The transformative impact of business models

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Abstract

The macroeconomic impact of advances in information and communications technologies is significant but problematic to assess. Research on these developments has been isolated to specific disciplines, easily outpaced by new innovations and few studies describe the multiple changes and their macroeconomic consequences in a holistic way. The increasing ability to organize, price and transmit information to the market is ushering in an era where economic actors are highly responsive to the market. Technological advance alone does not capture the benefits of these developments. It is the innovative business model that lies at the heart of this revolution in responsiveness. We outline four major economic shifts in this study by reference to some paradigmatic business models. These shifts include pricing strategy innovations and their effect on the creation and expansion of market spaces, structural shifts in electronic markets and the effects on transaction costs, the deeper interaction between firms and consumers and the effects on more efficient matching of supply and demand, and finally the economic impact of elasticity and infinite scalability in computing resources when delivered as a utility by cloud computing providers. These advances do not only increase the commercial possibilities, they actively alter the competitive landscape and the role of the firm and consumer. This paper establishes some key areas where the increased responsiveness of economic actors is increasingly stimulating innovation, efficiency and productivity.

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Introduction

The presence of information and communication technologies (ICT) is increasingly felt in economic and social life. It is hardly controversial to suggest that technological developments have had, and will continue to have, a profound impact on commerce and industry. The development and proliferation of specific technologies on a very large scale, such as the steam engine in the Industrial Revolution, often leads to a profound transformation of the economic landscape. While scholars have shown that the diffusion of technology is often a slow and unpredictable process, it is certainly one with a profound impact (Moore and Benbasat 1991; Rogers 1995; Tornatzky and Klein 1982). It is often only with the benefit of hindsight that the macroeconomic affects of these changes are well understood. Accordingly, it is very common for analysts to praise certain technologies as ushering in revolutions in the way business operates. However, deeper understanding of the causes and outcomes rarely benefits from these pronouncements. The expansion of electronic commerce on the Internet heralded such praise in the 1990s but insufficient effort was made to actually understand the phenomena and its implications for business models and the depth of penetration of commercial activity into everyday life. Scholarly analysis on the impact of ICT on economic productivity and efficiency has been isolated in specific disciplines and only a few studies seek to understand the macroeconomic impacts of these shifts (Cecchetti 2002; DeLong 2001; Kauffman and Walden 2001a; McDonough and Braungart 1998; Indjikian and Siegel 2005). Technology diffusion,

and the resulting innovation around it, takes time. The Internet bubble may have come and gone, but businesses are only now really beginning to innovate their business models in a way that could cause the deeper productivity and welfare gains that have been predicted with greater investments in ICT (Indjikian and Siegel 2005).

We argue that advances in ICT, and the creative business model innovations that implement them effectively, have a significant impact on the economic structure, productivity and efficiency of markets. Focus is not on specific technological developments or markets but on the effects of these changes at a higher level of analysis. Four elements of these changes are outlined in the study: 1) the emergence of new monetization mechanisms; 2) the leverage of post-internet markets; 3) the integration of consumers into the production cycle; and 4) the use of computing as a utility. The study hopes to establish some key areas where the increased responsiveness of economic actors - to each other and to the market – will have significant macroeconomic effects. The extent of the change in responsiveness and its impact on commerce suggests that there is a revolution underway. At the core of this *responsiveness revolution* is the business model. The *business model revolution* describes how innovative business models have capitalized on new technologies and pricing mechanisms in order to rapidly and efficiently match supply and demand in new and expanding markets. The business model is thus perceived as the mediating structure between new technical inputs and more efficient economic outputs (Henry Chesbrough and Rosenbloom 2002). From a macroeconomic perspective, the *business model revolution* identified describes the shifts in the behavior of all economic agents, be they retailers, consumers, or service providers, as a result of these innovations and the potential implications for productivity, efficiency, growth and welfare. We conclude that important macroecononomic shifts are underway, which must be understood to better guide public policy, corporate strategy, comprehension of current market practices and the identification of lucrative business models.

Methodology

This study seeks to understand the consequences of innovative business activity and ICT developments on a macroeconomic scale. Since this does not imply a clearly testable hypothesis, an inductive approach is essential. By identifying and summarizing the phenomenon in theory, and then depicting the transformations in practice by reference to a particular case, this research seeks to sketch a broad picture of the *business model revolution* described above. The lack of previous quantitative work on this subject justifies a more descriptive analysis. A review of emerging business models provides an empirical starting point to depict the characteristics of these overarching changes in economic behavior. The research is thus built on a multiple case study, where selection of cases is based on a theory building structure (Yin 1994). First, the phenomenon is identified, then critical concepts and developments are summarized, and finally the case study is introduced to provide an empirical example. These cases are selected according to their relevance for epitomizing one of the four phenomena that have been identified. The cases are thus critical and paradigmatic. While this case conceptualization admits a selection bias, these selection criteria are necessary in order to understand phenomena that begin at the innovative fringe of economic activity and whose success ensures their models' dissemination through imitation or a restructuring of market practices. The method is

limited in its ability to make robust predictions but effective in establishing the overarching changes underway.

Because the *business model* lies at the heart of our analysis, it is worth briefly discussing the term. There is considerable confusion surrounding the business model because public and academic discussions suggest few exact and feasible operational definitions of it (Eisenmann 2002). A literature review identifies the main elements of the business model to be the creation of value and the implementation of strategy to capture revenue from this value (Rajala, Rossi, and Tuunainen 2003). This idea is also found in literature on the business model in the software and electronic commerce business (Brousseau and Penard 2007; Mahadevan 2000; Osterwalder, Pigneur, and others 2002).

We conceptualize the business model's role according to Chesbrough's definition, which sees it as a mediating structure between a host of technical inputs and various economic outputs. Any business model must account for the internal and external dynamics of commercial enterprise. The former (internal) describes the business model and latter (external) assesses the market environment. While separated for analytical clarity, these dynamics are clearly interrelated. For example, the success of the business model relies on its successful appraisal of the market environment.

The internal dynamics of a business model rely on two key elements: value creation and value appropriation. The business model establishes the organizational, procedural and operational means by which a firm creates and appropriates value in their target market. Value creation involves all of the resources and processes deployed towards product strategy and logistical strategy. Value appropriation describes the revenue logic of the firm's operations.

This concept of the business model and the focus on macroecononomic developments informs the case study framework of this study. Attention to the business model may seem odd given the macroeconomic focus of the study yet it is often the critical mechanism that leverages ICT developments in a manner that promotes efficiency and growth. Since the study does not wish to discuss the impact of individual companies at length but rather to use snapshots of these business models as an operational example of higher order economic shifts, there is a particular analytical focus. After a brief introduction, the case studies are thus organized in the following framework:

Innovative model – in comparison to other firms in the same market, how is this business model providing innovative solutions?

Network component – what technologies are enabling these innovative solutions and value creation? How are they being used effectively?

Pricing structure – what pricing models are being employed in order to attract the largest consumer base possible at a profitable price?

Market segment – has the pricing structure and network architecture implemented in the business model enabled the company to tap previously inaccessible markets or expand existing markets?

Value proposition – what is the value to society, to customers and the firm?

Strengths/limitations – strengths are linked to the value proposition; limitations could encapsulate negative externalities, operational challenges, reliance on other stakeholders, and high uncertainty in the market?

Responsiveness – does the business model make the firm responsive to changes in demand, fluctuations in market conditions and pricing? Is there a strong component of flexibility embedded in the models that makes it more robust in the information age compared to more conventional strategy?

This framework emphasizes the role of the business model in economic growth while simultaneously recognizing that it is embedded in a wider environment of technological advance and innovation diffusion. A single business model is not attributed causal significance; innovative business models are not by themselves driving economic growth. Rather, these cases epitomize the changes underway that affect more important macroeconomic shifts over the long term. First, these changes and the corresponding cases will be discussed. The macroeconomic impact of these changes is then outlined. Finally, the clustered effect of these shifts will be considered in concluding section.

The emergence of new monetization mechanisms

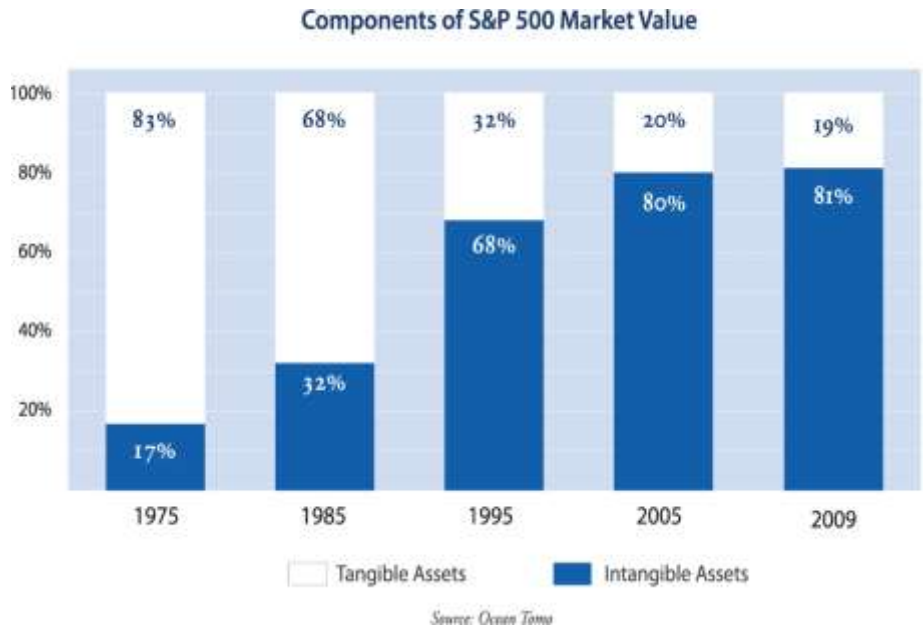
This section describes two different developments related to monetizing new spheres of economic activity that have emerged alongside the development of ICT infrastructure. The first is the expansion of international exchanges, and their corresponding pricing instruments, that enable the high volume trade of previously unexchangeable commodities. The two cases presented are the Intellectual Property Exchange International (IPXI), which trades commoditized patent licenses, and the European Climate Exchange (ECX), which trades derivative carbon emission financial instruments. The second is the rapid growth of free Internet services supported by revenues from sophisticated advertising software. This trend is depicted by reference to YouTube. These apparently different phenomena are considered

together because they both entail the use of innovative pricing mechanisms for the creation and expansion of formerly inaccessible markets.

The development of an exchange mechanism aggregates buyers and sellers while providing a basis for price calculation that is founded on the knowledge of what similar commodities have sold for in the past (H. Chesbrough 2006). The existence of markets based on objective, repeatable scoring tests for commodities force prices to meet demand and reduces the transactions costs of exchange (McClure). A robust and consistent exchange setting provides the levels of liquidity, transparency and access necessary to fully maximize the economic value of a resource. It can also reduce price volatility and lower the cost of capital (Kossovsky 2002). The creation of financial instruments to monetize non- or under-utilized assets encourages greater investment and can even create totally new markets. Standardizing the valuation procedures of the asset in question and rendering price responsive to market fluctuations is often the most significant obstacle to establishing such a market. The IPXI and ECX have created complex financial instruments to try to overcome this limitation, and this commoditization process has helped them tap previously inaccessible markets.

Intellectual Property Exchange International (IPXI)

While intellectual property rights (IPRs) have conventionally been perceived as a defensive legal claim, there is a growing body of literature that recognizes IP as an important asset class and patent licensing as a strong promoter of the growth and efficiency of technology markets (Arora 1995; Feldman and Florida 1994; Mazzoleni and Nelson 1998; R. P Merges 1999). A host of new monetization mechanisms - such



as securitizations, pooled patent portfolios, public auctions and financial exchanges - have been implemented in order to extract value from these IPRs. With intangible assets growing from 17% in 1975 to 81% in 2009 of the market capitalization of the S&P 500 Index (Ocean Tomo, 2009), it is no wonder that a growing number of players are seeking to generate revenue in this burgeoning market.

Figure 1. The Economic Value of Intangible Assets

While there are numerous problems associated with the efficient trade of patent rights (Caves, Crookell, and Killing 1983; Hagelin 2002; R. P Merges), IPXI hopes to overcome these obstacles by introducing a creative contract mechanism for the transference of non-exclusive patent license rights. The Unit License Right contract turns patent rights into a more transparent and standardized commodity by enabling buyers to utilize a standard setting along with third-party monitoring and enforcement technologies to facilitate exchange. The details of this pricing mechanism and its effects have been previously reported (Ghafele, Gibert and Malackowski 2011). Its relevance to this study is that IPXI has implemented a creative contract mechanism to price and trade a previously illiquid asset in an exchange setting. The responsiveness of these ULR prices to the market are made possible by an elaborate pricing formula composed of inputs monitored by the exchange intermediary. The exchange itself, which requires massive online data rooms to facilitate due diligence, process all of the submissions, and inform participants of exchange transactions, necessitates a highly functional IT infrastructure. This infrastructure enables IPXI to achieve its monitoring and enforcement responsibilities while also permitting all of the participants in the exchange to remain up to date and responsive to the actions of other actors in the market.

Table 1. IPXI Case Study

Innovative Model	• The ULR contract mechanism • The exchange of standardized non-exclusive patent licenses
Network Component	• Encryption-protected online data rooms • Real-time updates on market transactions
Pricing Structure	• ULR contract combines accepted IPR valuation methods • Exchange setting enables the buying and selling of ULR contracts at price established by the market

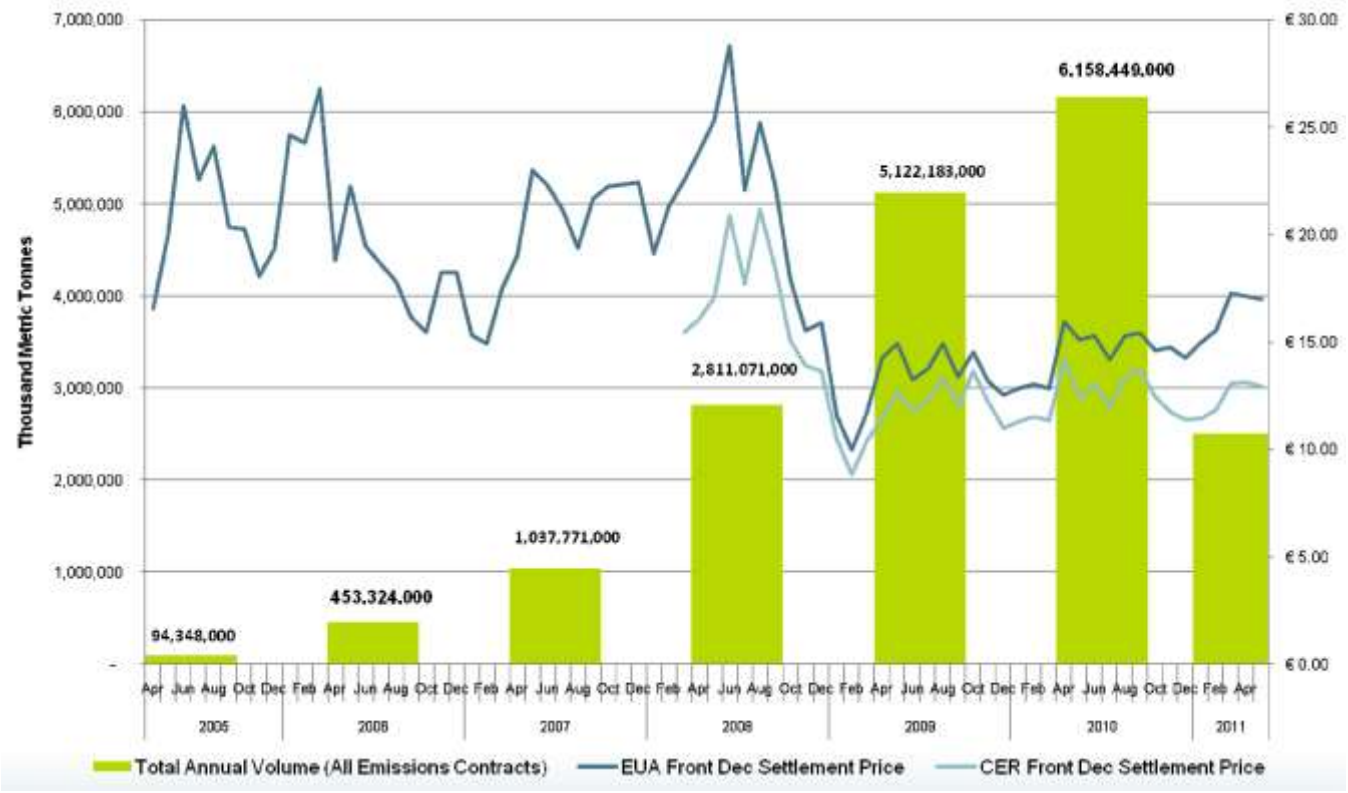
Market Segment	• Leverage of non- or under-utilized patent license rights • Growth and efficiency of technology markets
Value Proposition	• Generate greater revenue from patent rights • Link buyers and sellers for most efficient division of labour • Extract revenue from exchange intermediation • Ensure dispersion and integration of technology • Improve liquidity in patent license right market
Strengths and Limitations	• +: Promotes growth, transparency and access to technology markets • +: Enables start-up firms to access capital and removes need for complementary assets to commercialize technology • +: Contributes to standardization of IPR valuation procedures • - : Substantial operational difficulty of administering exchange setting • - : Transaction fees incurred from existence of intermediary • - : Continued uncertainty in valuation procedures and consequent difficult in stimulating initial participation levels necessary to get market off the ground
Business model	• Creates exchange setting where the pricing of patent license rights are highly responsive to fluctuations in the needs and demands of the market • Enables the flexibility to buy and sell patent license rights as a standardized commodity

The European Climate Exchange (ECX)

The growth of ecosystem services is another good example of the expansion of markets through the use of innovative pricing mechanisms to trade new commodities such as carbon emissions. The value of the global biosphere remained largely outside of the market until financial methods were invented to value and trade them. Since all economies would cease operating without the services of ecological life support systems, it has been argued that their value to the economy is infinite. However, conservative estimates initially placed the value of ecosystem services in the range of $16-54 trillion a year with an average of $33 trillion a year (Costanza et al. 1997). As they become scarcer in the future, it is reasonable to expect their value will increase. This is an enormous market that has been created by the identification of the economic value of what was previously an unpriceable and untradeable commodity.

The recognition of the economic value of ecosystem services, combined with the binding emissions target for 39 industrialized nations set by the Kyoto Protocol, which entered into force in 2005, caused a host of carbon financial instruments to be developed in order to trade emissions-based products on an international exchange. These exchanges create economic value through trade and aim to reduce biosphere degradation. The European Climate Exchange (ECX) is one of the biggest exchange platforms for carbon emissions derivatives trading in the world. Cap-and-trade schemes create scarcity by limiting the amount of emissions allowed. National allocation plans distribute emissions allowances to individual organisations that are independently audited every year. Those organizations that produce fewer emissions can sell their excess allowances on the market, while those that exceeded their emissions allowances can reduce them by investing in green technologies or buying allowances on the market. ECX trades the following futures and options contracts: European Union Allowances (EUA), Certified Emission Reductions (CER), and Emission Reduction Units. The growth of this market has been enormous:

Figure 2. ECX Annual Total Volume and Settlement Price



Like IPXI, a complex ICT infrastructure enables the exchange intermediary to remain responsive to market fluctuations and inform participants instantaneously of changes in share price. These new exchanges mirror the organization of traditional financial exchanges but have effectively created an entirely new market through the implementation of innovative pricing mechanisms.

Table 2. ECX Case Study

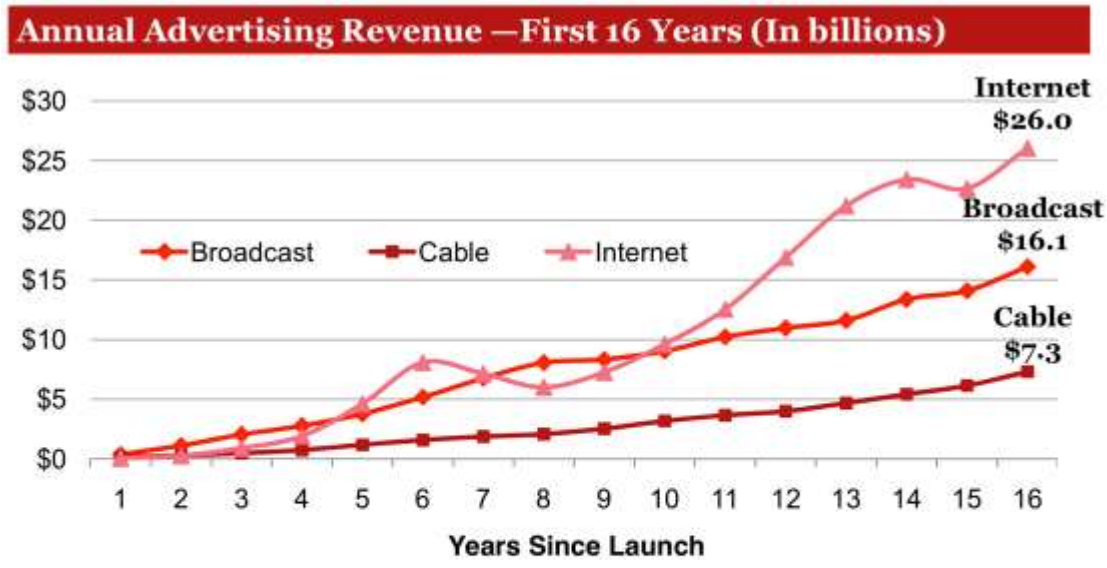
Innovative Model	• The EUA and CER contract mechanisms • The exchange of standardized carbon derivatives
Network Component	• Encryption-protected online data rooms • Real-time updates on market transactions
Pricing Structure	• Cap-and-trade scheme creates scarcity in order trade • Exchange setting enables the buying and selling of carbon allowance contracts at price established by the market
Market Segment	• Recognition of value of ecosystem services to economy and implementation of derivatives model taps new carbon market • Derivatives trading enables organizations to benefit from the carbon emissions reduction targets
Value Proposition	• Reduce carbon emissions in industrialized nations and consequently protect the biosphere • Link buyers and sellers for efficient price discovery of value of carbon allowance • Extract revenue from exchange intermediation • Enable high volume trade of a new commodity
Strengths and Limitations	• +: Promotes growth, transparency and access to carbon financial instruments • +: Enables cost-efficient reduction of carbon emissions • - : Applying economic rationale to emissions reduction may obscure its socio-political and ecological value

	• - : Relies on emissions reductions targets set by national governments; subject to political regulation
Business model	• Creates exchange setting where the pricing of emissions allowances are highly responsive to fluctuations in the needs and demands of the market • Enables the flexibility to buy and sell carbon derivatives as a standardized commodity

YouTube

Online services are typically characterized by low marginal costs, high fixed costs and a price mechanism that is only very loosely related to quantity (Edelman 2009). With the explosive growth in Internet penetration caused by flat-rate broadband fees and decreasing personal hardware costs, the monetization of user activity online has significant economic potential. The free provision of services online, while perhaps counter-intuitive in the old brick and mortar world, is a lucrative endeavour. Fee-free access to online services reduces transaction costs, creates environments of experimentation and progress, encourages use and grows a customer base for advertising revenue. Prices at zero are entirely sustainable when profits can be generated from complementary business. Encouraging use, a zero price maximizes social welfare and engenders the network effects necessary to best exploit the spin-off effects of free offerings to generate revenue from an online customer base (Mahadevan 2000). User attention sold to advertisers is often identified as one of the most important valorization strategies in digital network technologies (Brousseau and Penard 2007). With Internet advertising revenues totaling $26 billion in 2010 (up 15% from 2009) in the USA alone, the growth of the online advertising market leaves little room for argument over its importance (PWC 2011). Internet advertising has showed strong growth that has outstripped the relative performance of all other advertising platforms:

Figure 3. Annual Advertising Revenue Platform Comparison



	Year 5	Year 10	Year 15	Year 16
Internet	$4.62 billion	$9.62 billion	$22.66 billion	$26.04 billion
Broadcast TV	$3.77 billion	$9.03 billion	$14.09 billion	$16.10 billion
Cable TV	$1.17 billion	$3.18 billion	$6.15 billion	$7.31 billion

YouTube exemplifies the power of the free offering model when it is used effectively. Drawing on the network effects engendered by a massive user base, YouTube acquires user-contributed video content for free and distributes it to all other users for free. Over 2 billion videos are streamed everyday to over 300 million users worldwide (www.youtube.com). It now offers advertisers highly targeted ad space and use of Google's machine learning technologies in order to monitor and maintain an ad campaign responsive to the behavior of the target audience. YouTube offers brand channels, marketing programs, advertising alongside famous partners' videos, promoted videos, targeted advertising against certain videos, and a TrueView system for engaging opted-in viewers. Analysts predict that YouTube's shift to advertising generated $450 million in revenues for 2010 (http://www.nytimes.com/2010/09/03/technology/03youtube.html).

Table 3. YouTube Case Study

Innovative Model	• Centralized hub for user-generated content distributed for free • Sophisticated advertising model to generate revenue from activity of massive user base
Network Component	• Digital network technologies to receive, filter, store, and transmit video content • Web 2.0 technologies implemented to foster and maintain a highly participatory community
Pricing Structure	• Content service provision of enormous and continuously growing repertoire provided for free to users • Highly targeted advertising space and tracking software offered to partners and potential advertisers
Market Segment	• Fuelled the expansion of user-generated content on the web and aggregated the largest community of participants • Advertising model as major example of efficient monetization of a free service on large scale
Value Proposition	• Free access for users to vast repertoire of content • Participatory and engaging user forum • Democratic and decentralized submission of content that fuels cultural diversity, individuality and creative expression • Provision of highly targeted advertising space generates revenue from service provided free of charge • Elaborate software tools to track videos watched, copyright infringement, and advertising success
Strengths and Limitations	• +: Vast user base and network externalities associated with it • +: Distribution of decentralized, independent creative content • +: Avoidance of copyright lawsuits through scanning of content and correspondence with rightholders • +: Generates revenues from attention to user submissions • - : Storage costs of burgeoning content repertoire • - : Noise created by amount of content stored that very few people are watching
Business model	• Creates a highly participatory forum where individual users can submit their own content and engage in discussion

	• Links suppliers of creative content with users instantaneously in a setting where they feed off each other and create more • Advertising model is highly responsive to assessing the impact on users, the needs of customers, and revenue generated

The Macroeconomic Impact

The creation of markets through innovative monetization mechanisms provides a means for commodity prices to stabilize against demand. By establishing a space for price comparison and the aggregation of buyers and sellers, it makes a market investable. The exchange and pricing of new commodities should stimulate liquidity, transparency and standardization in a manner that positively impacts economic growth. Moreover, new markets created from innovative pricing systems monetize components of human exchange that were previously outside the bounds of economic activity. Such innovation could fuel a virtuous cycle of productivity growth that underpins a stable increase in GDP. Exchanges supply the market with important information relating to the relevant economic actors, the price mechanism, and the factors that determine value.

The creation of an exchange platform for patent license rights enables creators to get more returns for their investment, it promotes the idea of intellectual property as a valuable asset class and in doing so fuels the extraction of value from a largely untapped market with significant growth potential. Such an exchange would improve liquidity and efficiency in technology markets. Patents are more efficiently matched with firms who can commercialize them and the market levels the competitive playing field (Monk 2009). A patent license exchange dismantles barriers to entry by removing the need for complementary assets (Teece 1986), renders the division of labour among actors more efficient(Arora, Fosfuri, and Gambardella 2001), and the multiple, rivalrous sources of innovation that result are a critical driver of long-term economic growth (R. P Merges 1999). The financing constraints faced by innovative firms, due to the uncertainty of investment payoffs in technology markets, is mitigated by the existence of an exchange that enables firms to accumulate important capital resources to commercialize technology (Ughetto and Odasso 2010).

The pricing of ecosystem services, in terms of their value contribution to the global economy, would cause those commodities utilizing them directly or indirectly to increase substantially in price. The structure of factor payments – including wages, interest rates, and profits – would change considerably and world GNP would be different in terms of both magnitude and composition (Costanza et al. 1997). The recognition of the need to limit carbon emissions, implicit in a cap-and-trade scheme, should induce important positive externalities such as greater protection of the biosphere and the reduction of carbon emissions levels. The economic value unlocked through the monetization of ecosystem services contributes to GDP growth and could lead to modifications in national accounting systems in order to better reflect the value of natural capital. Since all economies would essentially stop functioning without the services of ecological life support systems, recognizing their value to the economy is a major step towards rendering the economic system more responsive to the realities of the modern world.

The growth of Internet-based business models that valorize free services through sophisticated advertising systems also have important effects. The value of Internet advertising in 2010 was $26 billion in the US market alone (IAB Report). The explosive growth of Internet use - exemplified by rising Internet penetration rates, which saw 480% growth worldwide from 2000 to 2011 – will further fuel this expanding market. The revenue streams exploited by Internet businesses are often not replicable in the brick and mortar economy (Mahadevan 2000). The value of free services is also in the efficiency gains prompted by the existence of the service. Free email, free content provision, free community-based creative initiatives represent valuable social welfare gains that are provided for free to users through market mechanisms. As the benefits of these services attract ever larger consumer bases, the network effects engendered can be capitalized on to more efficiently monetize online behavior. The impact of these changes on labour productivity, wage relations, job searching, and overall economic growth is only beginning to be felt. As continuous ICT developments boost efficiency and make possible the monitoring and organization of consumer behavior in electronic spaces, innovative business models will continue to find diverse ways to monetize this behavior and extract value from it.

The leverage of post-Internet markets

The birth and growth of the Internet has been frequently identified as initiating a major shift in the scope and practice of commerce today. After the adolescent optimism of the dotcom bubble era, where any and all online businesses attracted capital investment, electronic commerce has matured and analysts recognize the importance of a viable business model to truly leverage the opportunities afforded by Internet technologies. The characteristics of the Internet that enable real-time exchange - built on openness, speed, anonymity, digitization and global accessibility - are fertile soil for the growth of electronic commerce (Zon-Yau Lee, Hsiao-Cheng Yu, and Pei-Jen Ku 2001). Information-based goods and services are characterized by a number of important traits. They create network externalities, have high fixed costs and variable costs of reproduction tending to zero. High levels of interoperability and increasing returns of adoption are also prevalent (Brousseau and Penard 2007). An innovative successful business strategy online can alter the management strategies of an entire industry or even others. The literature on technology, risk and business models purports that ‘disruptive technologies’ – new technologies that shift the competitive landscape during their diffusion, such as the classic example of Xerox copying technology – drive innovation and become a critical factor in market development (Henry Chesbrough and Rosenbloom 2002). The technical and market uncertainty involved in the high technology field means that not all models utilizing an innovation are predictable and the business model must be integrated as part of the strategic logic in managing commercialization. The role of the business model online is to appropriate value not just from technology, but also from the social and economic relationships that technology can enable. Again, the notion of the business model as a mediating construct between technology and economic value is of paramount importance.

The structure of electronic markets has undergone considerable shifts. Several studies have described the impact of the Internet on intermediation activities (Caillaud and Jullien 2001; Kuruzovich 2008; Kauffman and Walden 2001b; Warkentin, Bapna, and Sugumaran 2000). The initial suggestion that the Internet would fuel a cycle of dis-intermediation – where the logistical stream is shortened, middle-men are cut out, and responsiveness to demand is achieved at lower cost – has been replaced with the notion of re-intermediation in a post-Internet economy (I. C.L Ng and Yip 2010). Services have found new ways to add value online by addressing transaction costs and information overload problems instigated by the sheer volume of activity online. These business models rely on the ability to render transactions between the two sides of the market more efficient. 'cybermediary' or 'infomediary' services connect consumers with suppliers in online communities that leverage the diverse opportunities afforded by digital technologies. ICT reduces the constraints in designing solutions to support inter-individual and inter-organizational coordination in the digital economy (Brousseau and Penard 2007). Literature on intermediaries in two-sided digital markets stresses the importance of the structure and quality of the intermediation service, since there is always the possibility that network users could bypass the service altogether (Brousseau and Penard 2007). Since these intermediaries connect a number of different actors across a diverse range of activities, their value is often embedded in a bundle of goods and services. Bundling is a marketing activity where two or more goods or services are packaged at a special price (Guiltinan 1987). On the Internet, bundling can provide innovative pricing solutions, better service value, reduced marketing costs, increases in demand, and reduced selling risk (I. C.L Ng and Yip 2010).

Peer-to-peer (P2P) architectures represent a significant alternative to conventional client/server relationships and network computing by employing concepts of parallel processing, content exchange, file management and collaboration. Studies have analyzed the affect of P2P's technological architecture on economic interactions and identified a range of economic issues such as incentives, public goods, club goods, encouraging participation and contribution, pricing approaches, and content pollution (Krishnan et al. 2007). Its most beneficial features include decentralization, lower costs, anonymity, ad hoc behavior, scalability, fault resilience and self-organization (Milojicic et al. 2002). It facilitates the direct exchange between users without any need for mediation by a centralized server. Negative aspects of P2P such as issues of security, accountability and reliable payment systems have historically inhibited its development into a mainstream business model. However, with the increase in reliability and types of micro-payment systems this situation is likely to change. Multiple P2P businesses have been established in recent years. There are P2P networks that allow customers to sample and purchase content such as Gnutella, Intent Mediaworks, Altnet, SnoCap, and Peer Impact. Digital broadcast video delivered via P2P such as Kontiki, NetCable TV, Dave TV, and Cybersky. Peeriodata has drastically cut costs by employing this model for distributed data storage. Bad Blue has utilized it to deliver enterprise information sharing solutions at low costs. As the P2P model works in some industries, it will continue to be implemented in new and innovative ways.

The demand for intermediation in a digitally networked economy that produces vast quantities of information is enormous. The growth of electronic commerce is fuelled by innovative intermediary business models that have evolved in response to this

demand in order to create and appropriate value in the digital market. Kiva, an online community that connects individual users to microfinance development loans all over the globe, is a powerful example of the role of the business model in organizing transactions and information online. Whipcar, a user-supported rental car business, is another. These two case studies illustrate how business models online are not just leveraging technology itself to appropriate value, but implementing technologies in tandem with a range of value-added goods and services in order to provide tailored products that are highly responsive to the demands of the market. The diversity of potential services online are exemplified by these two studies, one which provides a peer-to-peer lending service, and the other which provides a car rental service.

Kiva

Kiva is a non-profit organization founded in 2005 which manages a community of individuals and microfinance institutions that lend money around the world with the aim of alleviating poverty. It is effectively a peer-to-peer lending service. Bypassing the conventional banking system enables Kiva to offer low interest rate loans all over the globe. Individual users' loans are submitted to partner microfinance institutions that administer the loans on the ground. Volunteers than help these institutions work with potential borrowers to gain access to capital, they edit and translate their stories to post on Kiva.com, and they organize other Kiva initiatives. Kiva has grown at a phenomenal rate since its inception. Kiva's business model represents a market-driven initiative that helps achieve a crucial social development objective through the organized implementation of digital network and communications technologies.

Since 2005, over $231 million loans were made through Kiva to over 600,000 entrepreneurs around the globe (www.kiva.org/about/stats). This is possible because Kiva nurtured an online community over 950,000 users with an active contingent of over 600,000 Kiva users that have funded a loan. Kiva's strength lies in the fact that Internet technologies help it aggregate the loans of individual users. Though individual users may loan as little as $25, Kiva's average loan size to Kiva Entrepreneurs is $384.45. Lenders originate from 214 countries and currently enjoy a repayment rate of 98.79%. Over 306,000 loans have been funded through Kiva, of which 81.17% were made to women. The efficiency of this system is based on the aggregation of individual lenders, the due diligence of field partners who issue the loans on the ground, and the organization of transactions by the Kiva network. Kiva has even partnered with Moody's Investors Service to issue credit ratings for the microfinance institutions it works with.

Table 4. The Kiva Case Study

Innovative Model	• Peer-to-peer model implemented to create community for financing and issuing microfinance loans
Network Component	• Peer-to-peer model and network technologies used to aggregate lenders and field partners, identify entrepreneurs, transmit loans to field partners, and monitor and administer repayment • Web 2.0 technologies implemented to foster and maintain a highly participatory community

Pricing Structure	• Low interest rate loans to entrepreneurs possible due to high volume aggregation of tiny individual loans • Individual loans collected through online community with social development and poverty alleviation objectives
Market Segment	• Bypassed traditional finance institutions by aggregating global community of lenders and field partners to administer loans • Peer-to-peer lending model as major example of utilizing network technologies to achieve development objectives
Value Proposition	• Access to capital for poor entrepreneurs • Issuance of low interest rate microfinance loans globally • Participatory and engaging user forum • Market mechanism implemented to help alleviate poverty through the microfinance of entrepreneurial ventures • Careful organization of lending chain from individual users through field partners to entrepreneurs ensures loans at low cost with high repayment rate
Strengths and Limitations	• +: Vast user base and network externalities associated with it • +: High volume issuance of low interest rate loans • +: Detailed implementation and repayment framework • +: Bypass traditional lending institutions • - : Organization and maintenance costs of online community • - : Uncertainty due to reliance on field partners to administer loans
Business model	• Creates a highly participatory forum where individual users can lend money to entrepreneurs through the globe • Links loan supply to demand in a peer-to-peer model that bypasses traditional institutions and ensures low interest rate • Flexibility embedded in organizational model and localized implementation ensures robust lending system that is responsive to the needs of individual entrepreneurs

Whipcar

Whipcar is another example of a business model that leverages the collaborative opportunities enabled by Internet technologies. Launched in 2009, Whipcar is the first peer-to-peer car rental service. Recognizing that the average actual use time of a vehicle is far below its possible use time, the online community enables vehicle owners to register their car so that it can be rented out to other drivers when not in use. Offering full customer support, integrated insurance products, break down cover and automated screening of all drivers, Whipcar avoids membership fees and high administration costs by making owners and drivers connected through their service responsible for the final communications and handing over of car keys. Owners can set their own rental prices, of which Whipcar takes a fixed commission, and a pricing guidance service is also provided. The special insurance product, which does not make owners liable when a driver has an accident in their car, is integral to the service. Essentially, WhipCar has exploited the peer-to-peer model to undercut car rental prices, drastically reducing the overheads of a car rental company by providing

services that connect supply directly with demand in the car rental market and enhancing the experience through value-added support services. It claims over 40 different brands of cars with a fleet of over 2500 vehicles (http://www.whipcar.com/frequently-asked-questions/).

Table 5. The Whipcar Case Study

Innovative Model	• Peer-to-peer model implemented to create community for car rental service
Network Component	• Peer-to-peer model and network technologies used to aggregate car owners, insure their cars, identify renters, and organize exchange • Web 2.0 technologies implemented to foster and maintain a highly participatory community
Pricing Structure	• Customized rental price system where price is set by owners with support provided through Rental Price Guidance software • Peer-to-peer model aggregates owners with renters at minimal organizational cost
Market Segment	• Car rental price offered far below conventional rental prices by cutting overheads associated with fleet ownership • Peer-to-peer model enables bypassing traditional car rental service and utilizes car resources more efficiently
Value Proposition	• Access to car rental at low rate for users • Access to previously inaccessible rents for car owners • Insurance product enables peer-to-peer car lending • Participatory and engaging user forum • Careful organization of lending chain from car owners through central administration to car renters ensures insured rental at low cost
Strengths and Limitations	• +: User base and network externalities associated with it • +: Low rates on car rental • +: Monetization of under-utilized cars by owners • +: Detailed insurance and payment framework • +: Bypass traditional car rental institutions • - : Organization and maintenance costs of online community • - : Vehicle rental fleet limited to registered owners
Business model	• Creates a forum where individual owners can lend cars to renters in the area at times they choose • Links car supply to demand in a peer-to-peer model that bypasses traditional institutions and ensures low rental rate • Flexibility embedded in organization, insurance framework, and localized implementation ensures robust lending system that is responsive to the needs of individual users and owners

The Macroeconomic Impact

The value of intermediary services online will continue to grow as the number of Internet users continues to grow. As business models implement new technologies to harness the network effects engendered by a growing online community, the economic impact will be both deep and diffuse. Intermediaries play important roles in markets that lack liquidity through the facilitations of transactions within them. They can promote market participation, facilitate identification of counterparts for buyers and seller transactions, and organize information in the marketplace (Kauffman and Walden 2001b). ICT developments have caused a fragmentation of the traditional value chain and give rise to new competencies for intermediaries such as aggregation, brokerage, trust provision, and information supply (Aldrige 1998; Bailey and Bakos 1997; Croson and Jacobides 1997). As ICT enables a finer separation of business processes and reduces the cost of integration between them, greater responsiveness between economic actors and the market should yield greater productivity gains. By adding value to an exchange relationship between at least two parties, intermediating services impact market structure and efficiency. These services have grown because they lower transaction costs as a result of lower search, coordination and payment processing costs (I. C.L Ng and Yip 2010). These services can drastically alter product exchange processes in terms of distribution, perceived value and consumer empowerment. Moreover, the sheer volume of information online has generated an important role for intermediaries to aggregate and organize information for ease of consumption. This has given rise to a considerable market for what has been labeled *infomediation* (Arnold and Penard 2007; Bakos 2001; Baye and Morgan 2002; Caillaud and Jullien 2003).

The increasing use of systematic tracking technology such as RFID in some sectors and the information accumulated about transactions reduces transactional hazards and enables more efficient matching of supply and demand. The growth of digitized commerce is a crucial component of the responsive capability of modern businesses. The aggregated result of millions of business over-reacting to supply chain information was the business cycle. However the amount of information accumulated through electronic transactions could mitigate this. The inventory-fluctuation-driven component of the business cycle could be in decline as digital inventory systems render organizations more responsive to changes in their supply chains and market fluctuations (Delong 2002). The information gaps that yield uncertainty in production planning processes are thus reduced through the implementation of a digital supply chain.

The efficiency gains and transparency made possible by mature digital business models can stimulate lower prices and higher output simultaneously. Since long-term growth of GDP is partly determined by growth in labour productivity, the efficiency improvements resulting from adoption of network technologies may boost macroeconomic productivity growth as electronic commerce grows (Suijker 2002). Peer-to-peer business models exemplify these possible efficiency gains because an individual firm recognizes demand in a market and minimizes transaction and search costs by coordinating buyers and sellers directly in online communities. They effectively provide services that are in demand using an architecture that avoids a costly and cumbersome organizational structure. While macroeconomic effects are difficult to attribute to specific developments in electronic commerce, innovative intermediary business models are likely to have a strong long-term impact on the

market structures, organization and performance of the economy (Brousseau and Penard 2007).

The integration of consumers into the production cycle

As electronic commerce continues to grow, so does the amount of information about behavior in the market. The organization and control of the information generated by consumers in digital networks is critically important to a successful online business model. The information accumulated can be utilized to innovate and improve services. Consumption is a process that generates important information about demand preferences that can be used to more efficiently match supply with demand. A business that systematically manages this information can use it to develop sophisticated marketing methods in order to better adapt to demand preferences, or even shape them. The consumer is becoming increasingly implicated in the design and marketing process. The act of consumption online generates important information that can become a vital input in the production cycle. Peer-to-peer business models, such as Kiva and Whipcar, even integrate individual contributions directly into the production of their services. Supply and demand are becoming increasingly difficult to unravel when individuals are both users and creators. By recognizing the pivotal role of user contributions to innovative processes, and by implementing efficient means to exchange and organize this information, businesses can truly leverage the opportunities of a digital market (Brousseau and Penard 2007). Recommendation systems like those developed on Amazon, the Internet Movie Database (IMDB), and Netflix are increasingly an important value-added component of infomediation services provided online.

Many businesses online are now pushing these ideas further and implementing web 2.0 technologies to establish community driven business models. These crowdsourced business models undercut prices with creative approaches that recognize the power of a large user base to deliver cost-efficient and intelligent solutions. Crowdsourcing is the sourcing of a specific task to a network of individuals in an open call format (Brabham 2008). It is a valuable model for businesses because the final output of the collective labour of the online community is owned entirely by the organization that issues the call. A business can harvest the input of a diverse group of contributors, reward only the best contributors and avoid the costs associated with employment and office overheads. Using web 2.0 technologies to aggregate the creative input of diverse and decentralized contributors, crowdsourcing achieves results that a rigidly structured organization often cannot (Surowiecki 2004). ICT enables multi-directional, participative and inclusive behavior while simultaneously lowering the cost barrier separating professionals and amateurs (Delfanti 2010). The time-consuming tasks of sharing, organizing and transmitting the information produced by multiple users is increasingly done by sophisticated software, which further enhances the efficiency of the approach (Albors, Ramos, and Hervas 2008). As groups of users are increasingly integrated into the production process in this way, the traditional divide between amateurs and experts or consumers and producers is slowly eroded. Defying the rigid architecture of conventional business models, the approach generates innovative solutions by blurring the distinction between supply and

demand. Some succesfull examples of crowdsourcing include iStockPhoto, Threadless, and Innocentive.

Netflix

ICT infrastructure provides the channels to deliver content on demand while software tools help to turn user-generated information into a value-added component of a service. Netflix, founded in 1997 as a DVD rental company by mail, has adapted its services in light of new technologies to become the leading provider of subscription-based content services on the Internet. Netflix streams TV and film to 23 million members who pay $7.99 for unlimited access to a large and continuously increasing repertoire. Recognizing the importance of interoperability in digital environments, Netflix's service is available on over 200 devices including computers, mobile devices, internet-connected TVs and DVD players, and most gaming consoles. A sophisticated recommendation system, built on contributions from users who rate films as they watch them, lies at the heart of the Netflix model. Netflix has found a way to better match the supply of their content to demand by aggregating the information generated by individual users and integrating it into a value-added content delivery service. Moreover, the creation of the algorithm that underpins the Netflix recommendation system software was crowdsourced. Netflix refined its recommendation system by offering rewards to the winners of its Netflix Grand Prize. In this manner, Netflix was able to achieve efficient solutions to highly complex problems in its recommendation system software at minimal cost. Netflix has managed 41.3% growth in paying subscribers between 2009 and 2010 and a resulting 29.5% increase in revenues. Its historical stock price performance is a strong indication of its success in creating and appropriating value in a market through the implementation of innovative technological solutions:

Figure 4. Netflix Stock Index Comparison

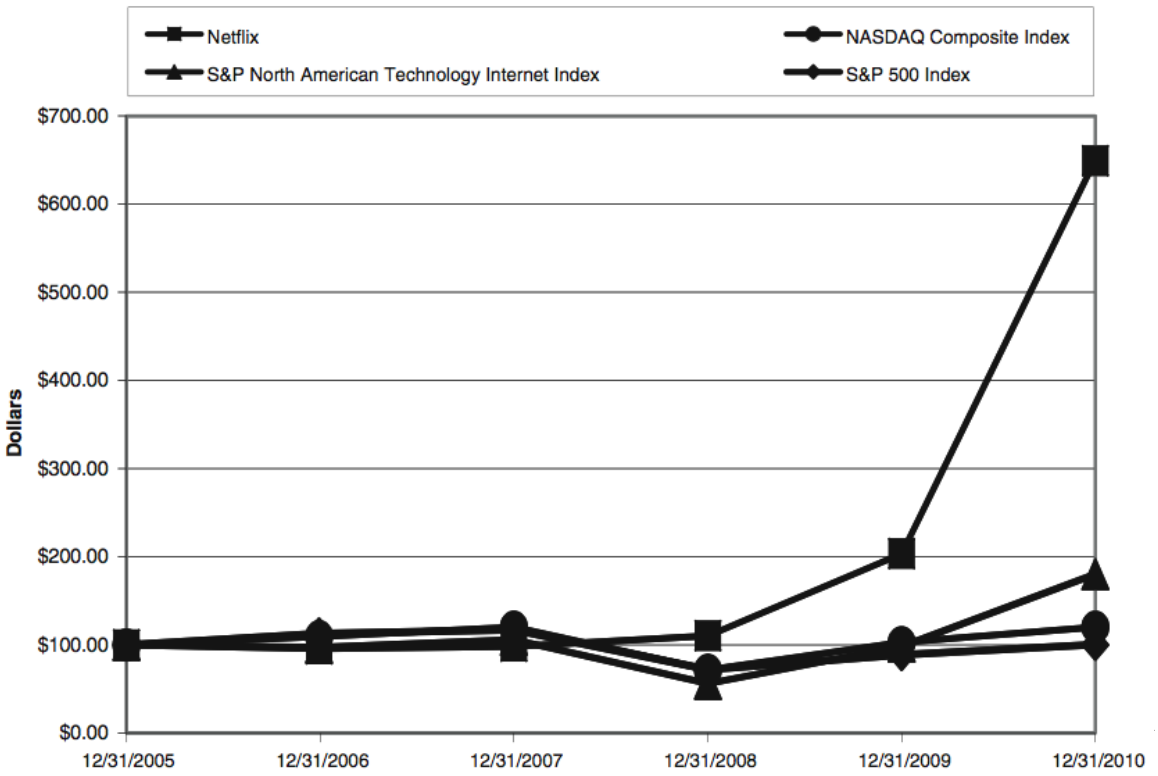


Table 6. The Netflix Case Study

Innovative Model	• On-demand digital content subscription service • Content recommendation system based on user ratings
Network Component	• Network technologies used to store and deliver content to customers at minimal cost • Online portal for navigating content, viewing recommendations and submitting feedback • Complex recommendation system based on user feedback accumulated and organized by software
Pricing Structure	• Flat fee subscription-based service that offers unlimited access to content repertoire
Market Segment	• TV and film rental offered below market rates by implementing digital network technologies to deliver content • Recommendation technology and ease of access online increases demand for content
Value Proposition	• Unlimited access to content repertoire at low rate for users • Interoperability of service on multiple devices • Minimized cost of content distribution business by digitizing content and using Internet delivery channels • Recommendation system accumulates information on demand preferences and guides user choice
Strengths and Limitations	• +: User base and network externalities associated with it • +: Low rates on content access • +: Stimulating demand through ease of access and recommendation system • +: Efficacy of recommendation system developed via crowdsourcing • +: Bypass traditional content rental businesses • - : Licensing costs of content providers • - : Costs of storing and streaming digital content • - : Service limited to US and Canada
Business model	• Information generated by users is integrated into recommendation system to add value to experience of service by making it responsive to preferences of users • Digital content distribution enables responsiveness to usage peaks and demand fluctuations in unpredictable content markets

Article One Partners

Article One Partners is essentially a social network business that helps patent offices and businesses ensure greater patent quality by implementing a crowdsourcing model to conduct prior art search. Prior art search done by a large group of experts and enthusiasts is often more efficient than searches run by a few examiners (Ghafele and

Gibert 2011). Since its only substantial running costs are the management of an online forum for peer review of prior art it is more cost effective than traditional law firms proposing similar services. Its comprehensive prior art search capabilities can help organizations optimize resources away from litigation and towards valuable research and development. This is possible due to its crowdsourced business model. Article One Partner's community boasts 3 million researchers in 140 countries (approximately 50% of which have advanced degrees and whose subject matter includes science and technology), over 6000 registrations and foreign language portals in Japanese, Korean, Mandarin, Russian, Spanish, Portuguese, French and German. Moreover, specific strategies are actively expanding this community: an Open Network where postings are public and email notices are constantly provided to the community as well as cooperation with a number global affiliate partners in foreign countries and technology hotbeds. Article One Partners has launched over 263 studies since its inception in November of 2008 and over $1,530,000 has been given out to the community in rewards. Over 30% of studies on patent validity have already produced key evidence. The incentives offered and the vast community already at their disposal helps Article One Partners overcome the traditional hurdles involved in leveraging the benefits of open peer review of prior art. Crowdsourcing prior art search has helped render the patent review system more responsive to the information available to a global community of practitioners and stimulates efficiency gains in a complex process of the patent system.

Table 7. The Article One Partners Case Study

Innovative Model	• Crowdsourcing the prior art search component of the patent application review process
Network Component	• Network technologies used to store, organize and transmit contributions of users • Web 2.0 technologies implemented to foster and maintain a highly participatory community
Pricing Structure	• Crowdsourcing its research input enables results at minimal cost where only useful contributions are rewarded • Complex prior art search studies sold at fixed rate
Market Segment	• Prior art search studies sold to individuals, firms and patent offices provides alternative to traditional review channels such as patent attorneys and patent offices • Efficacy and cost of crowdsourcing prior art search expands market for studies
Value Proposition	• Prior art search benefits from access to vast pool of diverse expertise • Automatic organization of submissions and management of online community • Minimized cost of prior art search study • Supports patent system by rendering prior art search more efficient
Strengths and Limitations	• +: User base and network externalities associated with it • +: Fast solutions to complicated prior art search problems at minimal cost • +: Size and diversity of online community of contributors

	• +: Use of technologies to manage communication, participation, and rewards of individual users • +: Bypass traditional prior art search providers • - : Value of product relies on contributors outside the boundaries of the business • - : Difficulties associated with fostering and maintaining an active online community
Business model	• Information contributed by users renders prior art search highly responsive to developments in a wide range of fields • Drawing from online community for service makes business responsive to demand fluctuations at minimal cost and makes the cost of training and employment effectively nil

The Macroeconomic Impact

The network externalities generated by online communities are one of the primary drivers of value in electronic commerce (Kauffman and Walden 2001b). Businessess should place these benefits at the heart of their business model rather than view them as a by-product of their activities. Suppliers enjoy reductions in customer search costs, the cost of product promotion, transaction costs, lead time and responsiveness to demand that is difficult to replicate in the physical world (Mahadevan 2000). The increasing interaction between consumers and producers has a strong impact on innovation and the accuracy of supply and demand matching. As software systems and organizational frameworks enable companies to respond to consumer preferences at near-instantaneous speeds, productivity is likely to increase. This is supported by the diffusion of ICT infrastructure in all sectors of the economy, which has long-lasting impacts on productivity, economic growth and labour relations (Indjikian and Siegel 2005). Productivity growth is impacted both directly, due to increases in capital per worker ratios, and indirectly, due to efficiency improvements.

However, the macroeconomic impact of ICT on productivity relies significantly on how it used and the skills available. Efficient tools must be paired with innovative solutions in order to leverage the new opportunities to their full extent. Having already transformed the search characteristics of the labour market (Kauffman and Walden 2001b), ICT developments that enable crowdsourcing will continue to transform labour relations. The crowdsourcing phenomenon itself may have an important impact. Crowdsourcing can be more productive than centralized alternatives because it relies on free input, open governance, and the universal availability of outputs (Delfanti 2010). As the barriers between consumers and producers dissolve, the efficiency of centralized production will be challenged by an open model that undermines some of the assumptions of participation in knowledge production and problem-solving. The prevalence of labour exploitation online may help transcend alienation and cause significant shifts in material production. Crowdsourcing can reconnect individuals with their profession and revives the importance of the consumer in the design and production process (Brabham 2008). This phenomenon is part of the wider trend towards collaborative networks online.

The long-term effects of this transformation in the relations of production are yet to be fully understood.

The Provision of Computing as a Utility

A critical factor in determining whether a business can leverage the opportunities provided by advancements in ICT is the availability of computer processing power. Steady reductions in the size and cost of computer processing has helped drive growth in the ICT sector. However, the capital required for building large-scale computing infrastructure remains substantial. Until companies can acquire computing capacity without massive up front investment, the costs of ICT hardware may be limiting growth. The idea of computing delivered as a utility that can be paid for on a pay as you go basis, like gas or electricity, has been a goal of major players in the IT industry for many years. It enables the growth of Software as a Service (SaaS), which seeks to deliver software applications over the Internet and shift software consumption from a one-off purchase to a continual service with value-added components supplied by SaaS providers. The hardware and systems software in datacenters that can enable SaaS are frequently referred to as a *cloud* in the business (Armbrust et al. 2009). While multiple definitions of *clouds* exist, the notion of parallel and distributed processing systems built on compute and storage virtualization technologies is integral (Buyya, Yeo, and Venugopal 2008). Cloud computing is the result of massive investment in ICT infrastructure by a single provider. The major factor enabling it is the construction and operation of large-scale datacenters at low cost locations. These datacenters are composed of real and *virtual machines* that can be deployed as a dynamic resource in order to overcome traditional single-machine constraints (Vaquero et al. 2008). Virtualization technology is a key factor in the ability to deliver computing as a utility. Despite confusion about the exact definition of the term, a substantial literature detailing the hardware and software specifications, business applications and potential evolution of the cloud computing industry exists (Weinhardt et al. 2009; Wang and T. S.E Ng 2010; Vaquero et al. 2008; Buyya, Yeo, and Venugopal 2008; Sotomayor et al. 2009; Motahari-Nezhad, Stephenson, and Singhal 2009; Dejun, Pierre, and Chi 2009).

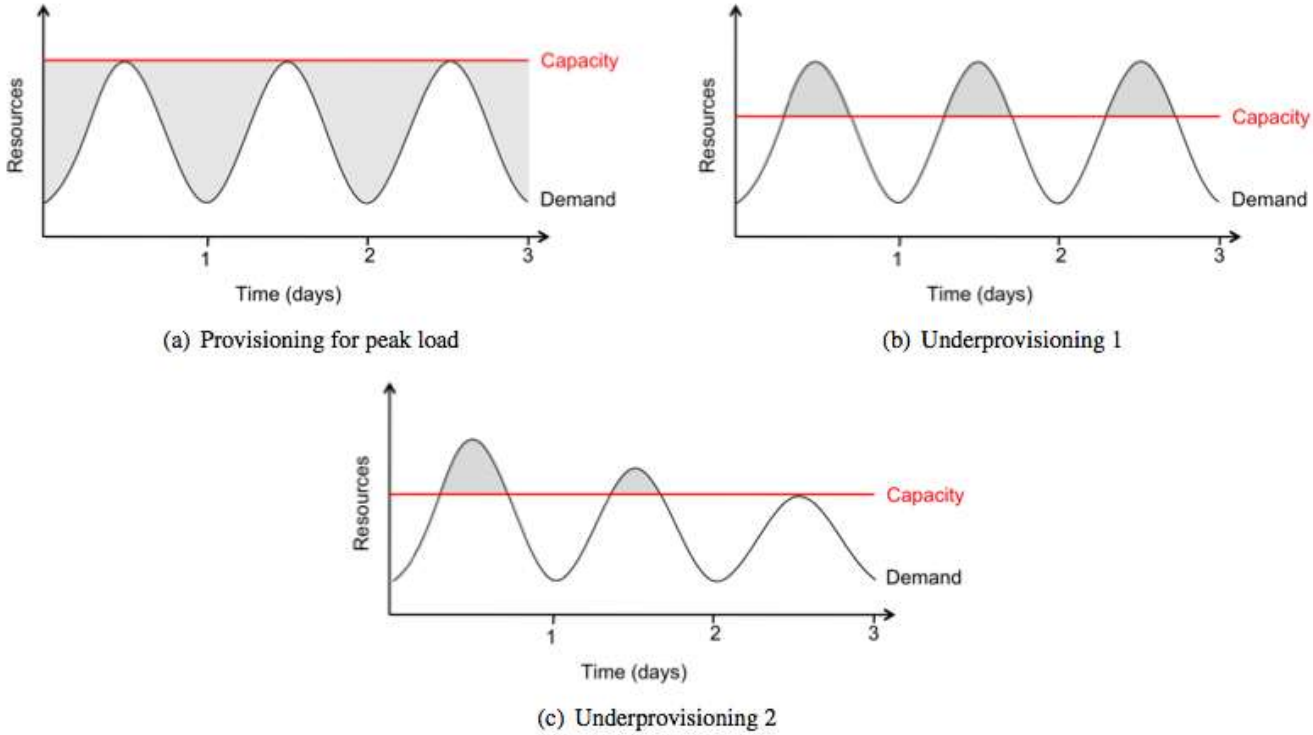
Utility services such as gas and electricity are an essential component of modern societies. Permitting consumers to ‘pay as you go’ for utilities reduces the need for individual investment in infrastructure and increases transparent access to a resource. While the idea of utility markets for computing resources is old, the ability to actually deliver computing as a utility is relatively new. It is the latest string in a line of ICT developments whose impact on efficiency should not be underestimated. Organizations providing a service where use varies with time, where demand is unknown in advance, or where complex batch analytics are required can rely on cloud computing infrastructure and reduce the need for massive up-front capital investment in ICT. The key idea of cloud computing is transparent resource access that is provided on a pay-per-use basis and relies on infinitely and instantly scalable infrastructure that is managed by a third party (Vaquero et al. 2008). Cloud computing, like any other utility, enables its user to access an infinite amount of data storage and processing capacity on demand according to a transparent price

mechanism. Virtualization technologies permit computing resource deployment that can be scaled up or down in real-time according to the needs of a business. The immediate and infinite scalability of data processing in a cloud enables the optimization of computing resources in an economy. Cloud computing is essentially about centralizing data processing in order to capitalize on economies of scale and scope (Weinhardt et al. 2009). The investment required for massive data centers means that only a handful of large corporations are likely to become providers. Major IT companies such as Google, Amazon and Microsoft are investing heavily in cloud computing infrastructure in order to tap a growing utility computing market. Cloud computing services are growing rapidly. Amazon Web Services, Microsoft Azure, Google AppEngine, and Sun Network.com are some of the biggest. Amazon Elastic Cloud Compute (EC2) is a component of Amazon's cloud computing service that implements a pay as you go pricing model that enables Amazon to capitalize on this market and permits businesses to benefit from computing resource scalability and elasticity.

Amazon Elastic Cloud Compute

Amazon has been a major player in the IT world since its inception. Originally implementing an innovative business model to cut overheads associated with a traditional brick-and-mortar bookshop, it has now expanded its activities to all aspects of the retail industry and web services. Amazon Elastic Cloud Compute (Amazon EC2), a part of Amazon Web Services (AWS), rents the computers necessary for users to run applications within Amazon's own data center. Amazon EC2 can thus help reduce costs and improve cash flow in web-based businesses. Avoiding ICT-related capital outlays minimizes the financial and strategic risk of a new business while infinitely scalable and elastic computing resource provision enables a business to be responsive to drastic changes in demand. This means a business' computing capacity can shrink or grow in real-time according to the needs of its customers. Traditionally, rigid capacity planning for computing resources meant businesses would either over-provision computing resources, leading to waste, or under-provision it, leading to inability to meet customer demand. Amazon EC2 enables demand capacity to match resource usage exactly by providing computing resources on a pay as you go basis. This reduces ICT investments and operational costs. It also ensures that customers are retained. Even if traditional capacity planning can accurately estimate the peak resource usage of a service, resources will be wasted outside of peak usage times. Furthermore, if a service underprovisions resources, not only is revenue not generated from available demand, but customers are likely to be dissatisfied with a service and not return to use it. The effects of resource capacity on demand and revenue are charted below:

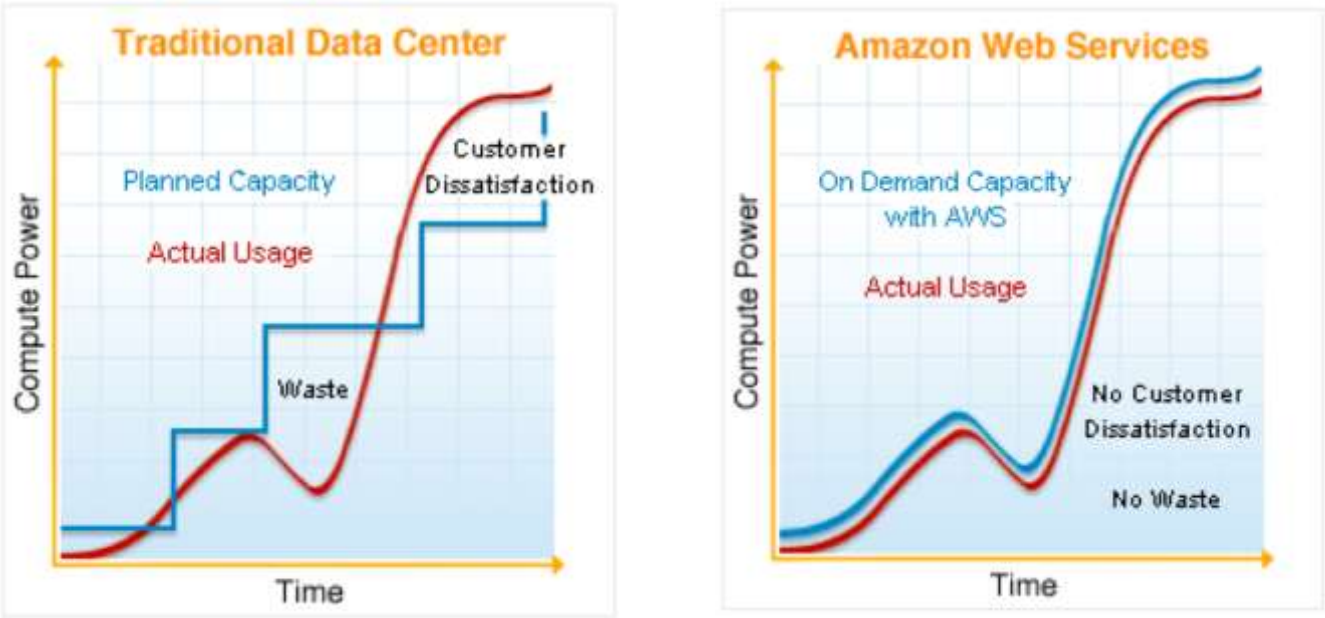
Figure 5. Capacity Provision and Demand



(Armbrust et al. 2009)

The shaded area in (a) represents wasted resources outside of peak usage times. In (b) the shaded area represents revenue from users that is not captured because resources could not be deployed for them. (c) portrays how the underprovision of resources can result in demand attrition that permanently reduces a portion of the revenue stream. Scalable and elastic computing enabled by services such as Amazon EC2 permit supply to meet demand exactly:

Figure 6. Capacity vs. Usage Comparison of Datacenters



(Source: http://aws.amazon.com/economics)

While further analysis of performance- and security-related issues remains important (Dejun, Pierre, and Chi 2009; Garfinkel 2007; Juve et al. 2009; Yigitbasi et al. 2010; Wang and T. S.E Ng 2010), platforms like Amazon EC2 will no doubt have a strong economic impact.

Table 8. The Amazon Elastic Cloud Compute (EC2) Case Study

Innovative Model	• Pay as you go utility computing model enables businesses to reduce hardware investment and maintenance cost as well as providing infinitely scalable and elastic resource usage
Network Component	• Virtualization technologies used to turn physical machines into multiple servers where resources can be deployed and released according to demand
Pricing Structure	• Pay as you go payment for computing optimizes resource allocation • Pay as you go reduces start up costs, hardware investment risk, and capacity planning problems
Market Segment	• Growing application market for Software as a Service (SaaS) • Web-hosting services that must accommodate peak usage times and other changes in demand • Efficacy and cost of utility computing likely to expand market for SaaS
Value Proposition	• Data storage and processing benefits from economies of scale and scope through the construction of large-scale datacenters at low cost locations • Service Level Agreements (SLAs) monitor usage and resource allocation • Minimized cost of ICT infrastructure • Supports web-based service economy through reliable, scalable and elastic infrastructure for data storage and processing
Strengths and Limitations	• +: Economies of scale and scope in data processing and storage • +: More efficient allocation of resources: capacity usage mirrors actual usage for services • +: Reduction of ICT start up costs • +: Use of technologies to manage security, usage monitoring, and other service components • - : Outsources a crucial component of web-based services to a third party • - : Need for transparency in resource usage and monitoring, security protocols and capacity deployment speeds in order to ensure uptake of services
Business model	• Infinitely scalable and elastic computing resources makes supply responsive to the peaks and troughs in demand • Pay as you go model reduces start up and maintenance costs, which allows business to grow rapidly in response to changes

	in the market

The Macroeconomic Impact

The economies of scale and scope achieved through the centralization of datacenter infrastructure have significant impacts on economic productivity and the efficiency of resource allocation. Elasticity of computing resources, where no premium is paid on scale, means that large capital outlays are no longer required in hardware to deploy certain services or in the operating expenses required to run them (Armbrust et al. 2009). The elasticity of computing resource enables start ups by reducing the costs associated with hardware investment and management (Vaquero et al. 2008). Companies no longer need to worry about over- or under-provisioning a service. The cost of datacenters to companies is essentially amortized. The absence of capital expense enables capital to be redirected to core business investment while pay as you go models for computing resources permit elasticity and the transference of risk (Armbrust et al. 2009). Companies can control the cost per user hour of operating their services. Dynamic pricing policies such as pay as you go achieve more efficient allocations and prices for high-value services (Weinhardt et al. 2009). Fine-grained pricing models make trade-off decisions between capacity provision and revenue appropriation more fluid and easily identified. Cloud computing creates a large market for both providers and software application developers. The total addressable market value of cloud computing has been estimated by Merrill Lynch at $160 billion, including $95 billion in business and productivity applications and $65 billion in online advertising alone (Hamilton 2008).

Cloud computing promotes entry and innovation in all sectors where ICT costs are relevant barriers (ETRO 2009). SMEs no longer need to invest in ICT infrastructure for one-time or infrequent computing tasks. Quick scalability ensures growth. Reduced barriers to entry promote business creation and investment in ICT-related services. The generalized reduction in the fixed costs of entry and production typically associated with the ICT industry enables a shift from fixed capital expenditure into operating expenditure. Important changes will be felt at both the consumer-, firm- and macroeconomic levels. Multilateral network effects among businesses operating in the cloud can increase efficiency and productivity. Other positive externalities include emissions reductions from the energy savings made possible by more efficient computing resource use.

Analysis suggests that the ability to rent computing power and pay on demand will have a ‘profound impact on the cost structure of all the industries using hardware and software, and therefore it will have an indirect but crucial impact on business creation and on the macroeconomic performance of countries’ (Etro 2009). Technological developments have been frequently identified as boosting aggregate productivity growth; the increase in data processing productivity enabled by cloud computing is thus likely to have a large impact on productivity growth (DeLong 2001). A study of the impact of cloud computing on the European economy concluded it would have a significant macroeconomic impact. Adopting conservative assumptions, Etro predicts cloud computing could create over one million additional jobs in Europe in the short-term and lead to a reduction of the unemployment rate by 0.2 to 3 percent in the medium run (ETRO 2009). By reducing fixed costs and promoting entry, cloud

computing increases competition in most markets and tends to reduce mark ups, consequently increasing demand and therefore production. The resulting increase in labour demand will generate pressure for higher wages that will incentivize longer working hours. In the long run the increase in output stimulated by cloud computing will lead to increases in consumption towards higher steady-state levels (Etro 2009). The largest impact on business creation levels is expected in the wholesale and retail sectors (over 156,000 new companies) and in real estate and other business activities (over 144,000 new SMEs) (ETRO 2009). This effect is permanent and deemed to increase over time.

Conclusions: The Macroeconomic Impact of the Business model Revolution

The continuous development and proliferation of ICT has important macroeconomic consequences. The 80/20 inversion from the domination of tangible to intangible assets as the primary component of market value leads to new challenges and opportunities in the 21st Century. Innovative business models are transforming the competitive landscape by integrating the technology and skills required to capitalize on these opportunities. New pricing and production models are expanding the scope of commerce into more facets of social life than ever before. Empirical work has found positive correlations between ICT investment and economic performance at all levels of aggregation (Indjikian and Siegel 2005). In the mid-1990s the US experienced a boost in productivity gains that originated from ICT-producing industries while investment in ICT assets in all sectors of the economy created a capital deepening effect. Studies on the impact of ICT suggest that it fuelled labour productivity growth in the US from 1.2% in 1975-1995 to 2.3% in 1995-2006 (EUDCR). The simultaneous downturn of EU productivity has been attributed to its outdated and inflexible industrial structure, which focused on low- to medium-technology industries and was slow to adjust to the pressures induced by technological change (EUICT). The attention now lavished on promoting the digital economy and information society in Europe by the European Commission and European Parliament testify to their importance.

The potential of certain technologies and their range of applications is rarely obvious. Over time, businesses have adapted their business models to integrate technology into the heart of their production cycle. The diffusion of ICT has in turn led to innovations with a strong impact on labour markets, industrial structure, and economic efficiency. Four interwoven phenomena have been outlined in this paper: new monetization mechanisms, post-internet markets, the integration of consumers into the production cycle, and cloud computing. These phenomena exhibit a shift in the speed and ability of economic actors to respond to information from each other and the market. These underlying shifts have fuelled a *business model revolution* in business models that exploit new platforms and processes in order to more efficiently match supply and demand in new and expanding markets. This revolution has important macroeconomic consequences that are summarized below:

Table 9. Summary of Macroeconomic Impacts

Business model component	Macroeconomic Impact
International commodity exchange markets via innovative pricing mechanisms	• Growth stimulated through liquidity, transparency and valuation standardization • Greater availability of information fuels productivity growth that underpins stable increase in GDP
Free Internet services supported by targeted advertising	• Network effects engendered by consumer communities impacts long-term growth
Intermediation in electronic markets	• Reduction in costs of integration between businesses stimulates productivity gains • Efficiency gains and transparency from greater information can fuel lower prices and higher output • Growth in labour productivity and consequently GDP
Peer-to-peer business	• Minimization of transaction and search costs boosts performance • Alternative, efficient distribution channels increase aggregate productivity
Digitized production and distribution	• Increase in capital per worker ratios and efficiency improvements • Labour productivity growth that underpins GDP growth • Better matching of supply with demand preferences yields more efficient allocation of resources
Crowdsourcing	• Transformation of labour relations • Decentralized production and demand for knowledge-intensive skills alters labour markets • Expansion of intangible asset-based economy fuels aggregate productivity growth
Cloud Computing	• Economies of scale and scope increase productivity • Elasticity and scalability of resources matches supply with demand efficiently • Reduction in barriers to entry promotes business creation, GDP growth, reduces unemployment and increases production • Network effects among businesses increase efficiency and productivity

These changes are likely to have clustered effects as greater responsiveness in all sectors of the economy contributes to productivity and efficiency growth. Cloud computing is the latest in a string of innovations that reduces computer processing costs and reduce barriers to entry in IT-related industries. As an increasing number of

industries incorporate IT into their production cycles, business creation, labour productivity, and resource allocation efficiency will improve. Furthermore, the intermediary services that enable the exchange of new commodities and the value-added mediation of information online will enjoy substantial productivity gains and greater responsiveness to demand fluctuations. As ICT becomes cheaper and Internet broadband penetration deepens, the population of consumers that can be reached through digital networks and integrated into production cycles through innovative organizational architectures - such as crowdsourcing and peer-to-peer – will increase. This will have an increasingly strong impact on the search characteristics of the labour market and the relations of production. Greater information exchange will erode the price premium on products by introducing transparency. It will also elevate the importance of social media in fostering consumer groups. The increasing value of electronic commerce, which transcends national borders and is often not regulated in the same way as traditional channels, will pose new challenges to governments in a number of areas. Fiscal policy, including exchange rate stabilization, the regulation of financial markets, and controlling for inflation, will no doubt need to adapt in response. Labour policy will see drastic shifts in employment standards, international workforce migration, unemployment rates, and an emphasis on high-knowledge industries. Social policy will play a vital role in mitigating the privacy concerns posed by the monitoring of consumer behavior online and the storage and management of information in datacenters.

Innovation and organizational flexibility will be a key factor in the ability of businesses to create and appropriate value in the market. The collapse in storage costs and responsiveness of inventory to demand fluctuations will render the market more efficient than before. The intellectual property rights embedded in all of these processes will play a crucial role in determining the ability of actors to access technologies, and consequently it will influence macroeconomic productivity and growth. The *business model revolution* will cause a collapse in the relative price of high-technology and knowledge-related outputs compared to manufactured goods and raw materials. This will further bolster the importance of knowledge-intensive skills in labour markets and negatively impact low-end workers. Emerging markets will have to adapt to these changes if they wish to remain competitive with economies that have already experienced some of the long-term benefits of ICT diffusion. Developed economies will need to find the right institutional architectures that promote growth in high-technology sectors, stimulate education, and enable electronic commerce or they will risk lagging behind in the global knowledge economy. The impact of the *business model revolution* is only beginning to be felt in sectors as diverse as retailing, finance, entertainment, and health. The macroeconomic consequences of these changes will no doubt be deep and diffuse. In an economy focused on knowledge, understanding the current transformations is the key to success.

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