcast networks and each channel's revenue from advertising becomes rather thin and their financial situation unsustainable. If this should happen, competition might be re-defined and productivity might become a more important factor of production.

In certain branches of the audiovisual media services, we might be already experiencing this change of trend: in fact, quiz and reality shows are becoming popular on broadcast and nonbroadcast television networks (Einstein 2004). Although (especially) the latter can represent a new format and a successful stylistic innovation, they are also cheaper to produce than the staple products of the past, i.e. the sitcoms. Alternatively, an excessive increase in the cost of programming and film production can be avoided by regulatory changes, as these types of changes can redesign the shape and extent of competition (as occurred in the past, for example, with the fin-syn rules and the results of the Paramount decisions).

Moreover, if we consider value-chain stages of the audiovisual content production, as Baumol et al. (1985) explained when describing the stagnancy of OTA television production, we find that at the top of the vertical division, stagnant activities, and at the bottom of the scale, the most progressive.

We find that organisational changes are a very important part of the innovation process; in fact, the organisational structure is often a direct response to certain technical change and it influences the effects and the shape of regulatory interventions, which can determine the pace of innovation in the sector, as explain in more detail below.

8.3. Innovation in the Media Industry and the Evolution of the Organisational Structure

In this research we have appropriated and illustrated an important concept of modularity. In the words of Pavitt (2005), as products increase in complexity, the number of modules increases and so does the range of fields of specialized knowledge the production of a system needs to draw from.

As explained in Chapter Seven, the number of activities in the audiovisual content media industry has increased as a consequence of the introduction of a cluster of technical inventions, some radical and some incremental, leading to new revolutionary products in the industry and followed by an important number of organisational, stylistic, managerial and regulatory changes that have transformed these products into new markets or sub-sectors. As an example, several fundamental and incremental technical innovations led to the creation of television and the

VCR, but a much larger number of other types of innovations transformed these tools into the main objects of the television and home entertainment industries respectively.

The modular theory viewpoint considers the advantages and disadvantages of having different modules integrated or simply interconnected. When we transpose these principles to service activities, instead of technical or logical interfaces, we look at the procedures that are used to combine two modules to see if they can or cannot be standardised ("the rules of the game"), because the relationship between users and providers, for example, might require tacit knowledge or contingent negotiations (or is characterised by *hidden rules*, to use a concept of the modularity literature).

In the evolution of the audiovisual media industry we have found two main types of activities that have experienced important changes towards a standardisation of the relationship between users and providers. These industries are the Cable Distribution industry and the Video Tape and Disc Rentals. In the first case, the Cable Compulsory License Provisions of the 1976 Copyright Act eliminated the need for bilateral negotiations between cable providers and television networks, making cable operators more independent and facilitated their operations and innovation routines (see section 7.2.3). For example, companies in this sector primarily compete on the content and the price of packages of channels that they can offer.

Thanks to the 1976 Copyright Act, changing the form of the packages offered to users requires economic calculations, the variables of which are already known because they are the number of subscribers and the royalty fee rates as they are determined by the Copyright Office and the Copyright Royalties Tribunal. Therefore, cable companies are able to innovate more independently and (apart from a few particular channels) without engaging in long negotiations with broadcast and nonbroadcast networks.

In the 1990s and at the time of this vertical modularisation (i.e. the establishment of standard rules between this industry and the distribution of audiovisual media inputs) the cable industry also undertook a process of innovation based on horizontal integration and the search for economies of scale, with the process of clustering as described above (see section 7.3.1 or Parsons 2003).

Similarly, in the case of the Home Entertainment industry, tapes and DVD rental outlets can benefit from a high degree of independence from the activities occurring above them in the value chain. Under the "old" regime, they would pay a wholesale price for tapes to be rented, and a sell through price for tapes to be sold. Moreover, distributors were responsible for the length of the window of the "exclusive" right to rent out new feature films the Home Entertainment industry benefits from. Under the new regime of rental sharing, Video and Disc

Rentals have more freedom in deciding (1) how many copies to buy (as the fixed cost is much lower), (2) for how long they can be rented and (3) when to sell the extra copies and at what price (see Dana and Spier 2001; Chiou 2006).

Here we claim that because of such standard rules, these industries are proper *modules* of the audiovisual content sector-"system" and this is because they are interconnected, but not integrated with the distributors. Therefore, because of these rules, they can work in combination with their own providers (at least) as efficiently as other similar industries that are more integrated. At the same time, however, in light of the modularity principle of increased local research, they can be more innovative.

Table 6: Exhibition Outlets, the economic performance of modular versus integrated

	OUPUT (Volume)		OUPUT per worker	
	1987-1995	1996-2004	1987-1995	1996-2004
Video tape and disc rental	111.85%	70.95%	43.55%	75.90%
Motion Picture and Video Exhibition	24.30%	17.51%	10.25%	4.88%
Cable and Other Program Distribution	33.77%	77.48%	-7.25%	32.67%
	OUPUT (Volume), annual average		OUPUT per worker, annual average	
	1987-1995	1996-2004	1987-1995	1996-2004
Video tape and disc rental	8.29%	7.10%	3.03%	7.49%
Motion Picture and Video Exhibition	3.06%	2.08%	1.18%	0.62%
Cable and Other Program Distribution	4.39%	7.45%	-0.82%	3.67%

Source: calculated by the author, from data published by the BLS.[92]

Consequently, in order to provide some empirical evidence, we take the *Video Tape and Disc Rental* (NAICS 53223) and *Cable and Other Program Distribution* (NAICS 5175) industries and we compare their economic performance with *Motion Picture and Video Exhibition* service industries (NAICS 51213). Here we have taken a particular interest in the period post-1996, the year that is frequently assumed to have marked the beginning of the New Economy and more specifically, of the large economic effects from the diffusion of ICTs.

The relationship between feature film distributors and exhibitors is characterised by relational contracting and therefore these two industries can be considered to be vertically integrated - and this independently from the fact that they might or might not belong to the same information conglomerate. Moreover, as explained above, movie exhibitors have undertaken a process of modernization characterised by more classical and manufacturing-type organisational innovations: cinema theatres have merged, economies of scale were sought and as a

[92] Indexes of Output and Output per person can be found on the BLS web site <http://www.bls.gov> under *Productivity and Cost*. The data used in these calculations was retrieved in January 2007

consequence, although the number of screens has increased, the number of single (or few) screen establishments decreased in favour of the diffusion of large multi-screen complexes.

All of these three industries, therefore, can be said to have been active innovators in the past decade: the first two (i.e. Cable and other Program Distribution and Video Tape and Disc Rental), we claim, were in a better position to benefit from technological change because of their organisational structure. The figures published by the BLS comply with our thesis, although they cannot confirm it because, of course, the economic performance of these industries depends on a number of idiosyncratic factors and not only on the organisational form.

In fact, as Table 6 shows, the Video Tape and Disc Rental industry has known a very rapid output growth, equivalent to an average annual increase of slightly over 8% between 1987 and 1995, and over 7% between 1996 and 2004. The Cable and other Program Distribution industries, on the other hand, have experienced a slower output growth in the first period (4.4% on average per year), but much faster in the second period (7.45%). By contrast, the Motion Picture and Video Exhibition industries have experienced an average annual increase of just over 3% in the first period, and only 2% in the second period (i.e. between 1996 and 2004).

This increase in output is coupled with a rapid increase of labour productivity in the second period (1996-2004) in the case of the Video Tape and Disc Rental and the Cable and other Program Distribution industries. However, besides the efforts made to achieve economies of scale, the Motion Picture and Video Exhibition industry productivity estimates show an average annual increase of just over 1% in the period between 1987 and 1995, and even lower, reaching 0.6%, in the period of general more rapid economic expansion, i.e. between 1996 and 2004.

Comparing the organisational structure of the audiovisual media industry to a system composed of different modules and concentrating on the form of their relationships, is certainly an innovative approach. This approach can also provide interesting insights into the relatively recent debates around the post-Fordist shape and organisational structure of the production process. Storper and Christopherson (1987) indicate the 1940s as the period when the production of audiovisual content (at the time, the film industry) shifted from a Fordist type of organisation characterised by techniques of mass-production, to a more flexible and vertically disintegrated and therefore post-Fordist type of organisations.

Opposing this argument, Aksoy and Robins (1992) argue that the most important feature of the production process in the Fordist era was that the Hollywood Majors could control the different stages involved in the production, distribution and exhibition phases of the film industry. This remained a key characteristic of the film industry after the 1940s, although the Majors were exercising indirect control of certain activities deemed to be separate entities.

Storper (1993) later replied to these criticisms of his analysis by stating essentially that he never questioned the extent of the power of the Hollywood Majors in the post-Fordist era. Rather, his argument focussed on the ability of the new organisational structure to provide more original and better products, and on the Majors' choice of converging towards this new structure contrary to the economic belief that integrated organisations could derive the benefit of economies of scale and therefore reduce costs.

Our analysis adds some new insights to this debate: first of all, we think that Storper was right in replying that the Majors' power over other companies providing services to them was not a fundamental question in his analysis.

The modularity literature suggests that contemporary production processes and organisational structures are the evolutionary result of technical change. As a result of technical change, the number of tasks increases and the quality and extent of different knowledge necessary also increases. On the other hand, although technical progress enlarges the number of tasks and activities that are part of a production process, the extent and the form of ownership within the industry that incorporate this production process is determined by economic factors.

In other words, the number of complementary tasks involved in the production of a complex good or the delivery of a service increases with technical change, and whether companies decide to undertake these tasks inhouse, outsource them, or simply buy them depends upon which option produce the greatest economic benefit.[93]

However, in the case of the audiovisual media services (and of the media more generally) the extent of the accumulation of production processes under a single corporation's ownership is mainly determined by regulatory measures, as will be explained in more detail in the next chapters. For example, at the end of the Golden Age of the Hollywood Studios, new media activities were created following the introduction of television. Throughout the history of the audiovisual content, however, the ownership of, or affiliation to the studios generating most of television programming was determined by the imposition of the fin-syn rules, and their consequent relaxation years later.

Moreover, and more importantly, although there are many ways of defining the shift towards a post-Fordist production, we propose that history-friendly economic theories provide the best way of defining this trend. As the neo-Schumpeterian school of thought suggests, new modes of production are typical of a long wave of economic development and they are linked to the

[93] As explained more in detail in the next chapter.

innovations that characterise the wave and therefore they have similar effects across various industries. Post-Fordism, as Allen (1992) generally defines it, is a response to the problems of Fordism and it is associated with flexible production and, in contrast to the principle of mass-production, it is a mode of production that attempts to respond to the increased variety of consumers and fragmented market tastes.

From the evolution of the audiovisual content media industries, we understand that technical progress increases the number of activities or modules, and that this is an enabling factor and an opportunity to increase the number of participants in the sector. However, as the neo-Schumpeterian school of thought suggests at a macroeconomic level, i.e. technical innovations need to be accompanied by corresponding social and institutional innovations (forming the socio-institutional climate) that match the techno-economic paradigm (see Perez 1986). At the level of audiovisual content industry, there is certainly an *ideal* - most suitable - regulatory framework (also determining the extent of the ownership of several audiovisual media activities) matching the current economic reality and wave of innovations.

In light of the viewpoint proposed, we now move to discuss the fitness, rationale and the effects of the recent waves of deregulation in the audiovisual content industry in the current period of a rapid technological change.

8.4. Mergers and Acquisitions in the Era of Digitalisation of Audiovisual Media Content Industries and the Fitness of the Current Policy Framework

So far, we claimed that in the case of the audiovisual media services, the existence of several different activities is enabled by technical change, while the structure of ownership of these tasks is more frequently determined by the regulatory framework or, at a higher level, by the socio-institutional climate. Here we review the rationale for mergers and acquisitions within (i.e. horizontal) and across (i.e. vertical) the different stages of the value chain that we have used in this research, i.e. (1) production and post-production; (2) packaging, marketing and distribution and (3) delivery and exhibition of the audiovisual media content industry.

What we are particularly interested in, is that following a merger or an acquisition, two companies are integrated together and when one is the provider of the other, there is less need to establish a formal, standardised procedure in order to interact. We treat relational contracting in the same way as we treat mergers and acquisitions, because of the form of this relationship, and therefore we refer to both case scenarios as to “integrations”.

As explained above, in this chapter we will focus attention on economic theory. Through economic theory, we will explain the rationale for these integrations from two different perspectives: that of companies in the audiovisual media service industry companies’ and of the

Good Regulator's. These perspectives can be found in the various *Reports and Orders and Notices of Rulemaking* that the FCC uses to justify their decisions. We will argue that the current regulatory framework is influenced by the basic mainstream economic approach, and we will provide an alternative to this viewpoint from another economic perspective, institutional and evolutionary. As we have already explained in section 1.3.2, however, mergers and acquisitions are approved by the regulator despite the negative effects that they can generate for consumers (e.g. see section 7.3.5).

However, from an economic viewpoint, media companies view horizontal integration favourably, first of all, because of what, in short, we could refer to as the logic of the three "s": economies of scale and scope and the realization of synergies.[94] Secondly, media companies are interested in horizontal integration in order to increase their power in the different markets they serve. In markets where there are barriers to entry, by gaining monopolistic power, firms increase their profits (as mainstream economic theory suggests).

Many market segments of the audiovisual media content industries present barriers to entry. The most common of these barriers are a high level of capital investment and access to tacit knowledge. For example, feature movie production generally requires tacit knowledge of the various networks of workers (see Lampel and Shamsie 2003), a high level of investment and a distribution contract, which is also said to be obtained by tacit knowledge. Similarly, feature film distribution generally requires tacit knowledge to obtain contracts with exhibitors (see Scott 2004), while the distribution of programming by cable also requires a very high level of investments.

Therefore, economic theory indicates that media industries have a lot to gain from integrating horizontally and they probably would do so more often if this integration might reduce consumer welfare, the maximization of which is a prerogative of the *good regulator*.

Therefore, the *good regulator*, on the other hand, can theoretically be in favour of horizontal integration among media companies when the benefits realized by economies of scale and scope and other synergies are passed on to the consumer in the form of new, better or cheaper goods and services. This is also justified by the shared assumption or understanding that the bigger the company, the larger is the amount of resources that can be invested in innovative activities. Consequently mergers and acquisition are likely to boost the rate of innovation.

[94] Very briefly, we define economies of scale as the capability of reducing production costs; economies of scope, as the ability to reduce costs by combining different products/functions, while the realisation of synergies, a concept that can include both economies of scale and scope, more generally defines the possibility of combining different production processes and products in strategic and innovative ways.

On the other hand, the *good regulator* can be against horizontal integrations, when it estimates that the negative effects of the reduced competition (monopolies or cartels, uncompetitive behaviour, reduced rate of innovation) can offset the potential benefits to the consumers as we have described above.

In our historical and evolutionary account of the audiovisual content media industry we find many examples of "pure" horizontal integrations (i.e. between similar activities) which take place in a period of general relaxation of media ownership restrictions, and are mainly justified by the search for economies of scale. As noted above, in the 1990s, the cable companies made efforts to cluster their services (see Parsons 2003) while the motion picture exhibition industry looked for the benefits of economies of scale and scope by establishing the multiplex cinema model.

We also find examples of regulations prohibiting horizontal integration: for example, the new limit of a conglomerate ownership of television stations in the USA is set to a cumulative reach of a maximum 35% of the total population (from the previous 25%), and this since the last change in regulation with the Telecommunication Act of 1996 (Corn-Revere and Carveth 2004).

Not surprisingly perhaps, media companies also view vertical integration favourably. First of all, for the same reasons that they might be in favour of horizontal integration: economies of scale and scope and the realization of synergies. Although economies of scale can be realised because companies providing different activities can group together certain common functions (finance, administration, etc..), these types of gains are less important in the case of vertical integration than in the case of horizontal integrations where activities are similar and more functions can be "cumulated".

The most interesting aspect of integrating activities that are vertically linked in the value chain, on the other hand, is the realisation of economies of scope and other synergies. Notably, in the Golden Age of the Hollywood Studios, the Majors distributed their own movies and also owned or had tight contracts with cinema theatre exhibitors in order to *secure exhibition windows and reduce the risk involved with the production* of their movies. For the same reasons, media conglomerates today own several different activities from production, to distribution to different forms of delivery of their content (see Gomery 2004).

Another vertical integration that is worth mentioning here as an example, for its (at least, announced) synergies, is the merger between the Time Warner Corporation and America On Line (AOL). This represents an interesting illustration (and discussed in more detail below) because at least at the time of the merger (2000) the potential of the Internet to become an important delivery and exhibition method for the type of media content that Time Warner

Corporation affiliates can provide ("high quality" and costly) was still to be fully demonstrated. Therefore the main rationale for this acquisition was based on the potential realisation of synergies, instead of clearly defined economies of scale and scope.

The *good regulator* may often be in favour of vertical integration, for the same reasons that it is in favour of horizontal integration: when (at least part of) the benefits realised are passed on to the consumer. Moreover, the manufacturing logic of "the bigger the company, the better its capabilities to innovate" still applies.

As argued above, the current wave of relaxations in terms of rules prohibiting vertical and horizontal mergers and acquisitions is mainly based on the perception of changed market conditions. Given the convergence to digital methods of communication, media companies virtually compete in the larger market of the information sector, which is characterised by the presence of very large (telecom / ICT) corporations.[95]

So far, we have reported the current common view on mergers and acquisitions, a view that is supported by the mainstream economic theories and shaped by a manufacturing-based economy. However, here we claim that, on the one hand, principles based on mainstream economic theories are coherent in explaining the horizontal integration in the media services. From a viewpoint of the economic performance, these integrations have been successful.[96]

On the other hand, the history of this "peculiar" sector shows that in periods when activities have been vertically separated, by establishing limits on the ownership or by defining open and standard rules of interactions between users and providers, innovation has increased and so did economic benefits.

First, as we have reported, major Hollywood distributors vertically separated distribution from production at the end of the 1940s and this with the (then successful) intention of fostering stylistic innovation in their movies (see Robins 1993). Second, following the introduction of the fin-syn rules in the 1970s, which prohibited broadcast networks from owning most of their own prime time programming, competition was redefined and intensified leading to stylistic innovations in the content of the programs, but also in the programming or packaging (i.e. the

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[95] As reported by the Johnson (2000), around the time of the merger, AOL had a market capitalisation of 163.4bn dollars, while Time Warner had a market capitalisation of 83.3bn dollars.

[96] A different picture in terms of "performance" following the recent wave of integrations, however, is drawn by accounts of political economy of communication. Notably, many of these accounts concentrate on a decrease of diversity and plurality of sources of information. As explained in the introduction of this thesis, we keep this analysis focussed on economic aspects and we generally do not engage with these writings. We make this choice because only a superficial analysis would have been the outcome of our efforts given the short time in this project and the constraint space in this thesis that could have been dedicated to this purpose. We intend to engage with this type of literature at a later stage of this research when we will be reviewing more in depth the performance of the media against goals that are alternative to utilitarianism.

choice of formats) (see Christopherson 2006). Third, as indicated above, delivery and exhibition activities that are interfaced with their provider with clear standard rules (and therefore interconnected), for example, Cable and other Program Distribution and Video Tape and Disc Rentals, have performed better economically than other delivery and exhibition activities which are more integrated with their providers, namely, the Motion Picture and Video Exhibition industries. Moreover, given the fact that the output of these industries is not strictly dependent on the creative input (i.e. they are progressive), the faster pace of labour productivity growth in the former two, can be explained (but not quantified) by a faster rate of innovation.

On the other hand, although it is possible to make a consistent case to illustrate that a sustained rate of innovation follows a vertical separation or standardisation of *rules of the game*, it is rather difficult to know if the rate of innovation would have been even higher in the case of integration, all other things being equal. In order to provide a partial remedy to this shortcoming, we provide a rather significant example of an integration which was undertaken with great – yet so far unfulfilled - expectations.

In 2000, the biggest Internet provider, AOL, merged with one of the biggest media conglomerates: the Time Warner Corporation. Expectations were high, because important synergies were expected from the union between an important content provider, a corporation that included newspapers, broadcast and nonbroadcast television channels and feature films production companies, and a company that, at least at the time, provided dial-up access to the Internet and to their portal page to over 20 million people (Economist 2000 and BBC 2000). The second reason justifying this merger was the potential of cross-promotion of each other's activities: a justification that however, seems rather secondary to what was estimated as a 350 billion dollar operation.[97]

Seven years after the merger, AOL, which is now the Internet branch of Time Warner, is still mainly involved in two markets: Internet access and advertising / marketing (The Economist 2006). In the access market AOL is still mainly providing the quickly ageing dial-up access systems. In this market, it is in competition with the telephone carriers and cable providers (and therefore, with other Time Warner affiliates too), who offer much faster and reliable broadband access. In the advertising market, it provides services (mail, chat programs, news) to attract an audience for advertisers. In this market, it competes with portals such as Yahoo!, MSN and Google.

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[97] Such was the estimated value of the new combined company (BBC 2000).

Without providing very detailed figures, it is reasonable to say that over the past five or six years, AOL lost considerable ground to its competitors. In the access market, it is clear that dial-up technology is destined to play a very limited role in providing users with access to the Internet, and therefore AOL cannot compete with telecom and cable companies unless there is a radical change in its business strategy.

On the audience market, the *Internet Measurement Results* of 2000 for the U.S., published by Media Matrix, showed that AOL was the most visited portal of all, with 58 million visits a month, over ten million more than Yahoo and Microsoft web sites (Business Wire 2000). A few years later, the situation was reversed: although the results of the exact same survey are now not available online, according to Nielsen/NetRatings, in 2004 AOL was the fourth most used search engine by Americans with a total of 23 million searches a month and well behind the leader Google and also (although to a lesser extent) Yahoo! and MSN (IT Facts 2004).

Regarding Internet advertising revenue, according to eMarketer.com, AOL earned 9.1% of the total U.S revenue or the equivalent of over 1.7 million dollars in 2006. However, although it has grown relatively faster than some of its competitors, the total revenue collected by this company was half of Yahoo!'s and less than a third of market leader Google's (Hallerman 2007).

Therefore, so far, the merger between AOL and Time Warner has not produced the expected synergies and as a result, the Internet division is now dragging down the financial results of the entire corporation (The Economist 2006). So, if on the one hand, integration can lead to economies of scale and scope and new innovations, on the other hand, they also influence quite heavily a company's technological trajectory. Here we make the following assumption that complies with notions of the modularity literature as explained above: in 2000, AOL was in a position of being better today than Google, Yahoo and MSN; the merge with Time Warner has probably displaced the focus of the company and narrowed the extent of its innovation strategy. AOL is obliged to look for synergies with affiliated companies, or at least, to not compete with its affiliates or favors its affiliates' competitors with its choices. This is partially illustrated by the better performances of two companies, Google and Yahoo!, that do not have strong vertical ties in the content markets.

8.5. Some Conclusions

At the beginning of this chapter the audiovisual media service sub-sector was defined as *peculiar*, because, although there is virtually no activity that is an exact match, it contradicts the neoclassical assumptions. As a consequence of this peculiarity, mainstream economic theories must be integrated with alternative theories or concepts in order to understand, more generally, the impact of new technologies on the economic performance and on the evolution of this service industry. The additional and alternative ideas, concepts and perspectives used here come mainly from modularity theories and evolutionary economics.

In this section, we consider the "peculiar" characteristic of the audiovisual media service industry by exploring its evolution. First the process of media production characterises itself by constantly striving for originality with every product - a search that sometimes leads to what Schweizer (2003) theoretically defines as stylistic innovations: movies with a particular innovative narrative, filmed in a new way, introducing new talents in their cast, or at a higher level and more generally defined, the introduction of new film formats and television genres.[98]

There are two main consequences of this feature that are worth mentioning: the first is that the output of media content activities depends upon what we have called the creative input and defined as *labour's originality of ideas, concepts and actions and the capacity of troubleshooting and finding solutions*. The second, is that a subjective measure of quality is impossible to define and measure, nor is the notion of qualitatively constant output required to estimate productivity.

As a consequence and in order to offset these shortcomings, it is useful to consider media content as the main input of a larger service industry, composed of different activities each using audiovisual media content in combination with different forms in order to create different user experiences. By looking at the different characteristics of these experiences and the price users are willing to pay, three groups of qualitative measures can be defined. These are (1) the *novelty* of the experience (i.e. the originality and the newness of the content); the (2) the *definition* of the experience (i.e. the accuracy of the content and the quality of the technical feature of the distribution method); and the (3) *user's customization* (the user's freedom to live the experience at its will).

This rather static picture of the audiovisual media service industry already shows that its products require a more complex analysis than the one inspired by theoretically substitutable goods whose share of consumption depends mainly on prices. These characteristics need to be considered when trying to understand the dynamics that are the main interest of this research: the impact of new technologies and innovation and more specifically their effect upon the evolution of the sector and in particular on its economic performance.

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[98] As described in chapter three, "Stylistic innovation is the sum of product and/ or process features, which: (a) Differentiate a (group of) producer(s) from other (groups of) producer(s), (b) Are based on particular cognitive structures leading to the realization of new means and/or ends in the product and/or process and (c) Are perceived as novel and therefore mismatching the collective expectations of a particular certification environment." (Schweizer 2003, 28).

Innovation in the audiovisual service industry (as in the case of the service industries overall), is a concept that includes different types of change. As our account of its evolution indicates, technical innovations play the role of enabling factors, while stylistic, managerial, organizational and regulatory changes are required to transform technical tools into industries and markets, and to revive the economic performance of these latter.[99]

More specifically, the value chain activities of the audiovisual media services industries can be divided into two groups: content and form activities. Content activities include the production and post-production tasks, while the form activities include the packaging, marketing and distribution activities, as well as the activities focused on the delivery and exhibition of content. Because the quantity and the quality of the output of the content activities depends on the creative input, these activities are stagnant, while form activities are progressive. Overall, the audiovisual media services are asymptotically stagnant and therefore a sustained rate of innovation is necessary to foster the economic dynamism of the sector.

The organisational setting of the industry plays a key role in determining the rate of innovation. Contrary to mainstream thinking (inspired by neoclassical economics, as we claim) and given the nature and the importance of the non-technical types of innovation, as well as the relative low level of investment required for new ICTs, large organisations are not necessarily more innovative than small ones. Furthermore an audiovisual media service (sub-) sector composed of large organisations is *not* in a better position to produce a faster pace of innovation than if the same sector was composed of more and smaller ones. This is not only the result of increased competition, but also the consequence of the multiplication of interconnected activities (or modules), with a multiplicity of defined focus and own innovation trajectories (better matching the peculiar goal/necessity of diversity of this sector).

Therefore, the current trend of regulatory changes does not best fit the positive (long-term) economic momentum. In fact, technical change increases the number of activities and knowledge necessary in the different stages of the production of audiovisual media services. This dynamic represents an opportunity, as the chance is there to multiply the existence of modules / semi-independent, innovative activities, leading to a higher rate of innovation overall. Instead, following the relaxation of rules regarding the ownership of different media activities, the sector has been concentrating, resulting in the integration of activities and the establishment of more *hidden rules* (i.e. relational contracting and exclusive networks). Moreover, the "official" rationale for allowing the vertical concentration of the media sector is the expected

[99] This group of types of change forms the microeconomic version of the neo-Schumpeterian notion of socio-institutional climate.

benefits of economies of scope: while the same economies of scope can be attained by *interconnecting* activities instead of *integrating*, variety and the extent of innovation suffer as a result.

Moreover, synergies and economies of scale do favour innovation when this is mainly characterised by technological change and positively correlated with the size of R&D projects (e.g. in manufacturing activities). However, only one media conglomerate (Sony) seems to be able to benefit from this effect and it is the only one with ties into the manufacturing-end of media related tool production.

In the past, on the other hand, when more areas of the audiovisual media service industry activities were kept separate by specific regulations, and when these regulations did not specify the terms of the relationship between the activities, these modules converged towards the establishment of efficient visible rules (i.e. standard contracts / *rules of the game* or arm's length market relationship). Therefore, the audiovisual media services and probably the media sector more generally, could benefit from regulations establishing standardised relationships between vertical activities of media services.

Chapter 9 - What is "New" About the New Economy?

In this second chapter of conclusions, we would like to reflect on some of the questions stated in the introduction about the New Economy. We do this by elaborating on our own findings, which are based on an institutional framework, and by comparing them to selected claims of the New Economy literature.

9.1. How Important are Increasing Returns to Scale in the Information Sector?

In Chapter Two we examined claims concerning the characteristics of the New Economy from proponents such as DeLong and Summers (2001). These authors rely on the understanding that digital products allow for increasing returns to scale because the production of the first copy (what we called the original) is expensive while the marginal cost of producing any extra copies is rather low. In the information market, when a company manages to gain a dominant position in the market, increasing returns to scale favour the realisation of a monopoly. In this economic environment, which these authors describe as "Schumpeterian economy" as opposed to "Smithian" economy, the monitoring and intervention role of the regulator is therefore reinvigorated.[100]

Increasing returns to scale are certainly one of the most striking features of the information sector that is of interest to many economists. Here, given our historical review of the information sector and given the fact that a few years have passed since the publication of this statement, we can elaborate more on DeLong and Summer's analysis.

First of all, this statement is clearly underpinned by a neoclassical analysis. In a neoclassical market, a company that benefits from increasing returns to scale can lower its prices after gaining extra market share, as it can produce its output more cheaply. As a consequence, lower prices attract more consumers and production increases triggering a virtuous circle. Therefore, in this situation, companies with a more "regressive" technological structure, producing at the margins of the production possibility frontiers, suffer the competition and eventually some are pushed out of the market.

[100] We take DeLong and Summer's paper as representative of the New Economy literature. Given the discursive nature of this paper as opposed to the narrower approach of other mainstream economic papers on the subject, which are focussed on mathematical models, these authors report many opinions and attempt a comprehensive answer to the question of what is "new" about the New Economy.

In addition to the theory, the claims of such New Economy theorists are informed by the evolution of the information industry and the software industry in particular.[101] However, their claims do not include an analysis of what triggers this virtuous circle or what gives a company a dominant position in the first place. What they state is only that in the New Economy more companies are likely to be in a position of benefiting from increasing returns to scale (because of the digital nature of their products or because of the high frequency of new inventions), which makes natural monopolies more likely. Our analysis based on the evolutionary account and principles of modularity moves beyond these statements and provides comprehensive arguments to explain the emergence of market dominance in the information sector.

For example, DeLong and Summers' analysis can be applied to Microsoft's family of operating systems Windows, as the different versions considered together have conquered the very large majority of this particular market. However, we could ask: how much is the success of Windows really dependent on the fact that the marginal cost of producing a new unit is low and decreasing with the number of copies published? In this study we have reported on accounts explaining that the success of this software stems from several core reasons. The most important factor is the fact that the early versions of this operating system (from the MS-DOS onward) were compatible and distributed with a computer built as an open modular system. Because of this characteristic, this particular type of system (the IBM PC) became the most replicated computer and the most diffused. Microsoft benefited from its non-exclusive agreement with IBM, in virtue of which its operating system could be sold with machines produced by other companies, and from the large diffusion of the type of product it was designed for.

Two other arguments related to this example justify the *marginal* role that increasing returns to scale played in creating monopolies in this sector. First, microprocessors produced by Intel are also modules of the IBM compatible PC and have conquered a market share of their own, which is comparable to Microsoft's family of operating systems. However, although the company Intel has certainly benefited from increasing returns of scale, microprocessors are much more expensive to reproduce than software; therefore, the importance of the low marginal cost for an information industry in the acquisition of a large market share is certainly questionable.

Second, nowadays many other types of operating systems which are developments of the operating system UNIX share many characteristics with Windows; yet they do not gain the same market share. In fact, they can be used in combination with IBM compatible PCs, they certainly compete in terms of quality, they have the same economic characteristics in the sense

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[101] As these authors use the example of the diffusion of Netscape and the expensive efforts that Microsoft had to undertake to overcome Netscape's market dominance.

that they are surely not more expensive to reproduce, but they are sold for a lower price if not for free.

9.2. The Influence of the Information Sector on the New Economy

In this thesis, we have examined two main (and linked) arguments that are used in the New Economy literature to describe the effects of the diffusion of ICT into the New Economy: the first is that ICTs are pervasive and applied to every productive process; the second is that ICTs improve productivity.

Given this project's choice of methodology and focus, we are not in a position to provide an in-depth commentary on the first argument as we have concentrated on the information sector. However, if we take the audiovisual media service industry (as the other case studies concern ICT providers) we can affirm that ICTs have been pervasive. In fact, we have provided examples of the application of ICTs in every stage of the value chain, from production (e.g. the creation of computerised images), to distribution (e.g. the Rentrak system, daily box office reports) and exhibition (e.g. high definition screens).

Drawing on our evolutionary analysis and to the theoretical framework which informs it, we can elaborate on the effects of ICTs on productivity levels in more detail. As a general rule, ICTs increase labour productivity in manufacturing activities; neo-Schumpeterian theories provide a rationale for this relationship, while neoclassical economics-based modelling demonstrates it empirically. Neo-Schumpeterian accounts view semiconductors as a key factor and telecommunications and the computer industries are carrier branches (Freeman and Louçã 2001). Notably, in a Kondratieff wave of economic development, motive and carrier branches are responsible for an acceleration of productivity in many other sectors (Perez 1986). Moreover, statistical trends published by the BEA and BLS show that the manufacturing sector in aggregate has experienced a positive trend at least since 1996.

However, we have also demonstrated that production processes that are characterised by a constant use of creative inputs do not experience an improvement of productivity in the long run and as a result of technical change. This is of course the result of Baumol's cost disease and the increasing cost of these types of inputs: in markets where there are no barriers to entry, "creative labour" increases in relative terms to offset the demand for labour generated by improvements on the "progressive" activities; while in labour markets where there are barriers to entry, because the creative labour is more specialised or rare the excessive demand translates into an increase of creative workers' salaries. In both these case scenarios, the relative cost of the creative inputs in the production process increases.

However, our analysis of Baumol's work also highlights that some service activities have been transformed from stagnant to progressive; we claim that this is the case for service industries that have been capable of standardising or "de-personalising" their production processes. In some cases, this process was helped and / or made possible by the increase use of ICTs (e.g. the contribution of online shopping to the retailing industry). As a result, although the aggregate productivity trend has changed in 1996, only sectorally focused analysis can determine if ICTs are pervasive and if they are responsible for productivity increases.

9.3. On Measuring the Impact of the Information Sector on the New Economy

Our analysis has highlighted different trends which question the effectiveness of the current aggregate measures of productivity calculated following neoclassical models. We have highlighted an expansion of service activities as a result of the increased complexity of goods and notably the output of service activities is more difficult to estimate than the output of manufacturing activities. Moreover, in virtue of the Baumol cost disease, there is an increasing share of employment that disappears from aggregate measures of productivity because it becomes part of those sectors whose output is difficult to measure.[102]

The enlargement of the service industry sector and existence of the cost disease pose another problem for the current methodology used in quantifying productivity trends. As explained above, characterising product quality and including qualitative changes in the notion of output has become a priority for agencies releasing official statistics, as the recent adoption of hedonic price measures for ICT hardware demonstrates. However, we question the benefits of such a development. In theory this methodology consists of attaching to products the value that the customer would give (BLS 2001). However, in practical terms, this is translated by comparing different physical or at least observable characteristics of "generations" of the same good across time. Although certainly the choice of the characteristics can be quite crucial for determining the extent of the quality changes, this methodology can be applied quite consistently to all manufactured goods.

The application of this methodology, however, becomes more complicated when service activities are the target. This is because defining characteristics of quality that can also be compared across time becomes a complex issue, given the multiplicity of elements that define a service (e.g. imagine providing for the characteristics of cinema theatres in terms of what can defines the "user experience": the comfort of the seats, the availability of tickets, the quality of the movie, the sound, etc). Moreover, not only the application, but even the theoretical principle

[102] E.g. the BLS defines the Nonfarm business sector as every activity apart from the government, agricultural and non-profit activities.

underpinning hedonic price measures conflicts with the idea of personal services. In fact, personal services are supposed to be user tailor-made. Therefore, if it is certainly a difficult task to compare services as they are delivered to different users, it is almost impossible to have a consistent system to compare services delivered at different times. Therefore, aggregate productivity trends are likely to depend on a number of decisions about characteristics and the quality of these characteristics, which are all contingent and specific to the products in question.

Hence, what we want to highlight here is that there is a further argument for concentrating on studies at sectoral or industry level in order to understand the impact of (different types of) innovations on the production processes. However, in light of the existence of the cost disease and eventually for the purpose of aggregation in a more general index, we claim that the quality of personal services could be approximated by developing indices of *capabilities* for creative inputs. These could include characteristics such as education, success rate in the troubleshooting procedure, etc.

9.4. On the Market Structure of the New Economy

Our analysis starts from a different viewpoint to that adopted by theorists such as DeLong and Summer (2001) on the "typical" market structure of the leading sectors of the New Economy. First, as explained more in details in Chapter Ten, the role of the regulator in the information sector is fundamental even if it varies according to the sub-sector. However, one of the reasons explaining this role is that the regulator manages (directly or indirectly) many types of scarce resources used by information sector activities: radio frequencies, wireline networks, Internet Protocol addresses, satellite orbits, etc…

Second, based on a hasty generalisation, these authors claim that monopolies and oligopolies are the consequence of technical change (and in particular, of the expansion of digital goods) and therefore likely to become more frequent in the New Economy. In contrast, our case studies demonstrate that, when monopolies and oligopolies are more likely, this is mainly due by regulatory changes.

In this project we have reported about a computer manufacturer industry dominated by a modular production process, characterised by a large web of interconnected companies. In these networks, there are few companies playing the role of platform integrators, having more influence on a system's technological trajectory than module makers. Moreover, in their niche markets they are proper or *de facto* monopolies or dominant firms in oligopolies; however, as the evolution of systems demonstrates, innovations can change market conditions and platform integrators can be overthrown.

In the wireline telecommunication industry, the trend experienced is the inverse: from a *de facto* monopoly in the 1920s, several technical and regulatory changes have led to the current situation characterised by an unprecedented number of participants in most markets within the sector. In the audiovisual media service industry, periods of more concentration have been alternated by periods of less market concentration. This latest phase is again a phase of increasing concentration and its existence is the result of changed regulations that have relaxed rules on accumulations of media ownership.

In summary, as the evolutionary accounts about the information sector industries and our claims in this project have substantiated, changes to the information sector's market structure were dependent on the combination of different factors. Therefore, we conclude that it is too simplistic to explain the reduced presence of multiple companies in information markets as the result of the existence of more production processes benefiting from economies of scale.

Drawing from complexity theories, our evolutionary accounts and from our theoretical framework we attempt a more complex generalisation of the relationship between innovation and market structure in the information sector. First of all, technological change increases the complexity of products (goods or services) and the "*logical*" response to this increased complexity is the multiplication of separate tasks. Whether the increased complexity and the multiplication of tasks results in an increased concentration or competition depends on several factors. Here we take into account factors such as the nature of the innovation, how this is created and brought into a market and the proprietary form that defines it. Moreover, we also claim that the regulatory framework and the contingent, dominant thinking shaping it also play a crucial role. These factors and the way in which they influence the market structure certainly do not represent an exhaustive list, although they can be demonstrated as their dynamics have been explained in this project.

First, the structure depends on the type of innovation introduced and characterizing the market in question and the features of the process leading to the introduction of this innovation. The success and the realization of an invention is the result of a trial and error process; past examples, however, demonstrate that those inventions that were shaped keeping in mind users' needs and planning a "smooth transition" from other (relatively similar) products and services, had more success (e.g. the VHS, the NTM, Rent tracking and sharing in video rentals, etc…) than "purely" supply-pushed innovations.

Moreover, some technical innovations can be introduced by a single company and their exploitation is protected by one or more patents (e.g. the Apple Macintosh); in this case, if successful (for example, for the reasons stated above) the innovation is likely to increase the market share of the company. However, another case scenario (characterised by many variations), allows for a technical innovation to benefit from network effects and increased chances of diffusion: when the technical innovation is a complex product / modular system, invented and introduced by a consortium of producers.

The number of participants and the market structure of the product in question and of its sub-systems, depends mainly on the proprietary form of sub-systems and interfaces, as explained above. The open design of the PC led to a large diffusion of this type of systems and a large number of competitors. In the case of the GSM, on the other hand, Motorola maintained its patents on the crucial parts necessary to produce telephone handsets and the right to deny the license to companies requesting it; therefore the number of companies able to produce GSM handsets is limited by the number of companies allowed to or able to buy and use the necessary licenses profitably.

Another factor that has characterised the success of certain inventions and transformed them into popular technical innovations is the "standardisation regime". We can identify two types of regimes, one where the standardisation process is led by the market (e.g. third generation mobiles phones in the U.S., videotapes, videodisks, etc…) and one where it is led by a central authority (e.g. NTSC, TACS, NTM, GSM, etc…). The main differences between the two are that, in the case of the former, the rate of investment is thought to be higher (given the simultaneous investments of competitors in the gaining of market share) and in virtue of the competition, the best standard is thought to come out as the winner of the battle. In the case of the second, the centralized standard regime, the speed of diffusion of the innovation is higher (because the process of standardisation removes any uncertainty about which standard is going to be dominant in the future) and the use of scarce resources used in combination with this standard is more accurate.

In the first case, the market structure is indeed an oligopoly as the more competitors, the smaller the chances of winning this battle. Moreover, efforts for winning a battle of standards can be quite expensive and potential losses high. Therefore if there are two or more competitors already, other companies do not have incentives to participate. In the second case, it still depends on the proprietary form of the standard, although central authorities (at least, officially) try to make the market as competitive as possible, therefore they try to make the standard as open as possible too.

However, in the case of modular systems of any type, the first contributors benefit from a technical knowledge advantage that (also in the case of knowledge that is not protected by patents) give them a competitive edge and a dominant position in the competition for market shares.

The second set of arguments explaining why the increasing complexity of product can lead to a bigger concentration or more competition in its market, depends on the regulatory framework and the dominant thinking providing its rationale. As a general rule, our analysis suggests that we can confidently state that in order to benefit from economies of scale, scope or other synergies, or simply to increase their market share and obtain a dominant position, bigger companies buy out smaller companies and similar sized companies merge.

In theory, mergers are allowed by the *Good Regulator* if their benefits are also passed on to the consumer.[103] Alternatively and more realistically, communications scholars interested in political rationale for changing regulations about concentration of ownership (e.g. McChesney 1999), argue that the relaxation of these rules is specifically intended to help the big businesses more than the consumers.

Besides the dominance of economic arguments in justifying the increasing relaxation of anti-concentration rules, there has not been so far a golden rule about a market structure that maximizes consumer benefits across the information sub-sectors and throughout different times. Monopolies are generally assumed to be more expensive for consumers and less innovative than companies in competition. Yet in this research we have provided at least three well-known scenarios where the regulator allowed and even favoured market concentration and even the creation of monopolies. In the 1920s AT&T was allowed to become a monopoly for reasons of national security; moreover, this company throughout the following fifty years turned out to be by far the most innovative company in the history of telecommunications in the US. In the same way, years later the regulator did not interfere with IBM's strategies to gain market dominance in the mainframe market because the dominant understanding of the situation was that thanks to this market dominance, the company was quite innovative and pushing the other competitors to be innovators as well. Last, justified by the convergence of the media and the potential realisation of economies of scale and scope, on the one hand, and by the potential competition from the larger IT companies on the other hand, since the 1996 Telecom Act companies in the media sector are subject to much less restrictions when they want to proceed with mergers and acquisitions.

[103] As explained by Carpenter et al. (2003), directors frequently rely on over-optimistic and biased outlooks about what a merge can bring to their company; however, in reality, the main driver justifying a merge is the increase of the shares' value and the personal benefits that they can draw from.

9.5. Some Conclusions

In this chapter, we wanted to highlight that an influential economic account of the New Economy – such is the viewpoint of DeLong and Summers (2001) – provide a superficial analysis of the changes brought about by the rapid diffusion of ICT in many productive processes that is too narrow and therefore incomplete.

Certainly, the production process leading to the production of a large majority of information goods is characterised by increasing returns of scale. However, we question the emphasis put on this characteristic and its importance in explaining which products and companies win market shares over others. Moreover, we argue that the capacity to decrease marginal costs by increasing the volume of production becomes less of a determining factor given the process of *services-ation* of the information industries: as companies attempt to gain market share by offering services tailored to respond to customers' specific needs, the price of goods embedded in the provision of service can become a less central factor.

More generally, DeLong and Summers (2002) review of the main changes brought about in the economy by the diffusion of ICT tools is very much "technology centred". In this writing, we question this viewpoint and indicate how regulatory changes, for example, can be as influential as technical changes, in determining the extent of an innovation's success and in shaping the composition of the market of products that derive from this innovation.

Therefore, following the historical analysis and multidimensional theoretical framework presented above, the next chapter provide more complex answers to these and further questions.

Chapter 10 - Conclusions: Innovation and the Economic Performance of the Information Sector and Beyond

In this chapter, we present the final conclusions of this study. In Chapter Eight we have drawn from the evolutionary account of the audiovisual media services and provided an alternative viewpoint to mainstream economic theory on certain key questions linking innovation and economic performance. Similarly, here we draw from, and compare the evolution of, all four information sub-sectors analysed in this study (the wireline and wireless telecommunication industries, the computer manufacturing industries and the audiovisual media service industry) in order to provide new insights (or a new rationale for old arguments) on current debates around innovation and economic performance, with a particular focus on organisational changes, competition and the role of the regulator.

10.1. Understanding Innovation and Economic Evolution of the Information Sector

First of all we have illustrated how change in the information sector is *evolutionary*: it depends on many contingent factors such as the history of a company introducing the change or policy makers' understanding and attitude towards the consequences of this change. Mechanisms are in place to deal with change, in the sense that they are part of the selection process or they refine and adapt it to better suit specific goals: these mechanisms include the market, organisations charged with the standardisation of certain technical innovations or other regulatory bodies (e.g. the FCC) with responsibility of managing common resources used in combination with these changes.

Clearly, change is also *multidimensional*: in the picture portrayed throughout the different accounts presented, we give technical change the special role of enabling factor leading to new opportunities for the creation of new markets and industry branches. This role however, cannot be fulfilled without the many other types of innovations, that here have been classified and summarised under four other headings: stylistic, organisational, managerial and regulatory.

More importantly, however, by combining evolutionary accounts with modularity theories, we are able to describe general dynamics explaining the links between the different types of changes and the economic performance of the various branches of the information sector.

As is the case of many other sectors, the output (goods or services) of information sector activities reaching the final consumer is the result of combinations of many intermediary inputs and contributions from different suppliers connected together by a rich web of relationships. Therefore, in order to carry out an analysis that is comprehensive and evolutionary, it becomes fundamental to highlight the strong links between activities, map and define markets and industries or describe the reach of conglomerations combining many functions.

In the case of most manufactured goods or a traditional Fordist production process, this can be a rather straightforward task, because in the most frequent case scenario there is a main producer of a final good and a number of "minor" component suppliers. In the case of activities of the information sector the task is more extensive and complicated. For example, feature films are one of the main inputs of several markets such as broadcast television, nonbroadcast television, home entertainment and cinema theatres. Clearly, trying to understand the evolution of the computer industry as separate from the software industry or considering the economic performance of the home entertainment industry as independent and not influential on that of cinema theatres, for example, would result in an incomplete and distorted analysis.

The main purpose of this mapping of activities and their relationships is essentially twofold: the first reason is to understand the business model of each activity starting, for example, from the rationale of the price *structure*, as pointed out in contributions belonging to the literature focused on platforms (e.g. Rochet and Tirole 2003). As noted above, Microsoft sells its operating systems very cheaply (mostly, for a hidden fee included in the price of new computers) in order to generate a network effect favouring the sale of its applications; Video and Disc Rentals, traditionally focused on the rental of films, have recently increased their revenue from the sale of their pre-owned DVDs and tapes and therefore they are more actively innovating (price discrimination according to the time of release, etc..) in order to benefit more from this source. Grasping the complexity of these business models is crucial to understanding, for example, the economic performance of a company and the influence of competitors with substitute or quasi-substitute products, or the rationale and the impact of regulatory changes.

In light of the argument dealt with in this project, however, the most important justification for this exercise in mapping activities and relationships is to gain a more complete understanding of the process of innovation for each activity or groups of activities within a sector. The general insight that we draw from theories of complex systems and apply in our evolutionary accounts is that the goods produced and services delivered by the information sector's activities are dynamic and innovations increase their complexity. This means that the variety of inputs increases, contributions and relationships between activities change, and their number generally grows.

In our account, we note two important and related aspects of the dynamics of innovations: the first concerns the characterisation and the importance of technological trajectories; the second concerns the fact that the information sector is now generally characterised by mass customisation, *services-ation* and a distinct or certain (but not total) trend towards technological convergence.

10.2. Modular Innovations and Technological Trajectories

First of all it is useful to remind ourselves here that the organisational settings which characterise the production of information goods and the delivery of information services are generally different from those of a Fordist production process: the main difference is that the organisation can be defined as modular, because the various contributors are interdependent and less subject to the decisions of the platform integrator or architect, and more importantly, because they are innovators.

Therefore, in mapping of the different activities leading to the production of a complex product it is also useful to highlight and single out the precise contribution of each production process. It is within their specific area that activities or companies mostly innovate, and this is what defines modular innovation. Therefore, as presented above, if we single out the contribution that a company like Dell makes to the personal computers it markets, we realise that most of the technology depends on the innovation generated by the component suppliers and this technology is available to other personal computer assemblers. In order to make a difference and increase its market share, the changes Dell introduces are not primarily technical, but organisational and managerial. As explained above, in the past these included the elimination of retailers from the value chain by delivering its products directly to the final users, the introduction of a quicker assembling process that reduced the need for stocks and increased the product options available to customers, and finally a renewed focus on customer care.

In this project, we found it very informative to apply these concepts of modularity to the media industry: in fact, we can illustrate very simply the reality of modular innovation in feature movie productions by drawing a parallel with the previous example. Indeed, since the consequences of the Paramount decisions and the diffusion of the blockbuster film format, all production companies work on a project-basis and “assemble” a temporary pool of collaborators working together for the realisation of a movie. Therefore, in the same way all computer assemblers have access to the same pool of different components, (virtually) all movie directors and producers have access to the same pool of artistic contributors (assistant directors, actors, photographers, technicians, etc…) as well as technologies, although in reality budgetary constraints certainly represent an important factor.

These contributors indeed represent modules; in fact, on the one hand, they agree on a set of visible rules with the director (for example an actor agrees to represent a character) but at the same time they contribute to the project with their own unique performance and innovations. Therefore, the *main set of original contributions* of a movie director consists of interpreting the manuscript, giving it a "visual form" by putting together all the necessary elements to achieve this goal. The key innovations or novelty factors (or at least the most important) that a director can introduce are stylistic. Therefore, a director is an innovator, if, for example, the film produced is shot using new techniques or new special effects that particularly suit the story; or if it presents a novel and original story that matches the ability and characteristics of one or more actors, etc.. In other words, a director is "co-responsible" for a stylistic change (although he would not be the only one) if the combination of elements chosen to form a movie generates some kind of chemistry of (modular) innovations that exceeds the expectation of key cultural gatekeepers.

Technological trajectories are defined by modular innovations: as explained above, module makers are free to innovate within limits defined by the extension of *hidden rules*, but a successful change "makes sense" if it fits and provides a contribution to the general technological trajectory of the system. When computers were becoming personal and entering the home, component makers were focused on miniaturising parts and software makers were focusing on creating simple interfaces so that non-technical people would be able to use computers.

This concept of technological trajectory applies to the media sector, although maybe in a less straightforward way. Probably, the best illustration is provided by television programme formats. As explained in the evolutionary accounts (drawing from the work of Einstein 2004) formats represent stylistic innovations and the characteristics and succession of different formats can be used to understand programme makers' technological trajectory. In fact, different formats have been popular at different times and many different productions have contributed to the popularity of these formats. For example, nowadays a television programme producer with an expectation of success would probably invest in crime investigation or the reality television formats, as these are the current types of programmes that "make sense" (i.e. are expected to respond to the current cultural taste of a large share of audience), but at the same time they must attempt to innovate in order to distinguish themselves from other programmes already in circulation (with a new and different characters, some other new features).

10.3. Convergence, Mass-Customisation and Services-ation in the Information Sector

The approach and studies undertaken for this research enable us to provide definitions and new arguments to explain some of the new features that characterise recent developments in the information sector.

The *convergence* towards the use of digital forms for different types of media content is a concept used to characterise the innovation trend in this sector and this is invoked by corporate actors as the main rationale for important regulatory changes. Many claim that media convergence stems from the increasing power (at reduced cost) of computers, the diffusion of the latter in different production processes and the introduction of digital formats for packaging, delivery and (if applicable) exhibition of video, images and voice or any type of media content.

Possibly less recognised is the idea that some regulatory changes are providing an important contribution to this process. These changes include all regulations that attempt to standardise the relationship between activities (i.e. modules) and to put providers of different platforms on a more equal footing: these include the changes brought about by the SHIVA, which attempts to facilitate the diffusion of satellite MVPDs and at the same time to submit this type of service to the same obligations as cable MVPDs; or the OVS regulations which attempt to promote the role of telephone companies as video carriers.

On the other hand, and as explained in more detail in the next section, we also claim that there is no consistent set of economic arguments to sustain the idea that those regulations favouring the vertical integration of media activities indeed foster the rate of innovation in the sector.

The combined effect of various types of innovations is also at the origin of the process of *mass customisation*. This is normally referred to as the current ability companies have to produce goods at mass production costs that respond to specific customer's needs (see Peters and Saidin 2000). We claim that mass customisation as described here is a process that also interests service activities in general and specifically the information sector. Mass customisation in our framework is explained as *modularity in use*: so, in the same way users have the possibility to buy a personal computer and choose among a variety of components, users of media services have the opportunity to choose among a variety of service portfolios from different providers.

Essentially, different providers offer a variety of services, some of which overlap, but specific conditions make them more appealing for some users than for others. For example, broadband services are offered by cable and telephone companies; several characteristics differentiate these two technologies and the services that are provided through these technologies, although they both consist of high speed internet connection. These include download and upload speed and a variety of services attached such as email addresses, the possibility to upload and publish web pages, etc… Moreover, the first may bundle the provision of broadband services with different packages of channels, the latter may bundle their internet connection services with telephone communication services.

Therefore, users have access to a variety of customised/customisable packages of services that would best fit their needs. Technological convergence (as we have defined it above) is undoubtedly a factor contributing to this process. However, we claim that focusing on technological convergence might produce negative effects mainly for two reasons. The first is that the idea of technological convergence stresses the importance of technical change and overshadows or neglects the role and the benefits of other types of change. The second is that there is more information to be drawn from the differences between services delivered than their apparent homogenisation, a concept promoted by the idea of technical convergence. In this study we present the case of the differences between various audiovisual media services and how the information about their different characteristics combined with the differences in prices can be used to put together a notion of quality. As the search for quality is certainly the main driver of innovation, this information is also useful to understand technological trajectories. Therefore, there is more to learn about how the services are diverging (and diversifying and distinguish themselves) than converging.

Mass customisation is not the only characteristic that defines the latest developments in the information sector: in this project, we have mentioned many times the concept of *services-ation*. This describes not only the quicker expansion of service activities and their growth in relative size at the expense of manufacturing activities, but also, and more importantly, the increased focus on services in the innovation process. We find two success stories particularly suited to illustrate this trend: the first concerns the main computer manufacturers, which have gradually introduced new service activities up to a point where now they represent their main focus and even their new manufactured products are designed to complement and enhance their portfolio of services. The second example concerns the story of the most successful first generation mobile technology, the Nordic Mobile Telephone (NMT); the entire system was designed (mainly by the network operators, instead of the technology manufacturers) starting from the idea of service: desired functionalities, users' needs (to easily adapt to the system) and expectations, for example, were taken onboard to design / choose the technology.

From the evolutionary accounts presented in the research, we observe that this services-ation of the information sector is a consequence of its increased complexity. In the computer industry innovation increased the range of applications of the tools produced, and the knowledge needed in order to manage these tools and to efficiently use them in various production services. For example, this situation enabled computer manufacturers to generate new value added from the knowledge associated with their products, first by starting to deliver support services; and then the more comprehensive consultancy-type of services and advice to other companies about how to put to the most effective use the new technologies.

In the audiovisual media services and in the telecom services, technical change and innovation in general are also at the origin of their services-ation: first of all, new tools have increased the chances of interaction and feedback between users and providers; secondly, the increased variety of tools used to communicate or to experience media, have increased the range of services delivered. Moreover, even the process of mass-customisation as described above can be included in this services-ation trend, as providers create different options trying to tailor their products to suit customers' tastes.

Last, but not least, among the factors that explain this process of services-ation we have included (and re-introduced) the neglected matter of the cost disease. Although this is only a claim and an intuition which requires further in-depth economic analysis focused on understanding who bears the increasing cost of the creative inputs, there are clear signs that the production of content in the media industry and the service activities in the telecommunication and computer industries, are seen by large information conglomerates as the most lucrative activities within the respective vertical value chains. Certainly, for many activities, the increasing cost of the creative input (paid to creative workers, such as actors, engineers, etc…) is likely to be less than the increase in prices of these activities (relative to progressive activities), which contributes to enlarge the profit margins.

10.4. Modular Organisation and the Rationale for Horizontal and Vertical Mergers and Acquisitions

So far in this chapter, we have mainly talked about activities and groups of activities within industries and sectors, instead of companies or conglomerates. This is because the principles of modularity we draw from can be applied to activities provided by different companies or (although under certain conditions) by activities/tasks within the same company. These principles and conditions provide interesting insights on questions of ownership and on the rationale for mergers and acquisitions in the information sector, which deserve to be reiterated and discussed in greater depth here, in a dedicated section of these conclusions.

Mergers and acquisitions involve a trade-off: on the one hand, they can produce economies of scale, scope and other synergies which are positive factors for the companies involved and for consumers. On the other hand, they can lead to monopolies and / or they are likely to decrease source, viewpoint and outlet diversities and affect the citizen in a negative way (see 7.3.5.). The FCC has introduced regulations that limit the extent of horizontal mergers (e.g. of broadcast television), but has a more liberal approach to vertical integrations (e.g. the end of the fin-syn rules) especially if these are cross-platforms, such as the one between AOL and Time Warner. This is because the FCC considers the new ICT markets as risky and therefore big industries can better support innovation.[104] The FCC balances advantages against shortcomings and, especially in the case of vertical integrations, finds the benefits to the consumer larger than the loss of diversity for the citizen. We would argue that this also reveals its preference for arguments that can be justified with mainstream economic theories against argument that find justifications in other theoretical approaches. Here we claimed that, at least in the case of vertical mergers, the hypothetical Good Regulator has the option to turn to a "third way" and to embrace a set of arguments that can facilitate the convergence of the fostering of diversity and of putting the industry in the best situation possible for being innovative.

As explained above, mergers are beneficial to the companies interested and the consumer because of the potential for economies of scale, scope and because of the possibility of realising other synergies. This argument is most relevant when the companies merging are similar and provide the same service or produce the same good, i.e. in the case of horizontal mergers. This is because the number of functions that can be grouped together is larger and so are the potential benefits. Companies that provide different services or produce different goods can benefit from economies of scale by merging "general" functions such as finance, human resources, information technologies, and others. As in information activities these departments normally play a support role rather than a core role, their size within the company is relatively limited.

As explained in the previous chapters, the history of the sub-sectors reviewed illustrates how mergers and acquisitions between similar types of businesses have been successful: these include mergers between cable companies in the 1990s, which were mainly motivated by network clustering (see Parsons 2003), mergers between cinema theatres ownerships and the rise of multiplex cinemas (see Chapter Eight in this study) and mergers between wireless telecom operators during the 1990s and the first years of the new millennium, which allowed companies to extend their networks (and generate a network effect) by putting their frequency licences and subscribers together (Curwen 2004).

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[104] A FCC's document about the transfer of licences between the newly formed AOL Time Warner Company states (FCC 2001 p4) "The balancing of potential harms and benefits to the public interest is particularly appropriate in the context of reviewing license transfer applications that are associated with significant mergers because such mergers are likely to create potential for both good and ill. For example, the same concentration of assets that may support technological innovation by providing sufficient capital to take the necessary risks or by reducing transaction costs may also allow the merged entity to create or enhance barriers to entry by its competitors. As a result of this ambiguity, the outcome most favorable to the public interest, in terms of the policies and objectives of the Communications Act, is often best achieved by allowing the transfers, and thus the associated merger, to proceed (thus obtaining the positive benefits of the combination), but only subject to certain conditions, either voluntarily agreed to or imposed by the Commission under its statutory authority, designed to minimize the potential harms or increase the potential benefits."

On the other hand, merging companies in the information sector that provide different services or manufacture different goods are more interested in achieving economies of scope and other types of synergies. Two types of economies of scope and synergies are typical of the information sector: the first is the possibility of bundling different but related services and goods together, facilitating the supply and providing more and different services at a reduced cost (and price) than if they were sold separately (e.g. Broadband internet and cable services); the second type of economy of scope/ synergy also refers to the bundling of different services and/or manufacturing goods, but this time for cross-promotional reasons. The latter include for example, broadcast networks adding to their schedules television programmes whose rights are owned directly by the network or through another company that is part of the same media conglomerate.

Although the realisation of economies of scale and scope is a typical argument for mergers and acquisition, here we claim that in the case of vertical mergers these arguments are overrated. In fact, in the information sector (and possibly in many other sectors) there are many examples of companies realising synergies and bundling different but related services and/or goods in a way that is mutually convenient, and this without merging. Here, we can put forward two of these examples: (1) mobile phone operators include new mobile phone sets (and regular upgrades) in their tariff plans, yet none of the network operators is affiliated with mobile phone manufacturers; (2) a very large majority of PCs is sold with the most recent Microsoft operating system, yet Microsoft is not (part of) any conglomerate that controls PC manufacturers. In other words, in the economic environment and under the current legislation, vertical ties between information activities that are mutually effective, are not only generally allowed, but are very common. Notably, nowadays many companies outsource part of their production chain to separate and specialised companies.

In effect, companies can realise (most of) the main benefits of mergers and acquisitions by simply establishing commercial relationships with related partners, therefore making an actual merger or acquisition unnecessary. The argument about the realisation of economies of scale still holds, although it is relatively weak to explain mergers between large companies. Therefore, the point we make here, is that in reality the argument of the creation of synergies as a consequence of a merger or acquisition becomes even less convincing when the consequences of the existence of technological trajectories are brought into the analysis. In fact, as explained in previous chapters, information companies that vertically merge with other companies preclude themselves from a series of technological developments, because they are forced to find synergies with specific companies (notably, the ones that are part of the same conglomerate) instead of being able to make any ties with any company on the basis of innovations that can be spurred as a result of a new relationship.

Moreover, if mergers and acquisitions lead to the realisation of economies of scale, keeping two companies collaborating as separate entities represents an opportunity cost. Yet, the modularity concept adopted in this project suggests that if the *rules of the game* governing the relationship between modules are standardised, this opportunity cost is minimised and at the same time the number of (potential) innovation opportunities is maximised.

Again, we illustrate this theoretical suggestion with examples taken from our evolutionary account: rules of the game are standards when, first, they present the characteristics of visible rules (i.e. the information accessible to other all the other potential module makers) as opposed to presenting the characteristics of *hidden rules* (i.e. such as being based on tacit knowledge or private information); and second, when the costs of creating and maintaining a relationship between two modules are minimised. This happens when there are general rules regulating a particular type of relationship instead of being the terms of the relationship contingent and requiring new negotiations. There are many examples in the information sector of relationships governed by standard rules; we list here three of them.

First, all PC manufacturers willing to sell their products inclusive of a Microsoft operating system must acquire a licence. The charge of this licence is normally passed on to the end-user (Evans, Hagiu and Schmalensee 2004). Second, in the audiovisual media service industry, cable MVPDs wanting to transmit (non-encrypted) broadcast and nonbroadcast networks signals do not have to negotiate this right with the latter; they automatically have the right to do so provided they pay royalties to the Copyright Office that are proportional to the number of their subscribers (see Chapter Eight). Third, in the wireline telecommunication sector, end-users in the US wanting to select an operator for long distance calls have the possibility to do so by subscribing to the long distance communication provider and by selecting this provider before calling by virtue of the equal access mechanisms. Compensations for connecting the call due by long distance providers to local networks' providers are regulated and calculated by a standard procedure, so that long distance network providers do not have to negotiate a rate with each individual local provider (see Chapter Five).

Another interesting case concerns the standardisation of the rules governing the relationship between activities that are part of the same company or conglomerate. As explained in Chapter Five, a certain number of regulations and case scenarios was introduced in the wireline telecommunication industry in order to give non-incumbent companies (whether voice or data service providers) "fair" access to the PSTN. For example, following the US Telecommunication Act of 1996 and the liberalisation of the local loop, among these rules, we find the openness of terms and conditions enforced on the incumbent operators and the obligation to provide its services to competitors requesting them and to apply the same conditions to affiliate and un-affiliate companies alike.

Another example concerns the participation of the incumbent carrier in the enhanced services market (i.e. the data transmission): following the Computer Enquiry III and from 1985, incumbent carriers were allowed to participate in these markets only through separate subsidiaries but in a regime of non-structural safeguards. In this case, the subsidiary of the incumbent carrier participates as a separate (and accountable) company in the enhanced services market while, at the same time, benefiting from the economies of scale and scope of being (structurally) “joined” to the main network provider.

We claim that these types of regulatory changes could be taken as examples and a starting point to create others that would standardise the rules of the game between audiovisual media service activities: as an example, the concentration of distribution companies is thought to be an important obstacle to the development (and the diversity) of production companies. As a result, similar rules could be applied in order to compel distribution companies to give projects produced by affiliates or independent companies the same access to their distribution network.

However, the most important suggestion highlighted by this analysis is that justifications inspired by mainstream economic thinking, supporting vertical mergers and acquisitions in the information sector (i.e. the potential for increased innovation and economies of scope and scale), lack of robustness. Moreover, a modular organisational structure, although embodying an opportunity cost given the existence of duplicate tasks and roles between collaborating companies is seemingly the most prone to incentives for innovation. In most cases the mechanisms that deal with change lead to the creation of standard rules: therefore when the market does not incentivise the creation of these rules, the regulator should be expected to play this role.

10.5. Innovations and the Role of the Regulator in the Information Sector

At the end of these conclusions summarising differences and common characteristics of the industries analysed in this project, we would like to provide a summary of insights on the role played by the regulator in the evolution of the information sector. Of course, the influence of the regulator on the shaping of this sector was very significant and this adds further arguments against the supremacy of the current mainstream attitude, which sees the role of institutions as marginal, as is inspired by neoliberal political thinking.

In this project, we have defined the regulator as the group of institutions, state or federal, with regulatory power over the information sector, the most common being the Federal Communication Commission (FCC), the Government and the Department of Justice in particular, the Senate and District Courts. The role of the regulator in the shaping of the information sector has been threefold: the first is a proactive role, the second concerns the managing of scarce “natural” resources associated with the information sector, and the third relates to its part as a mechanism for filtering and adapting change.

As illustrated in the evolutionary accounts included in this project, in its proactive role the regulator has been particularly influential in the first years of the development of all four of the information sub-sectors reviewed in the previous chapters: the wireline and wireless telecom industry, the audiovisual media services and the IT industry.

In order to fulfil this proactive role, the regulator has been financing and facilitating the creation of innovations in the sector and the expansion of activities, either directly through subsidies (typical of the telecommunication industry) or indirectly through contracts with private companies for the provision of public goods (as characterising in the semiconductor and computer industries).

The efforts made in bilateral and multilateral negotiations to remove trade restrictions affecting the export of services provided by American information industries, can also be considered part of the regulator’s proactive role. Although the regulator worked to increase the overseas audience for American cultural products since the time of the First World War (Garnham 1990 cited by Preston 2001), it was the Uruguay Round of the General Agreement on Tariffs and Trade (GATT) in the early 1990s which greatly extended the concepts and practices of 'free trade' and free flow of international investment to the service sectors (Preston 2001).

However, in the two decades that preceded the Uruguay round, many countries had trade barriers in place limiting the imports of cultural products. These barriers were not only in place to protect infant cultural industries as *economic entities* and against bigger and stronger foreign players. Interestingly, because of the nature of cultural products and the effects that the content can have on other “national” identities, American (and more general “Western”) efforts to promote the diffusion of its cultural product overseas are seen as a controversial issue among many scholars of political economy of communication and political science. The trade barriers erected also echoed these sentiments.

In particular, this viewpoint was shared by the majority of “international communication” scholars, which understood the Western diffusion of cultural text - such as the global system of diffusion of international news - as a form of cultural imperialism or neo-colonialism (Corcoran 2004).

However, core neoliberal ideas did not inspire all regulations affecting the information system throughout the entire period analysed here. As illustrated by the results of the successive computer enquiries and the various court cases involving the FCC and media industries, the attitude towards intervention in the telecommunication industry (wireline and wireless) is different to the types of interventions realised in the audiovisual media service industry and the computer industry. Clearly, the regulatory framework that dominates both markets seems to comply with the core neoliberal assumptions and let market mechanisms test the fitness and shape the evolution of all types of companies: however, the telecommunication industry especially in the beginning (although possibly less so since the latest reform of the 1996 Telecommunication Act) was understood as in need of protection and/or regulation.

Therefore, on the one hand, intervention in the audiovisual media services and IT industries is mostly targeted at avoiding or breaking monopolies and/or preventing predatory market behaviour. However, apart from these case scenarios, the guiding assumption of the regulator is to leave the market act as the main selection mechanism.

On the other hand, the rationale behind the regulation of the telecommunication industry is threefold: first all of telecommunications (at least the wireline industry) were understood as a critical national resource and therefore protected and regulated to align private goals and public needs; second, as long as telecommunication markets were considered natural monopolies, telephone networks were treated as scarce resources. As such, its exploitation required coordination and/or intervention: this happened with the Willis Graham Act in 1921 and the conscious decision to let AT&T create a *de facto* monopoly, the 1984 MFJ when the AT&T network was separated between a long distance provider (which was no longer a natural monopoly) and several RBOCs (which were still "natural" monopolies).

Moreover, wireless telecommunication devices rely on the exploitation of portions of the radio spectrum, which is also a scarce resource whose frequencies are allocated by the regulator. Third, the (local) telephone network is expected to fulfil a role of public or universal service. The management of scarce resources is also an instrument used by the regulator to fulfil what we have indicated above as its third role, the one of acting as filter for selecting and adapting to change. In fact, especially in the case of the airwaves, as the evolutionary account in this project testifies, the allocation of frequencies was vital for the testing and the realisation of new generations of technologies. Given that the radio spectrum is at least temporarily insufficient to satisfy all demand (although successive technologies introduce a more accurate use of the spectrum and "enlarge" it as a result), by deciding on its allocation the regulator decides on which technologies are more important (and their requests satisfied and their development favoured) and which ones are less important.

Moreover, in the case of the first generation of mobile telephony and television systems, the regulator (in the form of dedicated selection committees) had a direct involvement in the "battle of the standards" and the final word on the selection process. As Edquist (2004) explains, the emergence of a standard in the case of the first two generations of mobile telephony was the result of an "*institutional push*". In other media markets however, this type of battle was resolved by the market alone. By comparing the two processes, we notice that when the regulator intervenes in the selection, the determination of an overall standard results in a much shorter process and investors and related innovations benefit from a certain degree of certitude about the future of a particular technology, which is absent while standards are in competition. On the other hand, the longer market process is expected to lead to the selection of what is the best standard among the competing technologies.

10.6. Virtues, Shortcomings and Future Developments of this Research

As I stated in the introduction, the primary objective of this study is to propose an alternative analysis of the relationship between innovation and economic performance in the information sector and the influence of the latter on the current economic environment. From the start, I decided that the thesis was to be mainly written for an audience of economists (in particular, institutional economists) and communications scholars. This provides an essential clue for interpreting the concept of an *alternative* analysis.

Coming from an economic background (although relatively little exposed to institutional / evolutionary economic theories) after the first few months of reviewing communications papers, and in particular from the political economy of communications tradition, I have realised that these engaged very little with traditional economic authors and theories and with the economic literature more in general.[105] This is somewhat unusual given that communications is certainly a truly multidisciplinary field.

An explanation for this observation can be found in the critical reviews of the neoclassical economic approach. For example, from the words of Nelson and Winter (1982) and given the rigorous methodology that characterises mainstream economics, we understand that it is very uncommon that scholars of this school of thought integrate their analysis with a multidisciplinary theoretical framework. I found this argument very persuasive. However, mainstream economic models can be used in combination with multidisciplinary analysis depending on the availability of data and in order to illustrate a trend empirically. These models are very useful when one needs to focus on very specific industries or products, to compare

[105] This is true, of course, if *media economics* writings are not considered under the umbrella of the political economy of communications strand, but they are considered as economic papers focussed on the media sector.

trends between similar (and comparable) output, to see a correlation between the investments and changes in the production capacities of an economic activity. I used a model developed by Nordhaus in this thesis, for example, to compare output trends between different groups of industries to demonstrate the existence of a cost disease dynamic.

However, the diffusion of digital technologies in the information sector has introduced communications scholars with a new set of complex research questions. This includes questions about the origin, the nature and the consequences of innovation in this sector. Some of these questions concern economic aspects of the information sector and are the following: how is the convergence of media to digital platforms affecting the competition in the sector? How is this new trend leading to the introduction of new business models? How are these business models affecting the concentration of media/information conglomerates ownership? Are digital platforms likely to increase diversity in the media or reduce it? What is the best public policy framework that allows the information sector grow but does not affect (or can even improve) the diversity of information sources?

These are the kind of questions communications scholars are interested in and are investigating; and these are also the kind of questions that are directly linked to my primary research questions. Moreover, it is commonsense among communications scholars to think that in order to understand what is really *new* about *new media*, these need to be compared to the old media (e.g., see Preston 2001). Therefore, a study about economic and policy aspects of new media that has the expectation of being of interest to communications scholars should be grounded in a long term historical analysis and it should provide insights into complex and broad questions concerning the implications of innovations in the information sector. The economic approach that is best suited to these requirements is the institutional / evolutionary framework, as it focuses on economic aspects of innovation; it privileges a long term view; is openly interdisciplinary and pays a lot of attention to institutional factors and regulatory changes (Hodgson 1998).

Gradually, during the research and in the attempt to answer specific, secondary research questions, I have built a theoretical framework from many writings coming from different traditions: these include institutional economics / neo-Schumpeterian and other evolutionary accounts, mainstream economics (in particular, the productivity / New Economy literature), complexity economics, complex evolving systems, complex product systems (CoPS), modularity, political economy of communications, media economics, cultural economics and service innovation.

Building on this original combination of theories, I was able to provide interesting and alternative insights, for example, on the role of the regulator in the wireline telecommunication sector (see section 6.6) or on the fitness of the current regulatory framework (with particular attention to the rationale for mergers and acquisitions) in fostering innovation in the audiovisual media service industry (see section 8.4). Moreover, by merging different viewpoints I was also able to, first, give Baumol's idea of Cost Disease a new reading (see section 3.3.2) and second, to challenge with informed arguments some of the established notions about the New Economy (see Chapter Nine).

Moreover, particularly in this last chapter, I have offered alternative viewpoints as answers to common research questions concerning the effects of innovation in the information sector, by comparing three different information sub-sectors: the wireline telecommunication industry, the computer industry and the audiovisual media service industry. From this comparison, I have documented and learned from interesting common trends, such as the services-ation as a consequence of the increased complexity, as well as from (sub-sector) specific trends, such as the increasing cost of producing content in the audiovisual media service industry.

The research questions posed are very complex and clearly the answers offered are not exhaustive. More research on the subject should be carried out, more approaches explored and integrated to the framework. Moreover, this research focuses solely on the United States. While it is a shortcoming to base our understanding of the evolution of the information sector on the history of one country, it almost certainly represents on the other hand the most significant example. Clearly, integrating this analysis with other and different examples (e.g. the European case) as well as considering more carefully the "international dimension" of the American production, could lead to more interesting observations.

In this research the different schools of thought considered are necessarily "generalised". This is also a shortcoming. For example, in the evolutionary/ heterodox economics field, often mathematical modelling is not just used as an illustration, but rather it occupies a central role in the specification of a theory (e.g. the Social Structure Accumulation theories, such as the ones in McDonough et al. 2006).

Moreover, a number of generalisations were made in this study about mainstream economics, most notably those that can be referred to as the more traditional of the neoclassical body of literature, which most likely have inspired many *Reports and Orders and Notices of proposed Rulemaking* issued by the FCC. Many mainstream economists are aware of the shortcomings caused by the use of neoclassical assumptions, and now question their use and attempt to depart from them. As a result, in 2001 the Nobel Prize was awarded to George Akerlof, Michael

Spence, and Joseph Stiglitz, whose models recognize that not everyone has access to perfect information. Moreover, in 2002 the Nobel went to Daniel Kahneman and Vernon Smith for their work on more realistic theories of behaviour (Beinhocker 2007).

A central finding of this study, however, is that it is interesting and instructive to carry out an analysis of the changes that occurred in the information sector and how these changes are affecting the US economy by embracing a broader perspective; one that is multidimensional, institutional, historical and complex. Besides the careful review, it is acknowledged that some of our statements regarding mainstream economics (i.e. the "traditional" neoclassical economics) can be challenged by new and more recent examples. However, I have chosen to focus mostly on providing and explaining the alternative rather than illustrating the existing contradictions in the mainstream approach. While I regard this as a particular strength of the work, I appreciate that this approach will have its critics.

In attempting to build an inter-disciplinary theoretical framework on different theories, as done throughout this project, the theorist relies on the subjective choice of theories, and on that basis, clearly such choices in the present study may be questioned. In general terms, however, these choices were based on the general maxim used to define the "perfect" multidimensional framework: the use of the maximum number and variety of theories in order to grasp complexity and the least amount in order to promote coherence and simplicity. This idea underpins my choice.

Whilst recognising that the political economy of communication school of thought provides a rich body of literature focussing on media and information industries from different viewpoints, only a limited number of these authors feature in my analysis. As explained in the introduction to this study, through the hypothesis of the *Good State*, I concentrate on the argument that that the regulator could benefit from adopting a multidisciplinary approach. I demonstrate this by comparing the FCC's viewpoint on mergers and acquisition, which can be justified with mainstream economic principles, with other principles drawn from a set of heterodox economic theories. Although it cannot be stated definitely that the regulator could be "good" by adopting a multidisciplinary approach to asses whether changes are in the public interest, in light of my findings, it can be argued that the regulator could be at least "better" if it did so. I believe that at this stage of my research, writings in the political economy tradition are complementary to the interdisciplinary perspective adopted here. As I claim that economic theory alone does not provide an exhaustive explanation of the relationship between innovation and economic performance of the information sector, *de facto*, I am arguing that other theoretical approaches should be added to this multidimensional framework.

My (main) secondary research objective, as stated in the introduction, is to promote the utility of a multidimensional and multidisciplinary analysis of economic dynamics, especially for studying the information sector. In more general terms, my hope is that this research will inspire future writings to experiment with the most recent heterodox economic theories and interdisciplinary approaches and to use them as tools for studying the media in particular. Moreover, these writings should attempt to understand new media business models and the economic dynamics of their complex products and services, and feed back information to the more general theoretical economic framework in order to understand the shortcomings of traditional approaches and to provide a contribution to their own evolution.

Bibliography

Adam, K. Johanson, M. and Gravesen, I. 1995. Service Productivity: a vision or a search for a new outlook. *The ninth World Productivity Congress*. Conference held in Istanbul, on June, 4-7.

Administrative Council for Terminal Attachments (ACTA). 2006. *An Overview of the Administrative Council for Terminal Attachments* (ACTA) [Online]. Available from <http://www.part68.org/aboutMain.aspx > [Accessed March 2006].

Aghion, P. and Howitt, P. 1992. A Model of Growth Through Creative Destruction. *Econometrica*, 60 (2). pp323-51.

Aksoy, A. and Robins, K. 1992. Hollywood for the 21st century: global competition for critical mass in image markets. *Cambridge Journal of Economics*, 16. pp1-22.

Alexander, C. 1964. *Notes on the Synthesis of Form*. Cambridge, MA: Harvard University Press.

Allen, J. 2003. *Citing & Referencing: A Guide for Students*. Dublin: DCU Library

Amable, B. 1994. Endogenous Growth Theory, Convergence and Divergence. *IN*: G. Silverberg and L. Soete (eds.) *The Economics of Growth and Technical Change - Technologies, Nations, Agents*. Aldershot, UK and Brookfield, US: Edward Elgar. pp 20-44.

Arden, B. D. 2004. Competition versus Regulation: "Mediating Between Right and Right" in the Wireless and Wireline Telephone Industries. *Federal Communications Law Journal*, 57(1). pp107-128.

Arnbak, J. 1997. Managing the Radio Spectrum in the New Environment. *IN*: Melody, W. H. (ed.) *Telecom Reform. Principles, Policies and Regulatory Practices*. Lyngby: Den Private Ingeniørfond. pp131-139.

AT&T. 2006. *1976: First Digital Electronic Switching.* [Online]. Available from <http://www.corp.att.com/attlabs/reputation/timeline/76digital.html> [Accessed March 2006].

Baldwin, C. Y. and Clark, K. B. 1997. Managing in an age of modularity. *Harvard Business Review*. Sep-Oct. pp84-94.

Baldwin, C. Y. and Clark, K. B. 2000. *Design Rules: The Power of Modularity*. Cambridge, MA: MIT Press.

Balio, T. 1976. Retrenchment, reappraisal and reorganization. *IN:* T. Balio (ed.) *The American Film Industry*. Madison: University of Wisconsin Press. pp315-331.

Bardach, E. 1991. On the Representing the Public Interest. *Ethics*, 91(3). pp486-490.

Barro, R. J. 1990. Government Spending in a Simple Model of Endogenous Growth. *Journal of Political Economy*, 98(5). pp103-125.

Barro, R. J. and Sala-I-Martin, X. 1992. Public Finance in Models of Economic Growth. *Review of Economic Studies*, 59(4). pp645-661.

Bates, B. J. and Chambers, T. 2004. The Economics of the Cable Industry. *IN:* A. Alexander, J. Owers, R. Carveth, A. C. Hollifield, and A. N. Greco (eds.) *Media Economics: Theory and Practice*. Third Edition. Mahwah: Lawrence Erlbaum Associates Inc. Publishers. pp173-192

Baumol, H. and Baumol, W. J. 1987. The Mass Media and the Cost Disease. *IN:* R. Towse (ed.) *Baumol's Cost Disease: The Arts and other Victims*. Cheltenham, UK - Northampton, USA: Edward Elgar. pp180-194.

Baumol, W. J. 1967. Macroeconomics of Unbalanced Growth: The Anatomy of Urban Crisis. *American Economic Review*. 57(3), June). pp415-26. *IN:* R. Towse (ed.) 1997. *Baumol's Cost Disease: The Arts and other Victims*. Cheltenham, UK - Northampton, USA: Edward Elgar.

Baumol, W. J. 1987. Performing Arts. *IN:* J. Eatwell, M. Milgate and P. Newman (eds.) *The New Palgrave: A Dictionary of Economics,* 3. London : The Macmillan Press. pp842-843.

Baumol, W. J. 1993. Health care, education and the cost disease: A looming crisis for the public choice. *Public Choice*, 77. pp17-28.

Baumol, W. J. 2002. Services as leaders and the leader of the services. *IN:* F. G. Gadrey and F. Gallouj (eds.) *Productivity, innovation and knowledge in services :new economic and socio economic approaches*. Cheltenham, UK - Northampton, USA: Edward Elgar. pp147-163.

Baumol, W. J. 2007. Keynote Speech *IN: Service Competitiveness and Cohesion – Balancing Dynamics in the Knowledge Society*. RESER conference, 13-15 of September. Tampere, Finland.

Baumol, W. J. and Bowen, W. G. 1966. On the Performing Arts: The Anatomy of their Economic Problems. *American Economic Review*. 50(2) May. *IN:* R. Towse (ed.) 1997. *Baumol's Cost Disease: The Arts and other Victims*. Cheltenham, UK - Northampton, USA: Edward Elgar. pp495-502.

Baumol, W. J. and Oates, W. E. 1972. The Cost Disease of the Personal Services and the Quality of Life. *Skandinaviska Enskilda Banken Quarterly Review*, 2. *IN:* R. Towse (ed.) 1997. *Baumol's Cost Disease: The Arts and other Victims*. Cheltenham, UK - Northampton, USA: Edward Elgar. pp44-54.

Baumol, W. J. Batey Blackman, S. A. and Wolff, E. N. 1985. Unbalanced Growth Revisited: Asymptotic Stagnancy and New Evidence. *American Economic Review*. 75(4). pp806-817.

Beinhocker, E. D. 2007. The Origin or Wealth. Random House Business Books; London.

Bekkers, R. Duysters, G. and Verspangen, B. 2002. Intellectual property rights, strategic technology agreements and market structure: The case of GSM. *Research Policy*, 31. pp1141–1161.

Bellis, M. 1999. Selling The Cell Phone. [Online]. Available from <http://inventors.about.com/library/weekly/aa070899.htm > [Accessed March 2006]

Berezdivin, R. Breinig, R. and Raytheon, R. T. 2002. Next-Generation Wireless Communications Concepts and Technologies. *IEEE Communications Magazine*, March. pp108-116.

Bielby, W. T. and Bielby, D. D. 2003. Controlling Prime-Time: Organizational Concentration and Network Television Programming Strategies. *Journal of Broadcasting & Electronic Media*, December. pp573-596.

Bjork, U.J. 1995. The backbone of our business: American films in Sweden, 1910-50. *Historical Journal of Film, Radio & Television*, 15(2). June. pp245-263.

Blair, H. Culkin, N. and Randle, K. 2003. From London to Los Angeles: a comparison of local labour market processes in the US and UK film industries. *International Journal of Human Resource Management*, 14(4). pp619–633.

Blevins, J.L. 2002. Source Diversity after the Telecommunication Act of 1996: Media Oligarchs Begin to Colonize Cyberspace. *Television and New Media*, 31(1). pp95-112.

Blevins, J.L. and Brown, D.H. 2007. The Political Economy of Media Ownership Rulemaking within the U.S. Federal Communications Commission: an Analysis of Media Ownership Studies. Paper presented to the Political Economy Section of the International Association for Media and Communication Research (IAMCR) for its 50th Anniversary Conference in Paris, France, July 23-25.

Blevins, J.L. and Brown, D.H. 2006. Political Issue or Policy Matter? The U.S. Federal Communications Commission's Third Biennial Review of Broadcast Ownership Rules. *Journal of Communication Inquiry,* 30(1). pp21-41.

British Broadcasting Corporation (BBC). 2000. AOL, Time Warner confirm Merger. [Online]. Monday, 10 January. Available from <http://www.bbc.co.uk> [Accessed January, 2007]

Brooks, F. P. 1976. *Telephone: the first hundred years*. New York: Harper and Row.

Brown, A. 1996. Economics, Public Service Broadcasting and Social Values. *Journal of Media Economics*. 9(1). pp3-15.

Brown, C. 1982. *Plan of reorganization. United States of America v. Western Electric Company, Inc., American Telephone and Telegraph Company*, Civil action 82-0192, (in the United States District Court for the District of Columbia) [Online]., available from < http://www.bellsystemmemorial.com/> [Accessed March 2006]

Brusoni, S. 2003. Authority in the Age of Modularity. *SPRU Electronic Working Paper Series*, 101. pp1-24.

Brusoni, S. and Prencipe, A. 2001. Unpacking the Black Box of Modularity: Technologies, Products and Organizations. *Industrial and Corporate Change*, 10(1). pp179-205.

Bureau of Labor Statistics (BLS). 1997. *Multifactor productivity, private non-farm business: Productivity and related indices, 1948-1997*. [Online]. Available from <http://www.bls.gov> [Accessed October 2006]

Bureau of Labor Statistics (BLS). 2001. Multifactor Productivity Trends. 1999. US *Department of Labor News Release*, 1(402).

Bureau of Labor Statistics (BLS).1999. Unit Labor Costs for selected Industries, 1987-97. *Bureau of Labor Statistics Report*, 939. pp1-12. [Online]. Available from <http://www.bls.gov> [Accessed October 2006]

Business Wire. 2000. Media Metrix Releases Internet Measurement Results for the U.S., Australia, Canada, France, Germany, U.K. & Japan. *Business Wire* [Online]. Available from LexisNexis <http://web.lexis-nexis.com/professional/> via Dublin City University Library. <http://www.library.dcu.ie/> [Accessed on Mai 2007]

Campbell-Kelly, M. and Aspray, W. 2004. *Computer A history if the information, machine*. Second Edition. Boulder, US and Oxford, UK: Westview Press.

Cannon, R. 2003. The Legacy of the Federal Communications Commission's Computer Inquiries. *Federal Communications Law Journal*, 55(2). pp167-206.

Carpenter, M. Lazonick, W. and O'Sullivan, M. 2003. The stock market and innovative capability in the New Economy: the optical networking industry. *Industrial and Corporate Change*, 12(5). pp963-1034.

Carson, D. O. 2004. Satellite Home Viewer Extension Act, *Statement by David O. Carson, General Counsel, United States Copyright Office before the Committee on the Judiciary, United States Senate, 108th Congress, 2nd Session* [Online]. Available from Television Bureau of Advertising (TVB) <http://www.tvb.org> [accessed January 2007]

Caves, R. 2003. Contracts Between Art and Commerce. *Journal of Economic Perspectives*, 17(2). pp73-84.

Champlin, D. P. and Knoedler, J. T. 2002. Operating in the Public Interest or in Pursuit of Private Profits? News in the Age of Media Consolidation. *Journal of Economic Issues*, 36(2). pp459-68.

Chesbrough, H. 2005. Towards the Dynamics of Modularity - A cyclical model of technical advance. *IN:* A. Prencipe, A. Davies and M. Hobday (eds.) *The Business of Systems Integration*. Second Edition. Oxford and New York: Oxford University Press. Part II. pp174-98.

Chiou, L. 2006. The Timing of Movie Releases: Evidence from the Home Video Industry. *Occidental Economics Working Papers*, 4. pp1-42.

Christopherson, S. 2006. Behind the scenes: How transnational firms are constructing a new international division of labor in media work. *Geoforum*, 37. pp739–751.

Clark, H. 1847. Physical Economy: A Preliminary Inquiry into the Physical Laws Governing the Periods of Famines and Panics. *Railway Register*.

Clark, N.1985. *The Political Economy of Science and Technology*. Oxford: Basil Blackwell.

Cones, J. 1996. *The Feature Film Distribution Deal: A Critical Analysis of the Single Most Important Film Industry Agreement.* Carbondale: Southern Illinois University Press.

Connolly, M. and Kwerel, E. 2007. Economics at the Federal Communications Commission: 2006–2007. *Review of Industrial Organisation*, 31. pp107-120.

Corcoran, F. 2004. *RTE and the Globalisation of Irish Television*. Intellect; Bristol, UK and Portland, U.S.

Corn-Revere, R. and Carveth, R. 2004. Economics and Media Regulation. *IN:* A. Alexander, J. Owers, R. Carveth, A. C. Hollifield, and A. N. Greco (eds.) *Media Economics: Theory and Practice*. Third Edition. Mahwah: Lawrence Erlbaum Associates Inc. Publishers. pp49-67.

Coy, P. 1999. Commentary: The lessons of the AT&T breakup. [Online]. *Business Week*, 22(50), November. Available from <http://www.businessweek.com> [Accessed, March 2006]

Crafts, N. 2002. The Solow Productivity Paradox in Historical Perspective. *CEPR Discussion Paper*, 3142.

Croteau, D. and Hoynes, W. 1997. *Media/Society*. Thousand Oaks, California: Pine Forge Press.

Curwen, P. 2004. Has GSM won the technology war? *Info*, 6(1). pp61-62.

Curwen, P. 2005. The prospects for 3G in the USA: the view from Europe. *Info*, 7(3). pp16-32.

Cusumano, M. A. and Gawer, A. 2002. The Elements of Platform Leadership. *MIT Sloan Management Review*, 2002. pp51-58.

Dal Bó, E. 2006. Regulatory Capture: A Review. *Oxford Review of Economic Policy*, 22(2).

pp203-225.

Dal Bó, E. Dal Bó, P. and Di Tella, R. 2006. Plata o Plomo? Bribe and Punishment in a Theory of Political Influence. *American Political Science Review*, 100(1). pp41-53.

Dana, J. D. Jr. and Spier, K. E. 2001. Revenue Sharing and Vertical Control in the Video Rental Industry. *The Journal of Industrial Economics*, 3(49). pp223-245.

David, P. 1999. Digital Technology and the Productivity Paradox: After Ten Years, What Has Been Learned? *IN: Understanding the Digital Economy: Data, Tools and Research*. U.S. Department of Commerce. Washington, D.C. on 25-26 May 1999.

David, P. 2000. Understanding Digital Technology's Evolution and the Path of Measured Productivity Growth: Present and Future in the Mirror of the Past. *United Nations World Employment Programme Papers*, 99-011. pp1-27.

De Vany, A. and McMillan, H. 2004. Was the Antitrust Action that Broke Up the Movie Studios Good for the Movies? Evidence from the Stock Market. *American Economic and Law Review*, 6(1). pp135-153.

De Wolff, S. 1925. *Het economish getij*. Emmering: Amsterdam.

Dedrick, J. and Kraemer, K. L. 1998. Globalization in the computer industry: Implications of the Asian production network for the U.S. *Information System Research*, 9(4). pp303–322.

DeFillippi, R. J. and Arthur, M. B. 1998. Paradox in Project-Based Enterprise: The case of Film Making. *California Management Review*, 40(2). pp125-139.

DeLong, B. J. and Summers, L. H. 2002. The New Economy: Background, Historical Perspective, Questions, and Speculations. *Federal Reserve Bank of Kansas City Proceedings*, 2001. pp11-43.

Den Hertog, P. and Bilderbeek, R. 2000. The New Knowledge Infrastructure: The Role of Technology-based Knowledge-Intensive Business Services in National Innovation Systems. *IN:* M. Boden and I. Miles (eds.) *Services and the Knowledge-Based Economy*. London/New York, NY: Continuum. Pp 222-246.

Denison, E. F. 1962. The Sources of Economic Growth in The United States and the Alternatives Before Us. *Supplementary paper*, 13. New York: Committee for Economic Development.

Dobal, C. H. 1998. A Proposal to Amend the Cable Compulsory License Provisions of the 1976 Copyright Act. *Southern California Law Review*, 61. pp699-732.

Doherty, T. 2007. Quiz Show Scandals. [Online]. *The Museum of Broadcast Communications.* Available from < http://www.museum.tv/home.php> [Accessed July 2007].

Domar, E. 1961. On the Measurement of Technological Change. *Economic Journal*, 71(284). pp709-729.

Dosi, G. 1988. Sources, Procedures, and Microeconomic Effects of Innovation. *Journal of Economic Literature*, 26 Sep. pp1120-71.

Dosi, G. and Nelson, R. 1994. An introduction to Evolutionary theories in economics. *Journal of Evolutionary Economics*, 4. pp153-172.

Doyle, G. 2002. *Understanding Media Economics*. Oxford UK: Sage Publications.

Doyle, G. 2002b. *Media Ownership*. Oxford UK: Sage Publications.

Eckstein, O. 1980. Testimony, United States vs. American Telephone and Telegraph Co., *Civil Action no. 74- 1698*. U.S.D.C., D.C., 1974

Economic Classification Policy Committee of the United States (ECPC). 2003. Overview of NAPCS Objectives, Guidance, and Implementation Strategy and Goals: A United States Perspective. [Online]. *NAPCS Discussion Paper*. Trilateral Steering Group Meeting Washington, DC May 5-9. Available from <http://www.census.gov/eos/www/napcs/papers/> [Accessed July 2007]

Edquist, C. 2004. The Fixed Internet and Mobile Telecommunications Sectoral System of Innovation: Equipment Production, Access Provision and Content Provision. *IN*: F. Malerba (ed.) *Sectoral Systems of Innovation*. Concepts, issues and analysis of six major sectors in Europe. Cambridge University Press. pp 155-192

Edquist, C. Johnson, B. 1997. Institutions and Organisations in Systems of Innovations. *IN:* C. Edquist (ed.) *Systems of Innovations: Technologies, Institutions and Organizations.* London; Frances Pinter. pp 41-63.

Einstein, M. 2004. Broadcast Network Television, 1955-2003: The Pursuit of Advertising and the Decline of Diversity. *The Journal of Media Economics*, 17(2). pp145-155.

El-Sayed, M. and Jaffe, J. 2002. A View of Telecommunications Network Evolution. *IEEE Communications Magazine*, December. pp74-81.

Emerson, T. I. 1963. Towards a General Theory of the First Amendment. *Yale Journal*, 72. pp877-954.

Epstein, E. J. 2005. *The Big Picture, The New Logic of Money and Power in Hollywood*. New York: Random House.

Ethiraj, S. K. and Levinthal, D. 2004. Modularity and Innovation in Complex Systems. *Management Science*, 50(2). pp159-173.

Evans, D. S. Hagiu, A. and Schmalensee, R. 2004. A Survey of the Economic Role of Software Platforms in Computer-based industries. *CESifo Working Paper*, 1314.

Falch, M. 1997. Cost and Demand Characteristics of Telecom Networks. *IN:* W. H. Melody (ed.) *Telecom Reform. Principles, Policies and Regulatory Practices*. Lyngby: Den Private Ingeniørfond. pp101-115.

Federal Communication Commission (FCC) Media Bureau. 2006. *Twelfth Annual Report.*

[Online]. *MB Docket*, 05-255. Available from <http://www.fcc.gov > [Accessed January 2007]

Federal Communication Commission (FCC). 2000. *Fact Sheet, Satellite Home Viewer Improvement Act of 1999* [Online]. Available from <http://www.fcc.gov/mb/shva/shviafac.html> [Accessed July 2007]

Federal Communications Commission. 2001. *Memorandum Opinion and Order.* Applications for Consent to the Transfer of Control of Licenses and Section 214 Authorizations by Time Warner Inc. and America Online, Inc., Transferors, to AOL Time Warner Inc., Transferee. CS Docket No. 00-30. [Online] Available from <http://www.fcc.gov > [Accessed September 2008]

Federal Communications Commission. 2003. *Report and Order and Notice of proposed Rulemaking.* Biennial Regulatory Review – Review of the Commission's Broadcast Ownership Rules and Other Rules Adopted Pursuant to Section 202 of the Telecommunications Act of 1996 (MB Docket 02-277) Cross-Ownership of Broadcast Stations and Newspapers (MM Docket 01-235) Rules and Policies Concerning Multiple Ownership of Radio Broadcast Stations in Local Markets (MM Docket 01-317) Definition of Radio Markets (MM Docket 00-244) Definition of Radio Markets for Areas Not Located in an Arbitron Survey Area (MB Docket 03-130). pp1-258. [Online] Available from <http://www.fcc.gov > [Accessed September 2008]

Federal Communication Commission (FCC). 2005. *Trends in the Telephone Service* [Online]. Available from <http://www.fcc.gov/wcb/iatd/trends.html/> [Accessed March 2006].

Federal Communications Commission (FCC). 2005b. *Tenth Report: Annual Report and Analysis of Competitive Market Conditions With Respect to Commercial Mobile Services*. [Online]. Federal Communications Commission. Available from <http://www.fcc.gov > [Accessed March 2006]

Federal Communication Commission (FCC). 2006. *Fact Sheet, Part 68, Notice of proposed rulemaking* [Online]. Available from <http://ftp.fcc.gov/Bureaus/ Common_Carrier/News_Releases/2000/> [Accessed March 2006]

Feigenbaum, H. 2004. Is technology the enemy of culture?*International Journal of Cultural Policy*, 10(3). pp251-263.

Ferguson, D. A. 2004. The Broadcast Television Networks. *IN:* A. Alexander, J. Owers, R. Carveth, A. C. Hollifield, and A. N. Greco (eds.) *Media Economics: Theory and Practice*. Third Edition. Mahwah: Lawrence Erlbaum Associates Inc. Publishers. pp149-171.

Fischer, C.S. 1992. *America calling: a social history of the telephone to 1940*. Berkeley: University of California Press.

Fransman, M. 2002. *Telecoms in the Internet Age*. Oxford and New York: Oxford University Press.

Freeman, C. 1988. Diffusion: The Spread of the New Technology to Firms, Sectors, and

Nations. In A. Heertje (ed.), *Innovation, Technology and Finance*. Oxford: Blackwell for the European Investment Bank.

Freeman, C. 1988b. Technology Gaps, International Trade and the Problems of Smaller and Less-Developed Economies. *IN:* C. Freeman and B.A. Lundvall (eds.) *Small countries facing the technological revolution*. London and New York: Pinter. pp67-84.

Freeman, C. 1992. Introduction. *IN:* C. Freeman (ed.) *Long Wave Theory*. Cheltenham, UK - Brookfield, US: Edward Elgar. pp xiii-xxxvi.

Freeman, C. and Louçã, F. 2001. *As Time Goes By - From Industrial Revolutions To the Information Revolution*. Oxford and New York: Oxford University Press.

Freeman, C. and Perez, C. 1988. Structural crises of adjustment, business cycles and investment behavior. *IN:* G. Dosi, C. Freeman, R. Nelson, G. Silverberg and L. Soete (eds.) *Technical Change and Economic Theory*. London & New York: Pinter. pp38–66.

Freeman, C. and Soete, L. 1997. *The Economics of Industrial Innovation*. Third Edition. London & New York: Continuum.

Gadrey, F. G. 2000. The Characterization of Goods and Services: an Alternative Approach. *Review of Income and Wealth*, 46(3). pp369-387.

Gadrey, F. G. 2002. The misuse of productivity concepts in services: lessons from a comparison between France and the United States. *IN:* F. G. Gadrey and F. Gallouj (eds.) *Productivity, innovation and knowledge in services: new economic and socio-economic approaches*. Cheltenham, UK & Northampton, USA: Edward Elgar. pp 26-53.

Gallouj, F. 2002. Innovation in services and the attendant old and new myths. *Journal of Socio-Economics*, 31. pp137-154.

Gandal, N. Salant, D. and Waverman, L. 2003. Standards in wireless telephone networks. *Telecommunication Policy*, 27. pp325–332.

Garnham, N. 1990. *Capitalism and Communication*. Sage Publications.

Geuens, J-P. 2002. The Digital World Picture. *Film Quarterly*, 55(4). pp16-27.

Giardina, C. 2007. Worldwide digital screen count passes 4,000. [Online]. *The Hollywood Reporter*. Available from < http://www.hollywoodreporter.com> [Accessed March 2007]

Gomery, D. 2004. The Economics of Hollywood: Money and Media. *IN:* A. Alexander, J. Owers, R. Carveth, A. C. Hollifield, and A. N. Greco (eds.) *Media Economics: Theory and Practice*. Third Edition. Mahwah: Lawrence Erlbaum Associates Inc. Publishers. pp193-206.

Gomulka, S. 1990. *The Theory of Technological Change and Economic Growth*. London & NY: Routledge.

Gordon, R. J. 1999. *Has the "New Economy" Rendered the Productivity Slowdown Obsolete?* [Online]. Cambridge, MA: Northwestern University and NBER. Available from <http://faculty-web.at.nwu.edu/economics/gordon/> [Accessed May 2003]

Gordon, R. J. 2000a. Interpreting the "one Big Wave" in U.S. Long-term Productivity Growth. *NBER Working Paper Series*, 7752.

Gordon, R. J. 2000b. Does the "New Economy" Measure up to the Great Inventions of the Past? *NBER Working Paper Series*, 7833.

Gordon, R. J. 2002. Hi-tech Innovation and Productivity Growth: Does the Supply Create Its own Demand? *NBER Working Paper Series*, 9437.

Gordon, R. J. 2004. Five Puzzles in the Behaviour of Productivity, Investment, and Innovation. *NBER Working Paper Series*, 10660. pp1-66.

Gormley, W. 1979. A Test of the Revolving Door Hypothesis at the FCC. *American Journal of Political Science*, 23(4). pp665-83.

Granstrand, O. 1999. *The Economics and Management of Intellectual Property: Towards Intellectual Capitalism*. Cheltenham, UK: Elgar.

Greenspan, A. 1998. Is there a New Economy?. *California Management Review*, 41(1). pp74-85.

Greenwood, J. Hercowitz, Z. and Krusell. P. 1997. Long-Run Implications of Investment Specific Technological Change. *American Economic Review*, 87. pp342-362.

Grubesic, T.H. and Murray, A.T. 2004. Waiting for Broadband: Local Competition and the Spatial Distribution of Advanced Telecommunication Services in the United States. *Growth and Change*, 35(2). pp139-165.

Gullickson, W. and Harper M.J. 2001. Bias in Aggregate Productivity Trends Revisited. *Monthly Labor Review*, March 2002. Bureau of Labor Statistics (BLS). pp32-40.

Hallerman, D. 2007. Portal Marketing: The Big Four. [Online]. emarketer.com. Available online from <http://www.emarketer.com> [Accessed January 2007]

Hampton, B. B. 1970. *History of the American Film Industry: From Its Beginning to 1931*. New York: Dover.

Hargittai, E. 2003. Content Diversity Online. *IN: Media Diversity and Localism: Meaning, Metrics, and the Public Interest. Conference Report.* Conference held at the Donald McGannon Communication Research Center, Fordham University on the 15th and 16th December, 2003. [Online] available from < http://www.fordham.edu> [Accessed September 2008]. pp 109-111.

Hazlett, T. W. 2003. Is Federal Preemption Efficient in Cellular Phone Regulatory? *Federal Communications Law Journal*, 56(1). pp155-238.

Hesmondhalgh, D. 2002. *The Cultural Industries*. Oxford UK: Sage Publications.

Hill, P. 1977. On Goods and Services. *The Review of Income and Wealth*, 23(4). pp315-38.

Hill, P. 1999. Tangibles, intangibles and services: a new taxonomy for the classification of output. *Canadian Journal of Economics*, 32(2). pp426-446.

Hilton, G. 1972. The Basic Bahaviour of Regulatory Commissions. *American Economic Review*, 62. pp47-54.

Hindman, M. and Cukier, K. N. 2003. Measuring Media Concentration Online and Offline. *IN: Media Diversity and Localism: Meaning, Metrics, and the Public Interest. Conference Report.* Conference held at the Donald McGannon Communication Research Center, Fordham University on the 15th and 16th December, 2003. [Online] available from < http://www.fordham.edu> [Accessed September 2008]. pp112-115.

Hochheiser, S. 1998. The American Telephone and Telegraph Company (AT&T). [Online]. AT&T Archives. Available from <http://www.porticus.org/bell/ pdf/tattc.pdf> [Accessed February 2005]

Hodgson, G. M. 1993. *Economics and Evolution - Bringing Life Back Into Economics*. Cambridge, UK: Polity Press.

Hodgson, G. M. 1998, The Approach of Institutional Economics, *Journal of Economic Literature*, 36(1), March. pp166-92.

Holbrook, D. Cohen, W. M. Hounshell, D. A. and Klepper, S. 2000. The Nature, Sources, and Consequences of Firm Differences in the Early History of the Semiconductor Industry. *Strategic Management Journal*, 21. pp1017–1041.

Horwitz, R. 2003. On Media Concentration and the Diversity Question *IN: Media Diversity and Localism: Meaning, Metrics, and the Public Interest. Conference Report.* Conference held at the Donald McGannon Communication Research Center, Fordham University on the 15th and 16th December, 2003. [Online] available from < http://www.fordham.edu> [Accessed September 2008]. pp116-120.

Hundt, R.E. 1994. *Before the Committee on Commerce, Science, and Transportation, United States Senate on S. 1822, the "Communications Act of 1994" and "Telecommunications Equipment Research and Manufacturing Competition Act of 1994"*. [Online]. available from <http://www.fcc.gov/Speeches/Hundt/> [Accessed July 2007]

Hunt, E. K. and Schwartz, J. G. 1973. *A Critique of Economic Theory*. London: Penguin Books.

Hunt, E. K. and Sherman, H. J. 1990. *Economics - An introduction to Traditional and Radical Views*. Sixth edition. New York: Harper Collins.

IBM Corporate Archives. 2002. *IBM Global Services: A Brief History*. [Online]. IBM Archives. Available from <http://www-03.ibm.com/ibm/history/> [Accessed July 2007]

IT Facts. 2004. *Google, Yahoo, MSN, AOL, Ask Jeeves are top search engines.* [Online]. February 23rd. Available from <http://www.itfacts.biz> [Accessed Mai 2007].

Itven, H. Olivier, J. and Sepulveda E. 2000. *Telecommunications Regulation Handbook* [Online]. The World Bank: Washington, DC. Available from <http://www.infodev.org> [Accessed March 2006].

Jin, D.Y. 2008. Neoliberal restructuring of the global communication system: mergers and acquisitions. *Media Culture Society*, 30. pp357-373.

Johnson, T. 2000. That's AOL folks…[Online]. *CNN Money*, January 10. Available from <http://money.cnn.com/2000/01/10/deals/aol_warner/> [Accessed July 2007].

Jorgenson, D.W. and Griliches, Z. 1967. The Explanation of Productivity Change. *Review of Economic Studies*, 34 (July). pp249-83.

Jorgenson, D.W. and Stiroh, K. J. 1999. U.S. Economic Growth at the Industry Level. *The American Economic Review*, 90(2). Papers and Proceedings of the One Hundred Twelfth Annual Meeting of the American Economic Association. (May, 2000). pp161-167.

Jorgenson, D. W. and Stiroh, K. J. 2000. Raising the Speed Limit: U.S. Economic Growth in the Information Age. *Brookings Papers of Economic Activity*, 1. pp125-211.

Jorgenson, D.W. Ho, M. S. and Stiroh, K. J. 2002. Projecting Productivity Growth: Lessons from the U.S. Growth Resurgence. *Federal Reserve Bank of Atlanta Economic Review*, Third Quarter. pp1-13.

Jorgenson, D.W. Ho, M. S. and Stiroh, K. J. 2004, Will the U.S. Productivity Resurgence Continue? *Current Issues in Economics and Finance*, 10(13) December. pp1-7.

Kano, S. 2000. Technical innovations, standardization and regional comparison: a case study in mobile communications. *Telecommunication Policy*, 24. pp305-321.

Kassel, M. B. 2005. Must Carry Rule. [Online]. *The Museum of Broadcast Communications*. Available from < http://www.museum.tv/home.php> [Accessed March 2007].

Kennedy, L.J. and Purcell, H. A. 2004. Wandering Along the Road to Competition and Convergence - The Changing CMRS Roadmap. *Federal Communications Law Journal*. 3(56). pp489-562.

Kennet, D. M. and Uri, N. D. 2001. Measuring Productivity Change for Regulatory Purposes. *Journal of Media Economics*, 14(2). pp87-104.

King, J. L. and West, J. 2002. Ma Bell's orphan: US cellular telephony, 1947–1996. *Telecommunication Policy*, 2002(26). pp189-203.

Kodama, F. 2004. Measuring emerging categories of innovation: Modularity and business model. *Technological Forecasting and Social Change*, 71. pp623–633.

Kondratieff, N. 1928. The Long Wave Cycle. *IN:* F. Louçã and J. Reijnders (eds.) 1999. *The Foundations of Long Wave Theory: Models and Methodology*. Volume 1. Aldershot, UK - Brookfield, US: Edward Elgar.

Kraemer, K. L. Dedrick, J. and Yamashiro, S. 2000. Refining and Extending the Business Model With Information Technology: Dell Computer Corporation. *The Information Society*, 16. pp5-21.

Lampel, J. and Shamsie, J. 2003. Capabilities in Motion: New Organizational Forms and the Reshaping of the Hollywood Movie Industry. *Journal of Management Studies*, 40(8). pp2189-2210.

Landefeld, S. and Grimm, B. T. 2000. A Note on the Impact of Hedonics and Computers on Real GDP. *Survey of Current Business* (December 2000). pp17-22.

Langlois, R. N. 2002. Modularity in technology and organization. *Journal of Economic Behavior & Organization*, 49. pp19–37.

Langlois, R.N. 2003. The vanishing hand: the changing dynamics of industrial capitalism. *Industrial and Corporate Change,* 12(2). pp351–385.

Langlois, R.N. and Steinmueller, E.W. 2000. Strategy and Circumstance: the Response of American Firms to Japanese Competition in Semiconductors, 1980-1995. *Strategic Management Journal*, 21. pp1163–1173.

Lazonick, W. 2005. Evolution of the New Economy Business Model. *Business and Economic History Online* 3. pp1-60.

Linden, G. and Somaya, D. 2003. System-on-a-chip integration in the semiconductor industry: industry structure and firm strategies. *Industrial and Corporate Change*, 12(3), pp545-576.

London Economics and PricewaterhouseCoopers. 2006. *An Assessment of the Regulatory Framework for Electronic Communications: Growth and Investment in the EU e-Communications Sector*. [Online]. Europe's Information Society thematic portal. Available from < http://ec.europa.eu/information_society/index_en.htm> [Accessed July 2007]

Loomis, D.G. and Swann, C.M. 2005. Intermodal competition in local telecommunications markets. *Information Economics and Policy*, 17. pp97-113.

Louçã, F. and Reijnders, J. 1999. One and a half centuries of Controversy on Long Waves and the Dynamics of Capitalism: An Introduction. *IN:* F. Louçã and J. Reijnders (eds.) 1999. *The Foundations of Long Wave Theory - Models and Methodology*. Volume 1. Aldershot, UK - Brookfield, US: Edward Elgar.

Louw, E. 2001. *The Media and Cultural Production*. Oxford UK: Sage Publications.

Lucas, R. 1988. On the Mechanics of Economic Development. *Journal of Monetary Economics*, 22. pp3-42.

Lyytinen, K. and Fomin, V. V. 2002. Achieving high momentum in the evolution of wireless infrastructures: the battle over the 1G solutions. *Telecommunication Policy* (26). pp149–170.

Maitland, C. F. Bauer, J. M. and Westerweld, R. 2002. The European market for mobile data: evolving value chains and industry structures. *Telecommunication Policy* (26). pp485–504.

Mandel, E. 1992. The International Debate on Long Waves of Capitalist Development: an Intermediary Balance Sheet. *IN:* C. Freeman (ed.) *Long Wave Theory*. Cheltenham, UK - Brookfield, US: Edward Elgar. Pp 316-338.

Mann, M. 1997. Has Globalization Ended the Rise and Rise of the Nation- State? *Review of International Political Economy*, 4(3). pp472-96.

Mansell, R. 1997. Designing Networks to Capture Customers: Policy Regulation Issues for the New Telecom Environment. *IN:* W. H. Melody (ed.) *Telecom Reform. Principles, Policies and Regulatory Practices*. Lyngby: Den Private Ingeniørfond. pp77-88.

Market Wire. 2004. IBM Confirmed as Defra's Transformation Services Partner. [Online]. *Market Wire*, July 2004. Available from <http://findarticles.com/p/articles/mi_pwwi/ is_200407/ai_n8555817> [Accessed, Sep. 2007]

Marshall, A. 1890. *Principles of Economics*. Eight Edition. 1920. London: Macmillan.

Maule, C. 2003. Television. *IN:* R. Towse (ed.) *A Handbook of Cultural Economics*. Cheltenham, UK - Brookfield, US: Edward Elgar. pp458-475.

McChesney, R.W. 1999. Noam Chomsky and the Struggle against Neoliberalism. *Monthly Review*, 50(April). pp40-47

McChesney, R.W. 2001. Global Media, Neoliberalism, and Imperialism. *Monthly Review*, 52(19). pp1–19.

McDonough, T. Reich, M. Kotz, D. M. Gonzalez-Perez, M.-A. 2006 (Eds). Growth and Crisis: Social Structure of Accumulation Theory and Analysis. Social Sciences Research Centre (SSRC) and Centre for Innovation & Structural Change (CISC), at the National University of Ireland, Galway. [Online] Available from < http://ssagalway.blogspot.com > [Accessed December 2007]

McKinsey Global Institute. 2001. *US Productivity Growth 1995-2000*. [Online]. McKinsey Global Institute website. Washington: McKinsey & Company, Inc. Available from < http://www.mckinsey.com/mgi/publications/us/index.asp> [Accessed July 2007]

McQuail, D. 1992. *Media Performance: Mass Communication and the Public Interest*. Oxford UK: Sage Publications.

Melody, W. H. 1997. Interconnection: Cornerstone of Competition. *IN:* W. H. Melody (ed.) *Telecom Reform. Principles, Policies and Regulatory Practices*. Lyngby: Den Private Ingeniørfond. pp 49-61.

Meyer, M. H. Anzani, M. and Walsh, G. 2005. Innovation and Enterprise Growth. *Research-Technology Management*, July-August. pp34-44.

Miles, I. 2001. Services Innovation: A Reconfiguration of Innovation Studies. University of Manchester, UK. *PREST - Discussion Paper Series*, April, 2001.

Miles, I. 2003. Services and the Knowledge-Based Economy. *IN:* J. Tidd (ed.) *Service innovation: organizational responses to technological opportunities & market imperatives*. London: Imperial College Press.

Mill, J. S. 1844. *Essays on Some Unsettled Questions*. London: Longmans, Green, Reader, and Dyer Co. Second edition (1874).

Milyo, J. 2007. The effects of cross-ownership on the local content and political slant of local television news. *FCC Media Ownership Study* #6. Washington, DC: Federal Communications Commission. Available from <http://www.fcc.gov > [Accessed September 2008]

Miozzo, M. and Grimshaw, D. 2005. Modularity and innovation in knowledge-intensive business services: IT outsourcing in Germany and the UK. *Research Policy*, 2005(34). pp1419-1439.

Miskell, P.M. 2006."Selling America to the World"? The Rise and Fall of an International Film Distributor in its Largest Foreign Market: United Artists in Britain, 1927-1947. *Enterprise & Society: The International Journal of Business History*, 7(4). pp740-776.

Mortimer Holland, J. 2005. Price Discrimination, Copyright Law, and Technological Innovation: Evidence from the Introduction of DVDs. *NBER Working Paper Series*, 11676. pp1-48.

Mosco, V. 2002. Bridging the Gap: Processes of Communication and Institutions of Political Economy. *IN:* R. Mansell, R. Samarajiva and A. Mahan (eds) *Networking Knowledge for Information Societies: Institutions and Intervention*. Delft University Press (DUP) Science: Delft, NL.

Mowery, D. C. and Simcoe, T. 2002. Is the Internet a US invention ? An economic and technological history of computer networking. *Research Policy*, 31. pp1369-1387.

Nadiri, M. I. and Nandi, B. 1999. Technical Change, Markup, Divestiture, and Productivity Growth in the U.S. Telecommunications Industry. *The Review of Economics and Statistics*, 81(3). pp488-498.

Nall, D. A. 1993. Cable Television Subscriber Equipment: Lessons from the Common Carrier Experience. [Online]. *Federal Communications Law Journal*, 46(1). Available from <http://www.law.indiana.edu/fclj/pubs/v46/nall.html> [Accessed July 2007]

Napoli, P.M. 1999. The unique nature of communications regulation: Evidence and implications for communications policy analysis. *Journal of Communication*, 49(4). pp151-169.

National Cable Telecommunications Association (NCTA). 2001. *Cable television developments*. Washington, DC

National Science Foundation (NSF) 2001. Division of Science Resources Statistics. *Survey of Industrial Research and Development*. [Online]. Available from <http://www.nsf.gov/statistics/iris/> [Accessed March 2006].

National Science Foundation (NSF). 2006. *Industrial Research and Development Information System, historical data 1953-1998.* [Online]. Available form <http://www.nsf.gov/statistics/iris/> [Accessed March 2006]

Nelson, R. 1982. The role of knowledge in R&D efficiency. *Quarterly Journal of Economics,* 97. pp453–470.

Nelson, R. and Winter, S. G. 1982. *An Evolutionary Theory of Economic Change*. The Belknap Press of Harvard University Press.

Nordhaus, W. D. 1980. Testimony, United States vs. American Telephone and Telegraph Co. *Civil Action no. 74- 1698* (U.S.D.C., D.C. 1974)

Nordhaus, W. D. 2002. Productivity Growth and the New Economy. *Brookings Papers of Economic Activity*, 8096.

Oliner, S. D. and Sichel, D. E. 2002. Information Technology and Productivity: Where Are We Now and Where Are We Going? [Online]. Board of Governors of the Federal Reserve System (U.S.) *Finance and Economics Discussion Series*, 2002-29. Available from <www.frbatlanta.org/filelegacydocs/oliner_sichel_q302.pdf> [Accessed July 2007]

Organisation for Economic Co-operation and Development (OECD). 2003. *Developments in Local Loop Unbundling*. [Online] Paris: OECD. Available from <http://www.oecd.org/> [Accessed July 2007]

Oulton, N. 1999. Must the Growth Rate Decline: Baumol's Unbalanced Growth Revisited. *Working Paper*, 107. Bank of England.

Palmer, I. Dunford, R. Rura-Polley, T. and Baker, E. 2001. Changing forms of organizing: dualities in using remote collaboration technologies in film production. *Journal of Organizational Change*, 14(2). pp190-212.

Parsons, P. R. 2003. Horizontal Integration in the Cable Television Industry: History and Context. *The Journal of Media Economics*, 16(1). pp23–40.

Pavitt, K. L. R. 2005. Specialization and System Integration. Where Manufacture and Services Still Meet. *IN:* A. Prencipe, A. Davies and M. Hobday (eds.) *The Business of Systems Integration*. Second Edition. Oxford and New York: Oxford University Press. pp78-91.

Perez, C. 1983. Structural Change and the Assimilation of New Technologies in the Economic and Social System. *Futures*, 15(4). Pp357-75.

Perez, C. 1985. Microelectronics, long wave and world structural change. *World Development*. pp441-63.

Perez, C. 1986. Structural change and assimilation of new technologies in the economic and social system. In C. Freeman (ed.) *Design, Innovation and Long Cycles in Economic Development*. London: Frances Pinter.

Peters, L. and Saidin, H. 2000. IT and the mass customization of services: the challenge of implementation. *International Journal of Information Management*, 20. pp103-119.

Phillips, A. 2002. What It Was Like, What Happened, and What It's Like Now: Developments in Telecommunications Over Recent Decades. *Journal of Regulatory Economics*, 21(1). pp57-78.

Picard, R. 1982. Rate setting and competition in newspaper advertising. *Newspaper Research Journal*, 3. pp23-13.

Picard, R. 1989. *Media Economics: Concepts and Issues*. Oxford UK: Sage Publications.

Prencipe, A. Davies, A. and Hobday, M. 2005. *The Business of Systems Integration*. Oxford and New York: Oxford University Press.

Preston, P. (2001), *Reshaping Communications*. Oxford UK: Sage Publications.

Preston, P. and Kerr, A. 2001. Digital Media, the Nation State and Local Cultures: The development of multimedia content in Ireland. *Media, Culture and Society*, 23(1). pp109-131.

Prince, S.2003. The Emergence of Filmic Artifacts. *Film Quarterly*, 57(3). pp24-33.

Rebelo, S. 1990. Long Run Policy Analysis and Long Run Growth. *NBER Working Paper Series*, 3325.

Rhines, W. C. 2006. Miniaturization history is not the full Story, EDN, 51(20). p180.

Rifkin, J. 2005. When markets give way to networks… everything is a service *IN:* J. Hartley (ed.) *Creative Industries*. Oxford: Basil Blackwell. pp361-373.

Robins, J. A. 1993. Organization as Strategy: Restructuring Production in the Film Industry. *Strategic Management Journal*, 14 (Special Issue: Corporate Restructuring). pp103-118.

Rochet, J. C. and Tirole, J. 2003. Platform Competition in two-sided markets. *Journal of the European Economic Association*, 1(4). pp990-1029.

Romer, P. 1990. Endogenous Technical change. *Journal of Political Economy*, 98(2). pp71-102.

Sanchez, R. Mahoney, J.Y. 1996. Modularity, flexibility and knowledge management in product and organisation design. *Strategic Management Journal*, 17 Winter Special Issue. pp63–76.

Say, J. B. 1819. *A Treatise on Political Economy*. London: Longman.

Schreyer, P. 2001. The OECD Productivity Manual: A Guide to the Measurement of Industry-Level and Aggregate Productivity. *International Productivity Monitor,* 2. pp37-51.

Schumpeter, J. A. 1911. *Theorie der wirtschaftlichen Entwicklung*. Leipzig: Duncker & Humboldt.

Schumpeter, J. A. 1942. *Capitalism, Socialism and democracy*. New York: Harper and Row.

Schweizer, T. S. 2003. Managing Interactions between Technological and Stylistic Innovation in the Media Industries. *Technology Analysis & Strategic Management*, 15(1). pp19-41.

Scott, A. J. 2004. Hollywood and the world: the geography of motion-picture distribution and marketing. *Review of International Political Economy*, 11(1). pp33–61.

Sen, A. 1999. *Development as Freedom*. Oxford and New York: Oxford University Press.

Shaver, M. A. 2004. The Economics of the Advertising Industry. *IN:* A. Alexander, J. Owers, R. Carveth, A. C. Hollifield, and A. N. Greco (eds.) *Media Economics: Theory and Practice*. Third Edition. Mahwah: Lawrence Erlbaum Associates Inc. Publishers. pp249-263.

Simon, H. A. 1962. The architecture of complexity. *Proceedings of the American Philosophical Society*, 106. pp467–482.

Simon, H. A. 1969. *The Sciences of the Artificial*. Cambridge, MA: MIT Press.

Simon, H. A. 1982. *The Sciences of the Artificial*. Second Edition. Cambridge, MA: MIT Press.

Simon, H. A. 1996. *The Sciences of the Artificial*. Third Edition. Cambridge, MA: MIT Press.

Smith, A. 1776. *An Inquiry into the Nature and Causes of the Wealth of Nations*. Methuen & Co., Ltd.

Smythe, D. 1981. *Dependency Road: Communications, Capitalism, Consciousness, and Canada*. Norwood: Ablex.

Solow, R. M. 1956. A Contribution to the Theory of Economic Growth. *Quarterly Journal of Economics*, 70. pp65-94.

Solow, R. M. 1957. Technical Change and the Aggregate Production Function. *Review of Economics and Statistics*, 39(2). pp312-320.

Solow, R. M. 1960. Investment and Technical Progress. *IN:* J. A. Kenneth, S. Karlin, and P. Suppes (eds.) *Mathematical Methods in the Social Sciences.* Stanford, CA: Stanford University Press. pp155-173.

Solow, R. M. 1985. Economic History and Economics. *American Economic Review*, 75(2). pp328-31.

Solow, R. M. 1987. We'd Better Watch Out. *New York Times Book Review*, July 12 - 1987. pp36.

Stanback, T. 1979. *Understanding the Service Economy*. Baltimore: Johns Hopkins University Press.

Steindel, C. and Stiroh, K. J. 2001. Productivity: What is it, and Why do We Care About it? *Business Economics*, October. pp13-31.

Steinmueller, E. W. 2005. Technical Compatibility Standards and the Co-Ordination of the Industrial and International Division of Labour. *Advancing Knowledge and the Knowledge Economy*, 10-11 January 2005. National Academies. Washington, DC.

Stigler, G. 1971. The Theory of Economic Regulation. *Bell Journal of Economics*, 2. pp3-21.

Stiroh, K. J. 2002. Information Technology and the U.S. Productivity Revival: A review of the Evidence. *Business Economics*, January 2002.

Storper, M. 1989. The Transition to flexible specialisation in the US film industry: external economies, the division of labour, and the crossing of industrial divides. *Cambridge Journal of Economics*, 13(2). pp273-305.

Strover, S. 2005. *United States: Cable Television.* [Online]. The Museum of Broadcast Communications. Available from < http://www.museum.tv/home.php> [Accessed March 2007]

Sturgeon, T.J. 2002. Modular production networks: a new American model of industrial organisation. *Industrial and Corporate Change*, 11(3), pp451-496.

Takahashi, S. 2005. The Rise and Fall of Plug-Compatible Mainframes. *IEEE Annals of the History of Computing*, January–March. pp4-16.

Tamber, C. 1995. The Financial Interest and Syndication Rules - Take Two. *CommLaw Conspectus*, 3. pp107-120.

Tang, J. and Wang, W. 2004. Sources of aggregate labour productivity growth in Canada and the United States. *Canadian Journal of Economics*, 37(2). pp421-444.

Temin, P. 1987. *The fall of the bell system*. New York: Cambridge University Press.

Tether, B.S. Metcalfe, S. 2004. Services and Systems of Innovation. *IN*: Malerba (ed.) *Sectoral Systems of Innovation*. Concepts, issues and analysis of six major sectors in Europe. Cambridge University Press. Pp 287-316.

The Economist, 2003. Doing the walkie-talkie, *Economist Newspaper Ltd*, Jul 10th.

The Economist, 2006. From :-) to :-(20th of May 2006, *Economist Newspaper Ltd* 379(8478). pp63-64.

The Economist. 2000. Solving the paradox: productivity growth and information technology. *Economist Newspaper*. US Edition, Sep 23. p15.

Towse, R. 1997. *Baumol's Cost Disease: The Arts and other Victims*. Cheltenham, UK - Northampton, USA: Edward Elgar.

Triplett, J. E. 1996. High Tech Industry Productivity and Hedonic Price Indexes. *IN:* OECD, *Industry Productivity: International Comparison and Measurement Issues*. OECD Proceedings, Paris: OECD. Pp 136.

Triplett, J. E. and Bosworth, B. 2003. Productivity Measurement Issues in Services Industries: Baumol's Disease Has Been Cured. *Economic Policy Review*, 9(3). pp23-33.

Tuomi, I. 2004. Realising the Productivity Potential of ICTs. [Online]. *The IPTS Report*, 85. Available from <http://www.jrc.es/home/report/english/ articles/vol85/welcome.htm> [Accessed July 2007]

Tylecote, A. 1992. The Long Wave Debate. *IN:* C. Freeman (ed.) *Long Wave Theory*. Cheltenham, UK - Brookfield, US: Edward Elgar. Pp 125-158.

Ulrich, K. T. and Eppinger, S. D. 1999. *Product Design and Development*. Second Edition. New York: McGraw-Hill.

Unites States (U.S.) Census Bureau, (1997, 2002, 2004) *Statistics of U.S. Businesses*. [Online]. available from the <http://www.census.gov> [Accessed March 2007]

Usselman, S. W. 2004. Public Policies, Private Platforms: Antitrust and American Computing. In Coopey, R. (ed.), *Information Technology Policy - An International History*. New York: Oxford University Press. pp97-120.

Usselman, S.W. 1996. Fostering a Capacity for Compromise: Business, Government and the stages of Innovation and American Computing. *IEEE Annals of the History of Computing*, 18(2). Pp30-39.

Valletti, T. 2006. Mobile Call Termination: A Tale of Two-Sided Markets. *Communications & Strategies*, 61. pp61-77.

Van Gelderen, J. 1913. Springtide: Reflections on Industrial Development and Price Movements [Springvloed, Beschouwigen over industriele outwikkeling en prijsbeweging]. *De Nieuwe Tijd*, 18. pp253-269 and 445.

Vogel, H. 2001. *Entertainment Industry Economics*. New York: Cambridge University Press.

Vuorinen, I. Järvinen, R. and Lehtinen, U. 1998. Content and measurement of productivity in the service sector. *International Journal of Innovation Management*, 9(4). pp377 396.

Waterman, D. and Sung-Choon L. 2003. Time Consistency and the Distribution of Theatrical Films: An Empirical Study of the Video Window. Paper presented at the *Econometric Society Winter Meeting*, January, 2003, Washington, D.C.

Waters, R. 2004. Big Blue breaks out of the box. *Financial Times Limited*, March 17. London: Financial Times. pp13.

Weber, J. H. 2003. The fragmentation of America's Telecommunications system: the operational implications of network unbundling. *Information Economics and Policy*, 15(2003). pp201-222.

Whalley, J. and Curwen, P. 2003. Licence acquisition strategy in the European mobile communications industry. *Info*, 5(6). pp45-57.

Wildman, S. S. 2007. Indexing Diversity. *IN:* Napoli, P.M. (ed) *Media Diversity and Localism: Meaning and Metrics*. London and New York; Routledge. pp151-176.

Winston, B. 1996. *Technologies of Seeing: Photography, Cinematography and Television*. London: The British Film Institute.

Winston, B. 1998. *Media Technology and Society. A history: From the telegraph to the Internet*. London & NY: Routledge.

Winter, S. G. 1984. Schumpeterian Competition in Alternative Technological Regimes. *Journal of Economic History*, 5(3/4). pp287-320

Wolff, E. N. 2002. How stagnant are services? *IN:* F. G. Gadrey, and F. Gallouj (ed.) *Productivity, innovation and knowledge in services: new economic and socio-economic approaches*. Cheltenham, UK - Northampton, USA: Edward Elgar. pp 3-25.

Zysman, G. I. Tarallo, J. A. Howard, R. E. Freidenfelds, J. Valenzuela, R. A. and Makiewich, P. M. 2000. Technology Evolution for Mobile and Personal Communications. *Bell Labs Technical Journal*, January-March. pp107-129.[106]

[106] Note: Compiled following the Harvard System as explained in Allen (2003).

Appendices

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Appendix A - A Review of the Methodology Used to Estimate Capital Stocks and Services

As Steindel and Stiroh explain (2001) in their review of the productivity literature, “classic” estimates of rental prices follow a methodology that considers a firm’s investment decision between buying a productive asset or investing in some alternative opportunity. To be in equilibrium the firm should be indifferent to the two alternatives:

$$(1+i_t)P_{i,t-1} = c_{i,t}(1-\delta_i)P_{i,t}$$

If we identify *i* with the nominal interest rate, *P* with the acquisition price, δ with the depreciation rate and *c* with the rental or service price (i.e. the cost of capital) for the asset *i* at time *t*, this equation indicates that, at equilibrium, investing money in order to earn a nominal rate of return (the left hand side of this equation) should be equal to buying capital for the corresponding amount, collecting a rental fee (or making a profit from the capital for the period) and then selling the depreciated asset at the next period’s price.

After re-arranging the equation and introducing the percentage change in the acquisition price $\pi_{i,t}$, we obtain:

$$c_{i,t} = (i_i - \pi_{i,t})P_{i,t-1} + \delta_i P_{i,t}$$

As mentioned above, these prices are used as weights to aggregate different types of capital. The stock of capital is estimated from the flow of investments, normally using the “perpetual inventory method”.

$$S_{i,t} = S_{i,t-1}(1-\delta_i) + I_{i,t} = \sum_{\tau=0}^{\infty}(1-\delta_i)I_{i,t-\tau}$$

where *S* indicates the quantity of Stock of capital of the industry *i* at time *t*, while *I* indicates the index of aggregate investment

As explained above, the estimation of the terms used in the sources of productivity model is what distinguishes different authors' contributions. As an example, Oliner and Sichel (2002) do not use specific rental prices for each type of capital and use income shares as weights, following this example:

$$\alpha_j = (r + \delta_j - \pi_j) T_j p_j K_j \big/ pY$$

Where r is the nominal net rate of return on capital, which is the same for all types of capital; δ_j is the depreciation rate for the capital j; π_j measures any expected change in the value of this capital over and above that captured in the depreciation rate; T_j is a composite Tax parameter; p_j K_j the current dollar-stock of this capital and pY is the total current-dollar income in the nonfarm business sector.

Appendix B - List of Progressive Industries, Progressive Services and Stagnant and Asymptotically Stagnant Industries

B.1. Progressive Industries

Manufacturing, Mining, Utilities and Construction Mining; Utilities; Construction; Manufacturing (Wood products; Nonmetallic mineral products; Primary metals; Fabricated metal products; Machinery; Computer and electronic products; Electrical equipment, appliances, and components; Motor vehicles, bodies and trailers, and parts; Other transportation equipment; Furniture and related products; Miscellaneous manufacturing; Food and beverage and tobacco products; Textile mills and textile product mills; Apparel and leather and allied products; Paper products; Printing and related support activities; Petroleum and coal products; Chemical products; Plastics and rubber products);

B.2. Progressive Services

Wholesale trade; Retail trade; Transportation and warehousing; Publishing industries (includes software)*; Broadcasting and telecommunications**; Securities, commodity contracts, and investments; Insurance carriers and related activities; Funds, trusts, and other financial vehicles; Other services, except government;

B.3. Stagnant and Asymptotically Stagnant Industries

("Personal" services) Federal Reserve banks, credit intermediation, and related activities; Real estate; Rental and leasing services and lessors of intangible assets; Legal services; Administrative and support services; Waste management and remediation services; Educational services; Ambulatory health care services; Hospitals and nursing and residential care facilities; Social assistance; Accommodation; Food services and drinking places; Government; *(“Content Making" activities)*; Motion picture and sound recording industries; Information and data processing services; Computer systems design and related services; Miscellaneous professional, scientific, and technical services; Performing arts, spectator sports, museums, and related activities; Amusements, gambling, and recreation industries;

Notes: Major categories in Italic

* the sector is composed by asymptotically stagnant activities, such as the “classic” publishing industries and the progressive pre-packaged software industries; the majority of resources are concentrated in this latter, hence their classification under progressive Services.

** the same applies to this industry composed of the asymptotically Stagnant Broadcasting activities and the progressive Telecommunications Activities.

B.4. List of Adjustments performed on the Labour

Total Labour Force = Productive Workers in the private sector + All employees in the government sector

Educational services (69) and Government (82,83,86): The data refers to "all employees" instead of productive employees (data not available)

Electrical equipment, appliances, and components (20) = Electrical equipment and appliances (CEU3133500003) + Other electrical equipment and component (CEU3133590003)

Motor vehicles, bodies and trailers, and parts (21) = Motor vehicles and parts (CEU3133600103) + Motor vehicle bodies and trailers (CEU3133620003)

Other transportation equipment (22) = Durable goods (13) minus the sum of (14) Wood products, (15) Nonmetallic mineral products, (16) Primary metals (17), Fabricated metal products, (18) Machinery, (19) Computer and electronic products, (20) Electrical equipment, appliances, and components, (21) Motor vehicles, bodies and trailers, and parts, (23) Furniture and related products, (24) Miscellaneous manufacturing

Food and beverage and tobacco products (26) = Food manufacturing (CEU3231100003) + Other food products (CEU3231190003) + Beverage and tobacco products (CEU3231200003)

Textile mills and textile product mills (27) = Textile mills CEU3231300003 + Textile product mills CEU3231400003

Apparel and leather and allied products (28) = Apparel CEU3231500003 + Leather and allied products CEU3231600003

Publishing industries (includes software) (46) = Printing Industry (SIC based) + Software publishers CEU5051120003

Printing Industry (SIC based) = Newspapers EEU32271003 (n) + Periodicals EEU32272003 (n) + Books EEU32273003 (n) + Miscellaneous publishing EEU32274003 (n)

Broadcasting and telecommunications (48) = Broadcasting except internet CEU5051500003 + Telecommunications CEU5051700003

Information and data processing services (49) = Information (45)- Publishing Industries (46, estimate)- Motion Picture and Sound Recording (47)- Broadcasting and Telecommunications (48)

Finance, insurance, real estate, rental, and leasing (50) = Finance and insurance (51) + Real estate and rental and leasing (56)

Professional, scientific, and technical services (60) = Professional and business services (59) minus the sum of Management of companies and enterprises (64) - Administrative and waste management services (65)

Miscellaneous professional, scientific, and technical services (63) = Professional, scientific, and technical services (60) minus the sum of Legal services (61) and Computer systems design and related services (62)

Educational services, health care, and social assistance (68) = Educational services (69) + Health care and social assistance (70)

Hospitals and nursing and residential care facilities (72) = Nursing and residential care facilities CEU6562300003 + Hospitals CEU6562200003

State and local (86), from 1987 to 1989 = Government (82) – Federal (83)

State and local (86), from 1990 to 2003 = Local Government CEU9093000001 + State Government CEU9092000001

Table 7: Productivity of Labour Inputs and the division into effects: GDP, Mining, Construction and Manufacturing Activities, 1990-2003

Bea series number and description		PA	PS	S&AS	**Output per person**	**SUM (PPE + CRS + IE)**	**PPE**	**CRS**	**IE**
1	**Gross domestic product**					**21.35%**	**21.81%**	**0.45%**	**-0.92%**
6	**Mining**	**o**			**13.03%**	**0.18%**	**0.19%**	**-0.01%**	**0.00%**
10	**Utilities**	**o**			**45.40%**	**1.04%**	**1.14%**	**-0.07%**	**-0.03%**
11	**Construction**	**o**			**-11.46%**	**-0.38%**	**-0.50%**	**0.14%**	**-0.02%**
	Manufacturing	**o**				**9.44%**	**10.39%**	**-0.45%**	**-0.50%**
14	Wood products	o			-10.75%	-0.03%	-0.04%	0.00%	0.00%
15	Nonmetallic mineral products	o			36.79%	0.15%	0.16%	-0.01%	0.00%
16	Primary metals	o			45.65%	0.27%	0.31%	-0.03%	-0.01%
17	Fabricated metal products	o			25.24%	0.30%	0.34%	-0.02%	-0.01%
18	Machinery	o			11.43%	0.13%	0.16%	-0.03%	0.00%
19	Computer and electronic products	o			308.72%	4.80%	5.27%	-0.12%	-0.36%
20	Electrical equipment, appliances, and components	o			49.51%	0.29%	0.33%	-0.02%	-0.01%
21	Motor vehicles, bodies and trailers, and parts	o			52.56%	0.49%	0.50%	-0.01%	-0.01%
22	Other transportation equipment	o			51.61%	0.49%	0.56%	-0.04%	-0.02%
23	Furniture and related products	o			16.11%	0.05%	0.05%	0.00%	0.00%
24	Miscellaneous manufacturing	o			43.30%	0.24%	0.25%	-0.01%	0.00%
26	Food and beverage and tobacco products	o			7.22%	0.13%	0.14%	-0.01%	0.00%
27	Textile mills and textile product mills	o			43.67%	0.15%	0.17%	-0.02%	-0.01%
28	Apparel and leather and allied products	o			101.29%	0.42%	0.48%	-0.03%	-0.03%
29	Paper products	o			18.67%	0.12%	0.14%	-0.02%	0.00%
30	Printing and related support activities	o			10.60%	0.05%	0.07%	-0.01%	0.00%
31	Petroleum and coal products	o			80.36%	0.34%	0.38%	-0.02%	-0.02%
32	Chemical products	o			43.01%	0.73%	0.78%	-0.03%	-0.01%
33	Plastics and rubber products	o			53.01%	0.33%	0.35%	-0.01%	-0.01%

Notes: **PA**=Progressive Activities; **PS**=Progressive Services; **S&AS**=Stagnant and Asymptotically Stagnant; **PPE**=Pure Productivity Effects; **CRS**=Change in Relative Size; **IE**=Interaction Effect

Source: Own calculations as explained in section 3.4.

Table 8: Productivity of Labour Inputs and the division into effects: Service Industries, 1990-2003

	Bea series number and description	PA	PS	S&AS	Output per person	SUM (PPE + CRS + IE)	PPE	CRS	IE
	Services					**10.70%**	**9.95%**	**1.16%**	**-0.41%**
34	**Wholesale trade**	**o**	**o**		**56.24%**	**3.21%**	**3.43%**	**-0.14%**	**-0.08%**
35	**Retail trade**	**o**	**o**		**56.33%**	**3.71%**	**3.94%**	**-0.15%**	**-0.08%**
36	**Transportation and warehousing**	**o**	**o**		**31.01%**	**0.89%**	**0.92%**	**-0.02%**	**-0.01%**
46	Publishing industries (includes software)	o	o		53.73%	0.46%	0.47%	-0.01%	0.00%
47	Motion picture and sound recording industries			o	-9.04%	-0.01%	-0.03%	0.01%	0.00%
48	Broadcasting and telecommunications	o	o		68.33%	1.60%	1.70%	-0.06%	-0.04%
49	Information and data processing services			o	-0.96%	0.02%	0.00%	0.02%	0.00%
52	Federal Reserve banks, credit intermediation, and related activities			o	9.95%	0.41%	0.30%	0.10%	0.01%
53	Securities, commodity contracts, and investments	o	o		177.77%	1.26%	1.35%	-0.03%	-0.06%
54	Insurance carriers and related activities	o	o		-3.17%	-0.01%	-0.07%	0.06%	0.00%
55	Funds, trusts, and other financial vehicles	o	o		-80.08%	-0.08%	-0.09%	0.02%	-0.02%
57	Real estate			o	8.43%	1.08%	0.95%	0.13%	0.01%
58	Rental and leasing services and lessors of intangible assets			o	21.53%	0.22%	0.23%	-0.01%	0.00%
61	Legal services			o	-11.85%	-0.15%	-0.18%	0.04%	0.00%
62	Computer systems design and related services			o	10.36%	0.11%	0.06%	0.05%	0.01%
63	Miscellaneous professional, scientific, and technical services			o	8.61%	0.40%	0.33%	0.06%	0.01%
64	**Management of companies and enterprises**				**14.83%**	**0.27%**	**0.26%**	**0.01%**	**0.00%**
66	Administrative and support services			o	-4.32%	-0.01%	-0.09%	0.09%	0.00%
67	Waste management and remediation services			o	5.03%	0.02%	0.01%	0.00%	0.00%
69	**Educational services**			**o**	**-24.41%**	**-0.14%**	**-0.17%**	**0.05%**	**-0.01%**
70	Health care and social assistance			o	-16.65%	-0.78%	-1.01%	0.28%	-0.05%
71	Ambulatory health care services			o	-22.72%	-0.61%	-0.74%	0.16%	-0.04%
72	Hospitals and nursing and residential care facilities			o	-18.67%	-0.37%	-0.46%	0.11%	-0.02%
73	Social assistance			o	-3.68%	0.01%	-0.01%	0.03%	0.00%
76	Performing arts, spectator sports, museums, and related activities			o	5.08%	0.03%	0.02%	0.01%	0.00%
77	Amusements, gambling, and recreation industries			o	-10.40%	-0.03%	-0.05%	0.02%	0.00%
78	Accommodation and food services			o	4.22%	0.15%	0.11%	0.03%	0.00%
79	Accommodation			o	23.21%	0.19%	0.18%	0.00%	0.00%
80	Food services and drinking places			o	-0.40%	0.02%	-0.01%	0.03%	0.00%
81	**Other services, except government**		**o**		**-19.39%**	**-0.42%**	**-0.48%**	**0.08%**	**-0.01%**
82	**Government**			**o**	**-6.45%**	**-0.74%**	**-0.91%**	**0.19%**	**-0.01%**

Notes: **PA**=Progressive Activities; **PS**=Progressive Services; **S&AS**=Stagnant and Asymptotically Stagnant; **PPE**=Pure Productivity Effects; **CRS**=Change in Relative Size; **IE**=Interaction Effect

Source: Own calculations as explained in section 3.4.

Table 9: Productivity of Labour Inputs and the division into effects: GDP, Mining, Construction and Manufacturing Activities, 1996-2003

Bea series number and description		PA	PS	S&AS	**Output per person**	**SUM (PPE + CRS + IE)**	**PPE**	**CRS**	**IE**
1	**Gross domestic product**					**16.90%**	**17.17%**	**0.24%**	**-0.52%**
6	**Mining**	**o**			**-4.09%**	**0.00%**	**-0.05%**	**0.03%**	**0.00%**
10	**Utilities**	**o**			**21.13%**	**0.00%**	**0.50%**	**-0.03%**	**-0.01%**
11	**Construction**	**o**			**-8.64%**	**0.00%**	**-0.35%**	**0.15%**	**-0.01%**
	Manufacturing	**o**				**6.08%**	**6.77%**	**-0.37%**	**-0.32%**
14	Wood products	o			13.03%	0.04%	0.04%	0.00%	0.00%
15	Nonmetallic mineral products	o			21.92%	0.09%	0.10%	-0.01%	0.00%
16	Primary metals	o			27.01%	0.13%	0.16%	-0.02%	-0.01%
17	Fabricated metal products	o			13.44%	0.15%	0.18%	-0.02%	0.00%
18	Machinery	o			25.20%	0.26%	0.30%	-0.03%	-0.01%
19	Computer and electronic products	o			192.96%	3.12%	3.49%	-0.13%	-0.24%
20	Electrical equipment, appliances, and components	o			41.02%	0.20%	0.23%	-0.02%	-0.01%
21	Motor vehicles, bodies and trailers, and parts	o			40.74%	0.48%	0.53%	-0.03%	-0.01%
22	Other transportation equipment	o			19.90%	0.13%	0.14%	-0.01%	0.00%
23	Furniture and related products	o			8.51%	0.02%	0.03%	0.00%	0.00%
24	Miscellaneous manufacturing	o			31.29%	0.18%	0.19%	-0.01%	0.00%
26	Food and beverage and tobacco products	o			-0.35%	0.01%	-0.01%	0.01%	0.00%
27	Textile mills and textile product mills	o			24.00%	0.07%	0.08%	-0.01%	0.00%
28	Apparel and leather and allied products	o			81.56%	0.26%	0.30%	-0.02%	-0.02%
29	Paper products	o			10.61%	0.06%	0.07%	-0.02%	0.00%
30	Printing and related support activities	o			13.48%	0.06%	0.08%	-0.01%	0.00%
31	Petroleum and coal products	o			21.19%	0.07%	0.06%	0.00%	0.00%
32	Chemical products	o			32.04%	0.54%	0.59%	-0.03%	-0.01%
33	Plastics and rubber products	o			30.35%	0.20%	0.22%	-0.02%	0.00%

Notes: **PA**=Progressive Activities; **PS**=Progressive Services; **S&AS**=Stagnant and Asymptotically Stagnant; **PPE**=Pure Productivity Effects; **CRS**=Change in Relative Size; **IE**=Interaction Effect

Source: Own calculations as explained in section 3.4.

Table 10: Productivity of Labour Inputs and the division into effects: Services, 1996-2003

Bea series number and description		PA	PS	S&AS	Output per person	SUM (PPE + CRS + IE)	PPE	CRS	IE
	Services					**11.25%**	**10.79%**	**0.64%**	**-0.17%**
34	**Wholesale trade**	**o**	**o**		**34.13%**	**0.00%**	**2.17%**	**-0.11%**	**-0.04%**
35	**Retail trade**	**o**	**o**		**36.90%**	**2.46%**	**2.61%**	**-0.10%**	**-0.04%**
36	**Transportation and warehousing**	**o**	**o**		**15.63%**	**0.47%**	**0.48%**	**-0.01%**	**0.00%**
46	Publishing industries (includes software)	o	o		29.88%	0.30%	0.31%	0.00%	0.00%
47	Motion picture and sound recording industries			o	10.57%	0.04%	0.03%	0.01%	0.00%
48	Broadcasting and telecommunications	o	o		43.29%	1.08%	1.16%	-0.06%	-0.02%
49	Information and data processing services			o	10.60%	0.05%	0.04%	0.01%	0.00%
52	Federal Reserve banks, credit intermediation, and related activities			o	16.63%	0.59%	0.50%	0.08%	0.01%
53	Securities, commodity contracts, and investments	o	o		113.05%	1.37%	1.50%	-0.06%	-0.07%
54	Insurance carriers and related activities	o	o		0.62%	0.04%	0.02%	0.02%	0.00%
55	Funds, trusts, and other financial vehicles	o	o		-84.59%	-0.09%	-0.10%	0.03%	-0.02%
57	Real estate			o	5.55%	0.76%	0.62%	0.14%	0.01%
58	Rental and leasing services and lessors of intangible assets			o	11.71%	0.12%	0.13%	-0.01%	0.00%
61	Legal services			o	-6.16%	-0.06%	-0.09%	0.03%	0.00%
62	Computer systems design and related services			o	20.59%	0.20%	0.17%	0.02%	0.01%
63	Miscellaneous professional, scientific, and technical services			o	17.47%	0.70%	0.67%	0.02%	0.00%
64	**Management of companies and enterprises**				**14.34%**	**0.25%**	**0.25%**	**0.00%**	**0.00%**
66	Administrative and support services			o	3.59%	0.13%	0.09%	0.04%	0.00%
67	Waste management and remediation services			o	13.06%	0.03%	0.03%	0.00%	0.00%
69	**Educational services**			**o**	**-16.58%**	**-0.10%**	**-0.13%**	**0.04%**	**-0.01%**
70	Health care and social assistance			o	0.90%	0.19%	0.06%	0.13%	0.00%
71	Ambulatory health care services			o	6.21%	0.26%	0.21%	0.05%	0.00%
72	Hospitals and nursing and residential care facilities			o	-6.73%	-0.11%	-0.17%	0.07%	0.00%
73	Social assistance			o	5.32%	0.04%	0.02%	0.02%	0.00%
76	Performing arts, spectator sports, museums, and related activities			o	6.93%	0.04%	0.03%	0.01%	0.00%
77	Amusements, gambling, and recreation industries			o	8.26%	0.05%	0.04%	0.01%	0.00%
78	Accommodation and food services			o	7.15%	0.21%	0.18%	0.03%	0.00%
79	Accommodation			o	5.82%	0.06%	0.05%	0.01%	0.00%
80	Food services and drinking places			o	10.32%	0.19%	0.17%	0.02%	0.00%
81	**Other services, except government**		**o**		**-12.28%**	**-0.25%**	**-0.30%**	**0.06%**	**-0.01%**
82	**Government**			**o**	**0.35%**	**0.19%**	**0.05%**	**0.14%**	**0.00%**

Notes: **PA**=Progressive Activities; **PS**=Progressive Services; **S&AS**=Stagnant and Asymptotically Stagnant; **PPE**=Pure Productivity Effects; **CRS**=Change in Relative Size; **IE**=Interaction Effect

Source: Own calculations as explained in section 3.4.

Table 11: Productivity of Labour Inputs and the division into effects: GDP, Mining, Construction and Manufacturing Activities, 1990-1995

Bea series number and description		PA	PS	S&AS	Output per person	SUM (PPE + CRS + IE)	PPE	CRS	IE
1	**Gross domestic product**					**6.83%**	**7.02%**	**-0.03%**	**-0.16%**
6	**Mining**	**o**			**28.04%**	**0.00%**	**0.42%**	**-0.05%**	**-0.01%**
10	**Utilities**	**o**			**22.37%**	**0.00%**	**0.56%**	**-0.03%**	**-0.01%**
11	**Construction**	**o**			**0.20%**	**0.00%**	**0.01%**	**-0.01%**	**0.00%**
	Manufacturing	**o**				**3.32%**	**3.58%**	**-0.17%**	**-0.09%**
14	Wood products	o			-17.46%	-0.05%	-0.06%	0.01%	0.00%
15	Nonmetallic mineral products	o			19.77%	0.08%	0.09%	0.00%	0.00%
16	Primary metals	o			17.38%	0.11%	0.12%	-0.01%	0.00%
17	Fabricated metal products	o			13.85%	0.18%	0.18%	-0.01%	0.00%
18	Machinery	o			-4.61%	-0.07%	-0.07%	0.00%	0.00%
19	Computer and electronic products	o			93.50%	1.47%	1.60%	-0.06%	-0.06%
20	Electrical equipment, appliances, and components	o			14.78%	0.09%	0.10%	-0.01%	0.00%
21	Motor vehicles, bodies and trailers, and parts	o			18.69%	0.20%	0.18%	0.02%	0.00%
22	Other transportation equipment	o			30.78%	0.28%	0.33%	-0.04%	-0.01%
23	Furniture and related products	o			10.09%	0.03%	0.03%	0.00%	0.00%
24	Miscellaneous manufacturing	o			7.35%	0.04%	0.04%	0.00%	0.00%
26	Food and beverage and tobacco products	o			18.40%	0.33%	0.35%	-0.02%	0.00%
27	Textile mills and textile product mills	o			21.41%	0.08%	0.08%	-0.01%	0.00%
28	Apparel and leather and allied products	o			19.34%	0.08%	0.09%	-0.01%	0.00%
29	Paper products	o			3.20%	0.03%	0.02%	0.00%	0.00%
30	Printing and related support activities	o			0.26%	0.00%	0.00%	0.00%	0.00%
31	Petroleum and coal products	o			34.28%	0.14%	0.16%	-0.02%	-0.01%
32	Chemical products	o			10.94%	0.20%	0.20%	0.00%	0.00%
33	Plastics and rubber products	o			18.59%	0.12%	0.12%	0.00%	0.00%

Notes: **PA**=Progressive Activities; **PS**=Progressive Services; **S&AS**=Stagnant and Asymptotically Stagnant; **PPE**=Pure Productivity Effects; **CRS**=Change in Relative Size; **IE**=Interaction Effect

Source: Own calculations as explained in section 3.4.

Table 12: Productivity of Labour Inputs and the division into effects: Service industries, 1990-1995

Bea series number and description		PA	PS	S&AS	Output per person	SUM (PPE + CRS + IE)	PPE	CRS	IE
	Services					**1.95%**	**1.67%**	**0.35%**	**-0.07%**
34	**Wholesale trade**	**o**	**o**		**17.74%**	**1.04%**	**1.08%**	**-0.04%**	**-0.01%**
35	**Retail trade**	**o**	**o**		**15.73%**	**1.05%**	**1.10%**	**-0.04%**	**-0.01%**
36	**Transportation and warehousing**	**o**	**o**		**15.73%**	**0.45%**	**0.47%**	**-0.01%**	**0.00%**
46	Publishing industries (includes software)	o	o		17.45%	0.15%	0.15%	0.00%	0.00%
47	Motion picture and sound recording industries			o	-9.38%	-0.02%	-0.03%	0.00%	0.00%
48	Broadcasting and telecommunications	o	o		24.83%	0.59%	0.62%	-0.02%	-0.01%
49	Information and data processing services			o	0.81%	0.01%	0.00%	0.00%	0.00%
52	Federal Reserve banks, credit intermediation, and related activities			o	-0.41%	0.00%	-0.01%	0.01%	0.00%
53	Securities, commodity contracts, and investments	o	o		51.12%	0.38%	0.39%	0.00%	0.00%
54	Insurance carriers and related activities	o	o		1.74%	0.07%	0.04%	0.03%	0.00%
55	Funds, trusts, and other financial vehicles	o	o		9.96%	0.01%	0.01%	0.00%	0.00%
57	Real estate			o	6.34%	0.70%	0.71%	-0.01%	0.00%
58	Rental and leasing services and lessors of intangible assets			o	7.35%	0.08%	0.08%	0.00%	0.00%
61	Legal services			o	-3.65%	-0.05%	-0.06%	0.00%	0.00%
62	Computer systems design and related services			o	-7.97%	-0.03%	-0.04%	0.02%	0.00%
63	Miscellaneous professional, scientific, and technical services			o	-7.57%	-0.26%	-0.29%	0.03%	0.00%
64	**Management of companies and enterprises**				**0.39%**	0.01%	**0.01%**	**0.01%**	**0.00%**
66	Administrative and support services			o	-7.68%	-0.13%	-0.16%	0.04%	0.00%
67	Waste management and remediation services			o	-4.69%	-0.01%	-0.01%	0.00%	0.00%
69	**Educational services**			**o**	**-2.06%**	**-0.01%**	**-0.01%**	**0.01%**	**0.00%**
70	Health care and social assistance			o	-12.36%	-0.65%	-0.75%	0.12%	-0.01%
71	Ambulatory health care services			o	-22.36%	-0.65%	-0.72%	0.09%	-0.02%
72	Hospitals and nursing and residential care facilities			o	-7.45%	-0.15%	-0.18%	0.03%	0.00%
73	Social assistance			o	-2.76%	0.00%	-0.01%	0.01%	0.00%
76	Performing arts, spectator sports, museums, and related activities			o	4.11%	0.02%	0.01%	0.00%	0.00%
77	Amusements, gambling, and recreation industries			o	-15.00%	-0.06%	-0.07%	0.01%	0.00%
78	Accommodation and food services			o	-1.96%	-0.04%	-0.05%	0.01%	0.00%
79	Accommodation			o	16.36%	0.13%	0.13%	0.00%	0.00%
80	Food services and drinking places			o	-8.53%	-0.15%	-0.16%	0.01%	0.00%
81	**Other services, except government**		**o**		**-1.05%**	**-0.02%**	**-0.03%**	**0.01%**	**0.00%**
82	**Government**			**o**	**-3.86%**	**-0.49%**	**-0.54%**	**0.05%**	**0.00%**

Notes: **PA**=Progressive Activities; **PS**=Progressive Services; **S&AS**=Stagnant and Asymptotically Stagnant; **PPE**=Pure Productivity Effects; **CRS**=Change in Relative Size; **IE**=Interaction Effect

Source: Own calculations as explained in section 3.4.

Appendix C - List of Content Industries, Composite Content and Form Industries and Pure Form Industries

The indexes have been calculated according to the following definitions:

C.1. Content Industries

Employment: Motion picture and video production (NAICS 51211), Miscellaneous motion picture and video industries (51212-9) Internet publishing and broadcasting (516), Advertising and related services (5418), Photographic services (54192), Performing arts and spectator sports (711) (source, BLS, accessed March 2007); *Prices 1987-1997*, Photographic studios, portrait, (SIC 722), Advertising (731), Theatrical producers, bands, orchestras, and entertainers (792), Professional sports clubs and promoters (7941), Racing including track operation (7948); Prices 1998-2005, Advertising and related services (NAICS, 541800), Performing arts companies (711100), Spectator sports (711200), Independent artists, writers, and performers (711500), Promoters of performing arts and sports and agents for public figures (711A00) (source, BEA, accessed March 2007)

C.2. Composite Content and Form Industries

Employment: Newspaper, book,.. (NAICS 5111), Sound recording industries (5122), Radio Broadcasting (51511), Television broadcasting (51512), Cable and other subscription programming (5152); (source, BLS, accessed March 2007); *Output, Output per worker, Unit Cost Labour and Labour Compensation*: Newspaper, Periodical, Book, and Directory Publishers (NAICS 5111), Radio and Television Broadcasting (5151), Cable and Other Subscription Programming (5152), (source, BLS, accessed March 2007); *Prices 1987-1997*: Radio and TV broadcasting, except cable TV (SIC 483), Cable TV (484), Motion picture production, distribution, and allied services (781, 2), Motion picture theaters (783), Newspapers (2711), Periodicals (2721), Book publishing (2731), Book printing (2732) Miscellaneous publishing (2741), *Prices 1998-2005*: Newspaper publishers (NAICS 511110), Periodical publishers (511120), Book publishers (511130), Motion picture and video industries (512100), Sound recording industries (512200), Radio and television broadcasting (513100), (source, BEA, accessed March 2007);

C.3. Pure Form Industries

Employment: Printing and related support activities (NAICS 323), Broadcast and wireless communications equipment (33422), Audio and video equipment (3343), Magnetic media manufacturing and reproduction (3346), Motion picture and video exhibition (51213), Cable and other program distribution (5175), Video tape and disc rental, (53223), (source, BLS, accessed March 2007); *Output, Output per worker, Unit Cost Labour and Labour Compensation*: Printing and related support activities (NAICS 323), Audio and video equipment manufacturing (3343), Video tape and disc rental (53223), Motion Picture and Video Exhibition (51213), (source, BLS, accessed March 2007); *Prices 1998-2005*; Commercial printing, lithographic (SIC 2752), Commercial printing, gravure (2754), Commercial printing, nec (2759), Greeting cards (2771), Blankbooks and looseleaf binders (2782), Household audio and video equipment (3651), Prerecorded records and tapes (3652), Radio & TV Communications Equipment (3663), Photographic equipment and supplies (3861), *Prices 1998-2005*, Commercial printing, lithographic (NAICS 2752), Commercial printing, gravure (2754), Commercial printing, nec (2759), Greeting cards (2771), Blankbooks and looseleaf binders (2782), Household audio and video equipment (3651), Prerecorded records and tapes (3652), Radio & TV Communications Equipment (3663), Photographic equipment and supplies (3861); (source, BEA, accessed March 2007)

Statistics published by the BEA are available from http://www.bea.gov ; Statistics published by the BLS are available from http://www.bls.gov ;

Appendix D - Indicators of Innovations in the Telecommunication Sector

Table 13: Telecommunication Sector: Labour productivity changes (yearly averages), Phase 1 to 4

Productivity		Phase 1	Phase 2	Phase 3	Phase 4
		1952-1968	**1969-1984**	**1985-1997**	**1998-2003**
Output per hour	Telecommunications	6.23%	6.05%	5.10%	5.12%
	Non-farm Business	2.50%	1.70%	1.65%	3.12%
	Difference	149.18%	254.75%	209.52%	63.87%
Output per person	Telecommunications	6.43%	6.07%	5.38%	4.12%
	Non-farm Business	2.33%	1.23%	1.64%	2.83%
	Difference	176.38%	393.86%	229.09%	45.43%

Source: Based on data published by the Bureau of Labour statistics, <www.bls.org>, accessed on March, 2006. Averages and differences calculated by the author.

Table 14: Telecommunication Sector: Average yearly increase in Fixed Capital Investment, Phase 1 to 4

Capital Fixed investment	Phase 1	Phase 2	Phase 3	Phase 4
	1952-1970	**1971-1984**	**1985-1997**	**1998-2003**
Telecommunications & Broadcasting	8.72%	5.86%	5.64%	6.30%
Total	4.59%	4.67%	3.59%	4.66%
Difference	*89.85%*	*25.64%*	*56.94%*	*35.25%*

Source: Based on data published by the Bureau of Economic Analysis, <www.bea.org>, accessed on March, 2006. Averages and differences calculated by the author.

Table 15: Telecommunication Sector: Average yearly increase in investment in R&D (as a percentage of net sales), Phase 1 to 4

Company R&D funds as a percent of net sales in R&D-performing companies (yearly average over the period)	Phase 1	Phase 2	Phase 3	Phase 4
	1952-1970	**1971-1984**	**1985-1997**	**1998-2001**
Telecommunication equipment	3.8	4.9	7.2	12.3
Telecom Services	na	na	2.0	0.5
All industries	2.0	2.2	2.9	3.4
Difference between telecommunications and all industries				
Equipment	1.8	2.7	4.3	8.9
Services	na	na	-0.9	-2.9

Sources: (1958-1998), National science Foundation (NSF) - Industrial Research and Development Information System, historical data 1953-1998; available online at <http:// http://www.nsf.gov/statistics/iris/> retrieved March 2006; (1998-2001) NSF/Division of Science Resources Statistics, Survey of Industrial Research and Development (2001); Note: 1958-1971: Communication Equipment and Electronic components (SIC 366+367)

Table 16: Telecommunication Sector: Average yearly increase in investment in R&D (2000 prices), Phase 1 to 4

Total Funds for R&D, yearly increase	Phase 1	Phase 2	Phase 3	Phase 4
	1958-1970	**1971-1984**	**1985-1997**	**1998-2001**
Communication Equipment	10.39%	9.47%	-7.48%	31.30%
All industries	6.82%	10.76%	5.96%	6.02%
Difference between telecommunications and all industries				
Difference	*3.58%*	*-1.30%*	*-13.44%*	*25.28%*

Sources: (1958-1998), National science Foundation (NSF) - Industrial Research and Development Information System, historical data 1953-1998; available online at <http:// http://www.nsf.gov/statistics/iris/> retrieved March 2006; (1998-2001) NSF/Division of Science Resources Statistics, Survey of Industrial Research and Development (2001)

Table 17: Telecommunication Sector: Total Funds for R&D as a percentage of all industries, Phase 1 to 4

Total Funds for R&D as a percentage of all industries	Phase 1	Phase 2	Phase 3	Phase 4
	1958-1970	**1971-1984**	**1985-1997**	**1998-2001**
Communication Equipment	13.27%	10.62%	7.52%	5.56%

Sources: (1958-1998), National science Foundation (NSF) - Industrial Research and Development Information System, historical data 1953-1998; available online at <http:// http://www.nsf.gov/statistics/iris/> retrieved March 2006; (1998-2001) NSF/Division of Science Resources Statistics, Survey of Industrial Research and Development (2001)

Appendix E - The Evolution of The Wireless Telecommunication Industry

In this appendix, using the approach embraced in this research, we tell the story of the evolution of mobile telephone systems as a succession of intertwined technological innovations and regulatory changes.

Mobile telephone networks are clearly complex systems: as Kano (2000) explains the mobile telephone systems is composed of sub-systems such as the mobile phones, the radio base stations and the switching network equipment to track and route a call to the location of a mobile user.[107]

In Chapter Six of this project, we have explained the evolution of the telecommunication sector as a history friendly account of the interplay between technology and regulatory changes, using the modularity literature in order to classify, better understand and explain these changes and how they are related one to the other. In this section, however, we do not compare the evolution of the mobile telecommunication system as a process of modularisation. There are important reasons why such a methodology is discouraged here: the number of stakeholders involved in the mobile industry, or the number of markets and competitors within the industry (hence the number of "modules") depends, as explained below, to a large extent on competition policy (in the case of operators, for example) or on factors related to the participation in standardisation work and the existence of alliances and partnerships (in the case of the manufacturers) or the use of Intellectual Property Rights (IPRs). As a consequence, the number of modules might not necessarily depend from an *increased complexity* of the product. Therefore, looking at the modularisation of the industry is unlikely to provide (further) interesting insights on the economic performance of its participants, the rate and "quality" of the innovations introduced or, more generally, on the technological trajectory taken by the industry.

However, an important analogy with the analysis of the wireline telecommunication carrier sector presented in Chapter Six, needs to be drawn: As Kano explains (2000), the first R&D efforts that led to the creation of mobile phone systems of the first generation in the United States, were conducted almost entirely in the Bell Labs, when AT&T was a monopoly operator. Later (certainly also due to the fact that the 1956 consent decree prohibited AT&T from participating in the market for radio technologies), the most important innovations that have

[107] In his writing, he defines the innovations that affect the entire system as "*systemic*" and the innovations affecting and changing the sub-systems as incremental. Here, we adopt the same notion of incremental innovations, while we name innovations that affect the entire system as "radical", following more closely the neo-Schumpeterian tradition (e.g. Freeman and Perez 1988).

transformed the mobile telephone systems, were clearly enabled by the progress of the semiconductor industry.[108]

Alternatively, a more interesting take on the evolution of the mobile telephone systems is to address the differences between two types of policy frameworks or “attitudes” towards processes of standardisation. The first is more focussed on the idea of “free-market”: In this case, some high-level technological options are selected as standards by a central authority, but then the detailed choice of technology is delegated to operators. This differs from the second or “old” regime and policy framework where a single technology is elected as a standard and its adoption becomes *mandatory* for operators exploiting the licenses giving access to portions of the frequency spectrum. For this purpose, the account of the technological and regulatory changes presented here is not only focussed on the North American industries, where the former policy framework applies, but includes the major changes taking place in the European markets, where the latter type of framework was introduced from the late 1980s.

In the case of mobile telephone systems, however, the concept of “free-market” does not mean any absolute absence of the state or government influence as institutional economists well recognise in studies of the old and new telecom services (e.g. Melody 1997). In fact, the necessity of an (highly significant) authority’s intervention is unquestionable: indeed, governments or independent state regulators need to create a space for different technologies in the usable radio spectrum, a scare resource, which includes all usable frequencies between 3KHz and 300GHz (Curwen 2004). Notably, this process of creating and allocating the space for mobile telephone systems takes the form of, first, the allocation of a radio frequency band to a certain technology and second, the provision of several licensees each giving the exclusive use to a network operator of a given portion of the frequency, in a given geographic location.

Moreover, “national” intervention is essential as is international cooperation. In fact, the propagation of radio waves is governed by Maxwell’s laws of electromagnetics and by physical and environmental boundary conditions and not by national boundaries. Consequently, the International Telecommunication Union (ITU) has long been required to manage technical and operational criteria for an interference-free shared usage of frequencies, tables of the frequency bands entrusted to certain (groups of) nations and users under given conditions and an international frequency register of frequencies already assigned or in actual use (Arnbak 1997 p133).

[108] As a result, the mobile telephony industry can be considered a Carrier Branch from a neo-Schumpeterian viewpoint.

The rest of this section includes an account of entangled technical and regulatory changes characterising three generations of mobile telephone systems, as well as some information on the fourth or next generation networks. Secondly, the effects of the different approaches, centralised and decentralised technology choice, are illustrated by comparing the state of these industries in the United States and in Europe. Finally, conclusions on benefits and shortcomings of these two policy frameworks are presented.

E.1. The First Generation of Cellular Technologies (1G) and The Local Networks

As mentioned above, cellular mobile phone networks are complex products composed of several, technically sophisticated modules or sub-systems, created by significant R&D efforts. Consequently, the innovative process leading to the creation of the first cellular handsets and network presenting the basic functionalities (which are common characteristics of the different generations of technologies) is the result of a much more extensive R&D process than the ones leading to the following generations of technologies, focussed on adding functionalities and increasing the performance of the system and resulting from several incremental innovations.

Bell Labs started its work on radio research in 1914 while the first commercial mobile phone was introduced only in 1946 or 32 years later (Zysman et al. 2000). However, this first prototype of technology was making an extensive use of radio spectrum and with the range of frequencies that were allocated to this service by the FCC at the time, only 23 simultaneous conversations were possible in one service area (Bellis 1999).

In 1947, in order to remedy to the problem of the scarcity of frequencies, D.H. Ring, a scientist of Bell Labs, launched the idea of using "cells" for mobile telephony. These cells are simply divisions of service areas into smaller units, each covered by a FM base station, which picks up and hands-off calls as subscribers pass through them (King and West 2002). The obvious advantage is that frequencies can be re-used in different cells within the same service area.

However, as indicated below, AT&T and American carriers in general, did not forecast the mass diffusion of mobile phones of the 1990s; instead, at this time, they imagined that cellular phones would have been confined to an elite and specialist consumption.

Because of this attitude towards the mobile telephony market and because of the 1956 consent decree (as King and West [2002] suggest), it took almost 70 years from the beginning of formal research in the field, to the introduction of what is considered the first generation of cellular phone system in 1983. It was in that year that the Advanced Mobile Phone Service (AMPS), was made available for the first time by Ameritech in Chicago (Bellis 1999; Zysman et al. 2000).

Prior to the launch of the first commercial system in 1983, the FCC intervened in a significant manner in the shaping of the mobile industry at least twice. First, in order to stimulate research in the sector, the Commission stated in 1968 that if the technology had improved, more bandwidth frequencies would have been allocated for mobile phone communications. Second, in the early 1980s, after AT&T held trials with 2000 customers in Chicago, the FCC acted by electing the AMPS system as the (unique) industry standard (Bellis 1999; Gandal, Salant and Waverman 2003).

Table 18: Technical and Regulatory Changes Characterising 1G technologies

Year	Description	Source
1914	Radio Research started in the Bell System	Zysman et al., 2000
1946	Bell Labs introduces the first commercial mobile telephone system	Zysman et al., 2000
1947	D.h Ring, Bell's Lab scientist invents the conept of cellular telephony (the actualy use of "cells")	King and West, 2002; Bellis, 1999
1947	*AT&T proposal to the FCC to allocate a large number of frequencies of the spectrum to mobiles communication to stimulate research; the number of frequencies provided, however, only allow 23 simultaneous conversation in one service area, with the existing technology.*	*Bellis, 1999*
1956	*Following the Consent Decree AT&T gives up the wireless capability it developed*	*King and West, 2002*
1968	*The FCC declares they would allocate more frequencies to mobile phone is the technology improuves*	*Bellis, 1999*
1973	Dr Martin Cooper, General Manager for the System Division at **Motorola,** made what is assumed to have been the first call from a portable Cell phone	Bellis, 1999
1977	AT&T and Bell Labs have constructed a prototype cellular system	Bellis, 1999; Lyytinen, Fomin, 2002
1978	AT&T have trials in Chiacago with 2000 customers **(AMPS** becomes industry standard)	Bellis, 1999
1979	**NTT System** is launched (Japan)	Kano, 2000; Lyytinen, Fomin, 2002
1979	*the FCC first established SMR in 1979 to provide for land mobile communications on a commercial basis.*	*FCC 2005b*
1981	Motorola and American Radio telephone started a second U.S. cellular radio-telephone system test in the Washington/Baltimore area	Bellis, 1999
1981	Nordic Mobile Telephony, **NMT (450 Mhz),** is launched	Kano, 2000 Lyytinen, Fomin, 2002
1982	the **FCC authorizes commercial cellular service** for the USA and elect AMPS as the (mandatory) standard	Bellis, 1999; Gandal, Salant and Waverman, 2003; Zysman et al., 2000
1982	*The Commission starts the licensing process for commercial cellular providers*;*	*FCC 2005b, Bellis, 1999*
1983	The first **AMPS** (Advanced Mobile Phone Service) is made available in Chicago by Ameritech	Bellis, 1999; Zysman et al., 2000
1983	An updated version of the **NTM** system (900Mhz) is launched	Lyytinen, Fomin, 2002
1984	*the Commission adopts rules to award the remaining MSA (all minus 30) and RSA licences through lotteries.*	*FCC 2005b; Hazlett 2003*
1985	Total Access Communication System, **TACS**, is launched	Kano, 2000
1986	*Organisation of other lotteries for MSA (and RSA) licences*	*FCC 2005b,*
1988	*Lotteries for cellular licences for the RSA take place (also in 1989)*	*Hazlett, 2003*
1991	*The commission completes the cellular licences awarding procedure (all MSA and RSA are awarded) ***	*FCC 2005b*

Once the standard was decided and, in the process, the frequency band chosen (the 800 MHz band), the allocation of the "space" for cellular networks started in 1982. The United States was divided into 734 cellular market areas (CMAs), or 305 Metropolitan Statistical Areas (MSAs) and 428 Rural Statistical Areas (RSAs): at the same time 50 MHz of the 800MHz band was divided into two blocks, which were licensed to two competing operators. One block was assigned to the local incumbent wireline carrier, while the second block was assigned to a competitor, initially by comparative hearings and later (from 1984) by lotteries. This first process of assigning licenses for all CMAs was completed in 1991 (see FCC 2005b; Gandal, Salant and Waverman 2003; Hazlet 2003).

As explained above, we find it interesting here to compare the evolution of mobile telephone systems in the United States, with the evolution of the same industry in Europe. However, before the Global System for Mobile Communications (GSM) became the European standard in 1987, European countries had different local standards (e.g. The American produced Total Access Communication System [TACS] in the UK and the C-450 in Germany). Here, however, we only briefly describe the characteristics and the process that led to the creation of the most successful of the Europeans 1G cellular systems: the Nordic Mobile Telephone (NMT).

The NMT system was designed by a group of experts composed of the telecommunication administrators of four Nordic countries: Denmark, Finland, Sweden, and Norway (Lyytinen and Fomin 2002). This group of experts was formed in 1970 in order to expand their car radio services that, even though incompatible with each other and therefore each one usable only on their relatively small territories, they were among the most diffused in the world, particularly the Swedish and the Finnish ones. This group of scientists enjoyed a comfortable degree of freedom from their own employer, as they were bound to meet financial goals, but free in the selection of the technologies; moreover, their companies were not in direct competition so that they were quite free to share technical information with each other.

According to the account provided by Lyytinen and Fomin (2002), there were two other crucial factors which explain the success of the work of this group: contrary to the processes that lead to the creation of the AMPS or the C-450 systems, where Motorola and Siemens, respectively, played a dominant role in the standard's design, the group was rather free from pressures of manufacturers and their vision was mainly shaped *from a service viewpoint*.

This vision included a common and open technical design, efficient use of common radio frequencies and low cost terminals. Furthermore, their work lead to services that also shaped future generations of mobile: universal roaming, charging schemes and a quality of service similar to that of the wireline services.

The NMT was launched in 1981 and quickly became a success. This success was not only clearly indicated by the highest rate of penetration among the 1G technologies at the time (Lyytinen and Fomin 2002), but also by the success story of two major communication corporations, Ericsson and Nokia, both of which benefited from the expansion of this system and the openness of its design.

E.2. The Second Generations of Cellular Technologies (2G) And Their Regional Dimension

In this account of the evolution of mobile phone technologies, we divide the 2G standards into two families, using, as a base criteria, two fundamental innovations in the field of radio transmission allowing frequencies to be shared among different users. The main driver leading to the introduction of these innovations, as was the case for the introduction of cells, is the scarcity of frequencies available to mobile phone technologies.

The first of these two fundamental radio transmission technologies introduced is the **Time Division Multiple Access** (TDMA): this technology, also known as "digital" AMPS (D-AMPS), shares access to the frequency band into timeslots that are allocated to different users at regular intervals. Alternatively, the second of these technologies, the **Code Division Multiple Access** (CDMA), assigns a special electronic code to each signal and allows the entire frequency band to be occupied simultaneously (Curwen 2004).

One of these two radio transmission technologies, TDMA or CDMA, in its "original form", upgraded or "transposed" into a new technology following the introduction of incremental innovations (e.g. GSM and iDEN, as explained below), is part of every new second and third generation mobile phone system.

In the United States, contrary to what happened in the case of the 1G mobile networks, a mandatory standard for the 2G was not established. Instead, new standards based on one or the other radio transmission technology were released in short succession: TDMA IS-54 was released in 1991; CDMA IS-95, also known as CDMA-One, was released in 1993, a year before the release of an improved version of TDMA, the IS-136 (Bellis 1999; Zysman et al. 2000).

As in 1968, we find that in 1987 another USA regulatory decision operates to shape the new generations of systems and technologies: the FCC announced that more frequency bands are to become available for mobile communications (Bellis 1999). The allocation of these frequencies for what was later known as personal communication services (PCS), this time using a system of auctions instead of lotteries, started in 1994 with the allocation of narrowband blocks, small range of frequencies used for the transmission of data (messaging/paging). Different blocks of

Broadband PCS are successively auctioned between 1995 and 1997 (FCC 2005b; Gandal, Salant and Waverman 2003).

Table 19: Technical and Regulatory Changes Characterising 2G technologies

Year	Description	Source
1982	Conference of European Posts and Telecommunications **(CEPT)** starts the process of finding a standard (which will lead to GSM) for the entire European Market	Bellis, 1999; Curwen, 2004
1987	FCC declare that another technology is needed in order to use other frequencies (leading to PCS)	Bellis, 1999
1987	**GSM** becomes a standard / Operators sign a GSM MoU - Memorandum of Understanding	Bellis, 1999; Gandal, Salant and Waverman, 2003
1988	the Cellular Technology Industry Association **(CTIA)** is established	Bellis, 1999
1988	The European Telecommunications Standards Institute (**ETSI**) is established	Gandal, Salant and Waverman, 2003
1988	**Bell Labs** demostrated in a trial the first digital mobile system supporting digital speech, data transmission, adaptive modulation, and encryption.	Zysman et al., 2000
1989	In Germany the **first GSM concession** is awarded	Gandal, Salant and Waverman, 2003
1991	**TDMA IS-54** is released (IS=Interim Standard)	Bellis, 1999; Zysman et al., 2000
1991	*The commission completes the cellular licences awarding procedure (all MSA and RSA are awarded)*	*FCC 2005b*
1992	*First GSM licences are issued in Europe*	*Curwen, 2004*
1993	**CDMA IS-95** is accepted as a standard	Bellis, 1999; Zysman et al., 2000
1993	In Europe, there are over 1 million **GSM users**	Gandal, Salant and Waverman, 2003
1993	*Congress creates the statutory condition of CMRS*	*FCC 2005b; Koehler, 1998*
1993	*The Omnibus Reconciliation Act (OBRA) is enacted*	*Hazlett, 2003*
1994	The FCC announces that it will allocate the 1900 MHz band for PCS technologies	Bellis, 1999
1994	**TDMA IS-136** is released	Bellis, 1999; Zysman et al., 2000
1994	*First Auction of Narrowband PCS*	*FCC 2005b, Gandal, Salant and Waverman, 2003*
1995	Every country in Europe has at least **one GSM operator**.	Gandal, Salant and Waverman, 2003
1995	*Beginning of the assignement of Broadband PCS licences through auctions*	*FCC 2005b*
1996	**GSM-1900** is introduced in the States	Bellis, 1999
1996	*Brodbands PCS auction: The FCC auction block C*	*Gandal, Salant and Waverman, 2003*
1996	*The last auction of GSM licences in Europe takes place*	*Curwen, 2004*
1997	*The FCC completes the auction of Brodband PCS in January with the auction of block D, E and F.*	*Gandal, Salant and Waverman, 2003*
2005	*The last auction for Broadband PCS (242 licences that were returned to the commission) took place.*	*FCC 2005b*

PCS systems are very similar to cellular ones: they also use base stations and divide service areas into cells in order to maximize frequency re-use, however, they use different frequencies bands, smaller cells than cellular systems and they are designed from the beginning to use digital formats, for improved capacity and performance (Kano 2000). [109]

In order to auction PCS licensees the territory was divided into 51 Major Trading Areas ("MTAs") and 493 Basic Trading Areas ("BTAs") (FCC 2005b; Hazlett 2003).

PCS systems are based on either TDMA or CDMA radio transmission technologies.

At the same time of the development of PCS operators, another competing mobile phone system was developed by a company called then Fleet Call (now Nextel), and built by acquiring thousands of licenses granting the use of the Specialized Mobile Radio (SMR) spectrum. The latter comprises a range of frequencies initially allocated to local businesses for dispatch services and that, through a strategic regulatory waiver, could be employed to offer a service to the general public (Hazlett 2003). The technology employed by Nextel to exploit SMR frequencies was introduced in 1994 by Motorola. It is called integrated Digital Enhanced Network (iDEN) (The Economist 2003) and it employs TDMA radio transmission technology.

A fourth digital technology for mobile telephony, the Global System for Mobile Communication (GSM) was created by merging and improving Frequency Division Multiple Access (FDMA) and TDMA technologies. This was the first widely adopted in the EU member states and was later accepted as a standard in the United States in 1995 (Bellis 1999).[110]

Notably, the GSM standard was first developed and mainly adopted in Europe and imported into the United States only when it had already reached a high penetration rate in the region where it has been first introduced.

According to Kano (2000), there are three basic reasons explaining why in Europe the GMS standard was developed at a regional level: the first is that in the late 1980s, when standardization work began, cellular technologies had not yet gone through the "miniaturization process", which was later fostered by the progress of the semi-conductor industry and that allowed telephone handset to be easily portable. At the time they were mainly considered car-

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[109] Cellular Systems cells are typically 3 to 5 Kilometers in radius, while PCS' are typically 200-500 meters. The latter are supposed to be more economic (given the smaller amount of energy needed for the functioning of the base stations) and providing a better communication service, especially in the case of populated urban areas (Kano 2000).

[110] Here we consider the GSM standard as part of the TDMA "family", because the radio transmission technology underpinning the GSM standard is based on time allocation and because TDMA system users, when upgrading their networks to 2.5 or 3G systems (e.g. GPRS or W-CDMA), normally upgrade their networks to GSM first (see FCC 2005b).

phones, likely to travel within regions but unlikely to travel often across continents, and their development into personal communication tools was not yet envisaged. The second reason concerns the fact that Europe had decided to focus on the mobile communication system as one of its strategic high-technology projects in order to gain a competitive position at a global level. Moreover, the third reason was that the European (but also Japanese) tradition, in practice and "as a philosophy", at the time and still nowadays tends to have a central standard setting body selecting a technology instead of delegating the decision to the market as more generally tends to be the case in the United States (Kano 2000; 312-3).

Therefore, the process leading to the definition of a standard for the entire European market was started by the Conference of European Posts and Telecommunication (CEPT) in 1982 (Bellis 1999; Curwen 2004) and was continued by the newly created European Telecommunication Standards Institute (ETSI) in 1988 (Bekkers, Duysters and Verspangen 2002).

As explained above, the GSM standard was set and enforced at a European level: in fact, operators agreed on a unique standard (and signed, in 1987, a GSM Memorandum of Understanding [MoU]) while the European commission established a common allocation of spectrum for this technology (leading to easy roaming possibilities across European nation states). At the same time regulators managed the exploitation of licenses granting the use of the frequencies to the application of GSM system technologies (Gandal, Salant and Waverman 2003; Curwen 2005).

The history of the GSM standard partly reflects the experience and / or the success story of the NMT. In fact, the standard was conceived as a collaborative effort of operators, manufacturers and regulators, sharing a vision of a unique system, which, once created, was going to be unique and mandatory for the exploitation of the spectrum licensees.

However, some differences with the process that led to the establishment of the NMT standard emerge: the GSM standard ended up not being open and its conception was not mainly focused on the service, as in this case equipment manufacturers played quite a crucial role in determination of this standard. As Bekkers et al. (2002) explain, after signing the GSM MoU agreement in 1988, operators issued an invitation to tender for network equipment: this tender was subject to the renouncing by manufacturers of any IPRs binding the use and development of essential patents, which were going to be necessary to apply the selected standard. This request was in line with a procedure applied in the past where telecommunication manufacturers, which have been involved in the standard setting work, did not use this experience excessively to their own advantage by applying for patents and this following some kind of "gentlemen's agreement" (Granstrand 1999: 204, quoted by Bekkers, Duysters and Verspangen 2002).

The telecom manufacturers involved, however, did not accept this, stopping the GSM standardization work. In a second round of negotiations, operators lowered their requirements and tried to force network equipment suppliers to sign a declaration in which they agreed to serve the whole GSM community, both suppliers and operators, on fair, reasonable and non-discriminatory conditions. These conditions were not met as Motorola, which had played an important role in the determination of the standard, refused to grant non-discriminatory licenses for its sizeable portfolio of essential patents that turned out to be indispensable for GSM. Motorola was only prepared to enter into a limited number of cross-licenses with selected parties, and also to limit the geographic scope of such licenses to Europe. Motorola turned out be a determining factor for the GSM market structure, as, for the companies involved in these agreements, this cross-licensing reduced market risks while, for those not involved, it created barriers to enter the market (Bekkers, Duysters and Verspangen 2002).

However, the licenses to use the frequencies for GSM technologies were allocated between 1992 and 1996 (Curwen 2004) and for reasons that will be explained below, these agreements between manufacturers did not prevent GSM from becoming the most successful 2G standard for mobile communication.

E.3. The Third Generations of Mobile Phone Systems (3G) and Their Global Expansion's Prospects

As 2G mobile phone systems continued to evolve technically, they became capable of transmitting more data, more quickly as well as seeing the number of functionalities integrated in handsets increasing: somehow there has been a *continuum* of technical improvements and there are many different viewpoints on what can be considered the first 3G technology. Here, essentially, we follow Curwen (2005) and define 3G technologies as all mobile telephone systems allowing the transmission of data (voice, images, video, files, etc..) at speeds above 384 Kilobits per seconds (Kbps).

By the time work for the standardisation of the 3G technologies for mobile telephone systems began, it was apparent that total portability of handsets had been achieved thanks to R&D and innovation in the telecommunication as well as in the semiconductor industries.

Certainly, these technical developments pushed mobile telecommunication to a global scale even more than in case of the 2G technologies, hence the specification of frequencies to be used for this standard was already on the agenda of the 1992 World Administrative Radio Conference (WARC) (Zysman et al. 2000).[111]

Following the 1992 WARC, in 1997 the ITU started standardisation work for 3G technologies under the label of the International Mobile Telecommunications-2000 (IMT-2000) framework (Kano 2000). This standardisation work, which followed the vision of a global wireless standard, lead to the establishment of 5 *recommended* radio interfaces (Zysman et al. 2000).[112]

However, similarly to the developments that took place at the time of the 2G technology standardisation, a difference of attitude can be found between the United States and the European approach: the former tended to leave the market determine the dissemination of the different technologies, while in Europe the standard selection was centralised (see Curwen 2005).

Standardisation work in Europe started under the leadership of ETSI: however, soon non-European associations, operators and manufacturers demonstrated an interest in participating in this work. As a result, the standard chosen in Europe was the Universal Mobile Telecommunications System (UMTS), which adopts a technology deriving from the CDMA-One (Gandal, Salant, Waverman 2003); in more technical jargon, this standard is called Wideband CDMA (or W-CDMA).[113]

After W-CDMA became the UMTS standard in 1999, development work changed its home and moved to a newly founded (European based) industry forum, the 3G Partnership Project (3GPP), which includes among its members, other than the obvious ETSI, also ARIB and TTC of Japan and the US based T1 (Kano 2000).

That same year, another industry forum was formed, this time to develop the CDMA2000 (the 1xEV-DO followed by the 1xEV-DV) and the UWC-136 standards. This forum, which was named 3G Partnership Project 2 (3GPP2) and is based in the US, comprises among its members national standards organizations such as TTA (Telecommunication Technology Association) of

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[111] According to "WARC-92 frequencies for IMT-2000" resolution, "The bands 1885-2025 MHz and 2110-2200 MHz are intended for use, on a worldwide basis, by administrations wishing to implement International Mobile Telecommunications-2000 (IMT-2000) (UMTSworld 2006, online at <http://www.umtsworld.com/technology/frequencies.htm>).

[112] (1) IMT-2000 CDMA direct spread (for UTRA FDD); (2) IMT-2000 CDMA multi-carrier (for cdma2000*, including 1X and 3X); (3) IMT-2000 CDMA TDD (for harmonized UTRA TDD and TD-SCDMA from China); (4) IMT-2000 TDMA single carrier (for UWC-136); and (5) IMT-2000 FDMA/TDMA (for DECT) (Zysman et al. 2000; 112). ITU recommendation M.1457 can be found at <http://www.itu.int/rec/R-REC-M.1457/e>

[113] The latest technology becoming part of this standard is now W-CDMA with High Speed Data Packet Access (HSDPA).

South Korea, ARIB and TTC of Japan, in addition to the Telecommunication Industry Association (TIA) (Kano 2000).

CDMA2000 and W-CDMA are the most widely deployed standards worldwide: the former, however, by January 2003 had already 32,000,000 subscribers against 160,000 of the latter (Gandal, Salant and Waverman 2003).

The main reason for this differential in the diffusion of the two technologies is that CDMA2000 is introduced as an *incremental technology*, as it is, in fact, an upgrade of CDMA-One and later versions, and consequently, its implementation can result from *upgrading the network* in different steps.

Table 20: Technical and Regulatory Changes Characterising 3G technologies

Year	Description	Source
1992	*At the World Aministrative Radio Conference (WARC) spectrum was defined for the next generation systems.*	*Zysman et al., 2000*
1997	**IMT-2000**, the ITU standardisation work for the 3G technologies, is lunched	Kano, 2000
1998	The EC mandated deployment of 3G services (using WCDMA technology) by the end of 2002	Gandal, Salant and Waverman, 2003
1998	DDI and IDO of Japan announced they would adopt **cdma2000** as 3G technology	Kano, 2000
1999	3G Partnership Project **(3GPP)** is established	Kano, 2000
1999	3G Partnership Project 2 (**3GPP2**) established by the TIA (US), following the ETSI example	Kano, 2000
1999	The first version of the 3G standards are completed	Kano, 2000
2000	*Congress enacted the MTSA (Mobile Telecommunication Source Act)*	*Kennedy and Purcell, 2004*
2001	NTT DOCOMO launches **WCDMA**	Gandal, Salant and Waverman, 2003
2001	*The FCC raise the Spectrum cap from 45 to 55Mhz in an RSA*	*FCC 2005b*
2002	*the FCC allocates extra spectrum suitable for offering advanced Wireless Services (AWS)*	*FCC 2005b, Curwen, 2005*
2003	CDMA2000 has 32,000,000 subscribers worldwide, compared with 160,000 for WCDMA	Gandal, Salant and Waverman, 2003
2003	*Beginning of the implementation LNP - Local Number portability*	*FCC 2005b, Arden 2004*
2003	*Congress phases out the spectrum cap*	*FCC 2005b*
2003	*The FCC allows licencees to buy and sell spectrum (subject to approval)*	*FCC 2005b*
2004	*[completing the process started in 2002] the FCC allocates more spectrum suitable for offering advanced Wireless Services (AWS)*	*FCC 2005b; Curwen, 2005*
2005	*The last auction for Broadband PCS (242 licences that were returned to the commission) took place.*	*FCC 2005b*

W-CDMA, on the other hand, is a "disruptive" technology and is not compatible with the legacy systems (i.e. GSM and later technologies based on TDMA) which it is gradually replacing (Curwen 2004).

Moreover, the choice of adopting the W-CDMA standard (and not CDMA2000 or another technology) can be explained (as Gandal, Salant and Waverman [2003] do), more than on technological grounds, with the European Operators' intention of not giving CDMA 2G operators and equipment suppliers (mostly US based) a competitive advantage.

Another advantage of the CDMA2000 implementation, still based on its backward compatibility, is that this technology can work in the spectrum of the legacy technology it is replacing, while W-CDMA requires the use of new frequencies. This feature made the transition to the new technology, for CDMA-One users, run more smoothly. The FCC struggled more than the European authorities to generate the necessary room in the spectrum to accommodate the new technology, as a consequence of its liberal approach to technological innovation.

European countries aligned with a WARC resolution and allocated two frequency bands (1,920-1,980 and 2,110-2,170MHz) to the third generation mobile phone system (Curwen 2005).[114] The creation of this extra space and the allocation of the frequencies suggested by the WARC-92 were more problematic in the United States: as Curwen explains, the 1,710-1,860MHz frequency band was heavily occupied by the military and the 2,110-2,150MHz frequency band was used by schools and health care centres and the 2,500-2,690MHz frequency band was reserved for Multichannel Multipoint Distribution Services (MMDS) and the Instructional Television Fixed Service (Curwen 2004).

The solution to the problem was delivered partly in 2002 and finally in 2004, when first 90 MHz [115] and then an extra 20 MHz[116] were allocated to what the FCC generally refers to as Advanced Wireless Services (AWS) (FCC 2005b).

However, the re-allocation of frequencies to AWS was not without its shortcomings, as Curwen explains (2004): For example, in February 2002, the Bush administration announced the intended creation in the 2003 budget of a $715 million fund to reimburse federal agencies willing to vacate airwaves due to be auctioned for 3G. Eventually, an agreement was reached with the Department of Defense (Curwen 2005).

E.4. The Next Generation Networks (NGNs): Not Only Networks, But Conversion of Technologies

The next generation of networks (NGNs) is still a concept that is a work in progress; given the historical approach embraced here, discussing this in detail here, would be superfluous. However, it is important to mention some characteristics of the mobile telephone system technological path which already seems to have been established.

Two characteristics seem to be crucial for NGNs. These networks are going to be Internet Protocol (IP) based (Berezdivin, Breining and Raytheon 2002; El-Sayed and Jaffe 2002). This will allow using the “neutrality” or the Internet as a network, in combination with many services (voice, data, internet, multimedia, etc.. etc…) and this from a variety of platforms (Mobile Phones, portable computers, handhelds, etc..).

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[114] See footnote 92

[115] In the 1710-1755 and 2110-2155MHz bands (FCC 2005b).

[116] in the 1915-1920MHz, 1995-2000 MHz, 2020-2025 MHz and 2175-2180 MHz (FCC 2005b).

The second fundamental characteristic is that the future NGN tools are going to be able to seamlessly switch between different standards back and forth between public wireless LANs and cellular networks, depending in the availability and bandwidth available, and this using a same subscription (El-Sayed and Jaffe 2002, Edquist 2004). The standards' battle for the emerging WLAN is fought between (the winning) American Institute of Electrical and Electronic Engineers' 802.11 "a" (operating in the 5 GHz band and with a potential capacity of 50 MB/s), the "b" (operating in the 2.4 GHz band and with a potential capacity of 10 MB/s) and the ETSI HiperLAN 2 standard, this latter seemingly lagging behind (Edquist 2004 p178).

This should lead to a highly efficient use of the wireless spectrum and resources, which however, will not prevent wireless technologies from requiring a larger size (or new blocks) of the spectrum (Berezdivin, Breining and Raytheon 2002).

E.5. The Mobile Telephone Systems' Market Performance in The United States and Europe

After reviewing the main differences in policy attitude between US and Europe throughout three generations of mobile phones, we describe where these differences have led to. Generally, network operators in the US are thought to have a "development lag" in comparison to their European counterparts. However, the different policy frameworks and as well as the differences in the evolution of the telecommunication sector together have shaped the mobile telephone system industries in different ways. Here we briefly outline differences and describe the development lag.

E.5.1. Competition

The FCC in a recent report suggests that the level of competition in the mobile telephone system industries in the US, is among the highest in the world: this suggestion is explained by the fact that in the US there are five national operators, which is the highest level of competition in the mobile operators markets, matched by only a few Western European countries (e.g. UK, the Netherlands and Austria), while in most European countries, there are only three or four operators. Moreover, competition between operators is not only characterised by price and marketing, but products are more differentiated because of the "technological" freedom operators and manufacturers benefit from (FCC 2005b).

The belief that the more liberal approach in the United States in terms of standardisation has led to fiercer competition is further substantiated by the fact that US operators show significantly lower revenue per minute (a measure used as a proxy on pricing) than operators in European countries (FCC 2005b).

These FCC's assertions, however, can be misleading. In fact, certainly the European markets, considered together, are more fragmented than the United States: this is also the result of different factors specific to the mobile telephone system industries, for example, as the auction of frequencies had not taken place at the same time and the main authorities regulating the spectrum and deciding on the limits of concentration, are still national. However, besides this market fragmentation, the situation in terms of number of competitors at a European regional level is quite similar to the US: as Whalley and Curwen (2003) explain, in Europe, five big companies (each owns several operators) own 43 percent of the licences; this percentage grows quite considerably if you take into consideration the five biggest markets (France, Germany, Italy, Spain and the UK).

Moreover, the revenue per minute might be lower in the case of the US, because call terminations from landline to mobile phones are charged to mobile phone subscribers, while in Europe terminations are charged to callers. Valletti (2006), for example, using a multisided platforms model, shows that the market of call termination is actually a monopoly. This is because mobile subscribers do not consider the price of termination charges (as they do not pay them) when selecting an operator. Moreover, in Europe wireline users calling mobile phones obviously do not have the option of different services or price plans as call terminations are charged "across the border" by the mobile operator when they have to call a mobile phone numbers.

The revenue per minute, thus, might be less dependent on the level of competition (as the number of competitors is unlikely to change this situation unless call terminations are charged to mobile subscribers), but more on other factors which are specific to the markets than what the FCC's report leads us to believe.

E.5.2. Use of Mobile Phones

Another feature of the American market is that the average minutes of use per subscriber are significantly higher in the United States (FCC 2005b). Probably in light of the fact that consumers in the US are used to "unlimited" access charged at flat rates (as is the case in the local wireline communications markets), mobile phone operators offer a large amount of call-minutes included in their monthly subscriptions.

However, it might be because of the popularity of flat rates and possibly because termination charges are paid by mobile phone subscribers (and consequently mobile phone users might keep their handset off for long periods), that users in the US talk more on the phone, but use less Short Messages Services (SMS) or other types of data transmission than European users (see FCC 2005b).

E.5.3. Penetration Rates and Revenues

The fact that subscribers in the US talk more on the phone than subscribers in Europe does not mean that mobile phones are more used in the North American market. In fact, the FCC reports that 71 percent of European subscribers use SMS more than twice the amount as the US (FCC 2005b).

The higher popularity of mobile phone systems in Europe is also confirmed by data on revenue and subscriptions: this data shows that the total revenue of operators in the EU (15 countries) was in 2004, 104 billion euro, against 80 billion euro in the United States (London Economics and PricewaterhouseCoopers 2006).

Penetration rates in Europe are also much higher: at the end of 2004, the penetration rate in the US was at 61%, lower than the lowest penetration rates in Europe, where the highest rates pass 100% given the existence of many subscribers with multiple SIM cards (FCC 2005b).

E.6. Explaining the US Development Lag in Mobile Communications

The development lag of the US operators in comparison to the European operators has been accumulated throughout the deployment of two generations of mobile phone systems. There are some historical reasons explaining this lag.

The first explanation comes from the early understanding of the service that mobile phone systems could deliver. In fact, the RBOCs, who were given the chance to develop mobile phone systems in the first round of frequency allocations did not think of it as a service with huge potential (King and West 2002). As Kano (2000) reports, even at the time of the AT&T divestiture (1984) a Senior AT&T executive affirmed, expressing the company's view, that there was little future in mobile communication.

Therefore, even though the mobile phone system was introduced first in the US (King and West 2002) and many fundamental technologies such as the vocoder, steerable antennas, and the cellular concept were introduced by the Bell Labs (Zysman et al. 2000), the modern concept of the mobile phone industry, a concept focussed on the service rather than on the technology (e.g. mass consumption, the same quality of wireline communication tools) was introduced by the NMT in Europe. This seems to have played a key role in shaping the early diffusion of mobile telephony in Europe and the beginning of the US development gap (Lyytinen and Fomin 2002; King and West 2002).

Secondly, it is clear from our own account above that the regulatory framework and technical innovations are closely related. Therefore, the "institutional push" to use an expression introduced by Edquist (2004), or, in other words, the initial support of the regulator, is likely to have increased early operators' chances of success. As a result, according to King and West (2002), the fact that, on the one hand, in Europe most of the pioneering networks were built by institutional agencies (network operators linked or owned by the state) played in their favour, while, on the other hand, AT&T not only was not an institutional agency, but it was even prevented by the Department of Justice, following the 1956 decree, to carry on with R&D in mobile communication.

E.7. Benefits and Shortcomings of the Different Policy Frameworks

The third and last explanation of the US development gap in mobile telephony points to its policy approach to standardisation. It is clear that a market based spectrum allocation and the decentralised decision on the use of technology applied by the American authorities is a strategy that has produced worse results than a centralised and tighter management of the spectrum combined with a centralised approach to standardisation, applied by the European (and also Japanese) authorities.

This is demonstrated, on the one hand, by the success of the GSM standard in Europe, and on the other hand, by the success of AMPS in the US, the last standard imposed "from above" in this region, which, besides a relatively late appearance among 1G technologies, has reached one of the highest penetration rate (see Kano 2000).[117]

Two objectives provide the rationale for the US policy attitudes towards standardisation: the first is encouraging network investments and the second is favouring technological advancements (Kennedy and Purcell 2004). Moreover, it is believed that, a non-market based selection can lead to a technological bottleneck.

These two arguments, however, can be challenged in light of the evolution of the mobile telecommunications system as we have outlined it above in our historical account.

First of all, the idea that competing technologies foster investment in networks is underpinned by the fact that, given the incompatibility of two different standards, network sharing is not possible, thus more network elements have to be built than in the case of a common standard.

However, as Kano explains (2000), the centralised determination of a standard creates a certain degree of certainty or a more stable technological trajectory, while, and this has been the case

[117] At year end 1998, there were 50.7 million AMPS subscribers in USA and Canada, the equivalent of a penetration rate of 16.9%. This was quite a high penetration for the 1G system, compared with that in Japan, (3.9% in 1995) and that in Western Europe (not exceeding 5% for NTM and TACS together) (Kano 2000).

with the development of 2G technologies in the US, the existence of competing standards can foster a “wait and see” attitude among operators.

In fact, as compatibility between networks is key in order to extend the network coverage (thanks to roaming agreements) as the case of GSM testifies, investing important resources in order to build a wireless network relying on what might turn out to be an “unsuccessful” technology instead of a successful technology, can seriously affect an operator’s financial results.

This attitude is one of the factors, according to this author (Kano 2000), explaining the lag in deploying 2G technologies in the US when they are compared to Europe.

Therefore, given the fact that the uncertainties generated by competing standards has delayed the introduction of new generations of technologies, while the centralised approach has accelerated this process, generating thereby other investments in network resources, the answer to the question of which of the two policy frameworks is better to increase capital investment in this industry is likely to depend on many factors (e.g. the actual choice of the technology in the case of the centralised framework, depending on its compatibly with the legacy system, or the frequency of the introduction of a new standard).

Moreover, we claim that in a modular system as opposed to two competing ones, investments can be channelled into local research and contributes to the “global” technological trajectory.

Secondly, supporters of the neutrality of spectrum allocation and the decentralised choice of technology affirm that this policy framework favours the development of different technologies, while the centralised choice of a standard can lead to technological bottlenecks: if the standard selected by the central authority is not the best performing and the conversion to another standard is costly and difficult, this conversion does not take place, generating a loss for the consumer.

In this appendix we have divided successive standards and technologies into two categories, depending on two different basic radio transmission technologies which have characterised successions of different standards: TDMA and CDMA.

Technologies based on CDMA are superior to their equivalent based on TDMA. As Curwen explains (2004) CDMA assigns a special electronic code to each signal, allowing the entire frequency band to be simultaneously occupied. This is claimed to provide greater capacity, better sound quality, lower power consumption and a decreased potential for fraudulent use.

Moreover, without going into further technical details, it is simply necessary to mention that although there are five different IMT-2000 standards as declared by the ITU, almost all 3G technologies deployed are based on CDMA (i.e. CDMA2000 1xEV-DO, 1xEV-DV, W-CDMA).[118]

Therefore, on the one hand, supporters of the decentralised approach to technology selection can put forward this example as a demonstration that by maintaining an open standard technology approach, the better technology ends up winning the "war of standards". On the other hand, however, the historical account presented here also explains that the centralised technology selection approach does not necessarily lead to bottlenecks: in fact, the ETSI has enforced a 3G technology that is not compatible with the legacy standard. Moreover, given the fact that the standard selection is "open" as it does not necessarily follow a predetermined trajectory and that extensive returns to research can be generated if this research leads to elements becoming part of a new mandatory standard, R&D on a disruptive technology is likely to take place even in a regime of centralised choice.

Moreover, the US market-based (and more liberal) allocation of spectrum contradicting its assumed potential for favouring the expansion of new technologies, has lead to problems in creating the space for the new generation of standards, as explained above in the case of the introduction of 3G technologies.

The European policy framework, therefore, seems to have been more successful in terms of generating high penetration rates, a high level of use of the technologies as well as higher returns for operators when these are compared to their counterparts in the US.

This framework, however, has changed over time and given the recent success of the competing 3G technology (CDMA2000) in terms of penetration rate, one can question if these changes have had a positive influence or if the development gap, built over the two generations of technologies, is now shrinking.

In fact, if we consider the framework leading to the creation of the NMT system as the European benchmark for the 1G technologies, we start from a collaborative effort between

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[118] As published on 3GToday, CDMA based technologies are by far the most used. In August 2006 the number of 3G CDMA subscribers was 385 Millions, of which over 263 millions were CMDA2000 1X subscribers, 42 millions were CDMA2000 1XEV-DO and 79.5 were W-CDMA subscribers. <http://www.3gtoday.com/wps/portal/subscribers > online retrieved on October, 2006

operators and manufacturers, creating an open system not protected by IPRs, supported by the government and with a clear service focus driving its design.[119]

Work leading to the 2G of mobile telecommunication systems started following the example of the NMT: the project was backed at a European Commission level, which made the use of particular frequencies mandatory for its member states. Moreover, we can consider that the service (operators) point of view was more determinant than the manufacturers': this demonstrates the fact that a common system using common frequencies had been imposed to allow operators to benefit from economies of scale, and secondly, that the manufacturers involved in the design of the standard were expected not to use IPRs to limit competition and gain market power. However, manufacturers did exercised this power and the system ceased to be open.

Work for the determination of the 3G standards has moved further towards protecting the interests of the manufacturers, more than those of the operators: the new standard is not compatible with the legacy one, which would have allowed a more gradual transition towards the new generation technologies. [120]

Moreover, even though the technology chosen derives from the CDMA-One standards, it is not the same as the technology that is popular in the US (CDMA2000), a decision clearly taken to protect local manufacturers.

Whether this shift in the policy framework will be beneficial for the operators and/or the consumer, other than clearly for manufacturers, is too early to say. What is evident now is that holding IPRs binding basic components of a new standard can not only be the source of important revenue as it was in the past, but also of important bargaining power.

However, more generally, we suggest here that, especially now that the debate on shaping the coming NGN is ongoing, the analysis of the evolution of the three generations of standards and of the different success stories can provide very useful insights for these current debates.

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[119] As discussed above, the NMT is not the only 1G system available in Europe, but only the most successful. All these characteristics apply only the NMT system, as for example the C-450 system used in Germany was designed mainly by Siemens.

[120] However, in order to offset the high cost of starting a new network, operators have been allowed to share (Maitland, Bauer, and Westerweld 2002).