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COMPETITION POLICY AND INNOVATION

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ABSTRACT:
We briefly review the rationale behind technological alliances and provide a snapshot of their role in global competition, especially insofar as it is based around intellectual capital. They nicely illustrate the increased importance of horizontal agreements and thus establish the relevance of the topic. We move on to discuss the organisation of industries in a dynamic context and draw out consequences for competition policy. We conclude with an outlook on the underlying tensions between technology alliances, competition policy, and industrial policy.

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1 Introduction

Technological progress harbours the prospect of a future in which there would be cures for and vaccines against wicked diseases such as HIV/AIDS, cancer, or malaria. People the world over would enjoy the benefits of mobility in safe, zero-emission vehicles and make use of effective, affordable communication devices for both work and play. And industry would meet the growing demand for goods and services by an increasing global population while drastically reducing its negative impact on environmental sustainability.

Making this future a reality requires innovations. To bring them about, firms as the major agents of technological change must invest in new products and processes. In so doing, they face costs associated with R&D that they often cannot bear individually. They confront technical risks and uncertainties related to market acceptance. And because of the increasing complexity of new applications, they come up against limits of their internal capabilities to solve a constantly evolving set of problems single-handedly.

Firms have responded to this challenge through mergers and by cooperating with each other. For example, they have formed international technology alliances, including with universities and science institutes. These partnerships aim to share costs, pool risks, and complement or enhance individual capabilities through joint R&D or technology development. At the latest count there were almost 6,000 of such alliances, concentrated in the Triad economies of the US, Europe, and Japan (NSF 2004, Table 4-16). The tally is conservative in that it undercounts collaborative relationships among small firms and in certain technology fields. They are concentrated in sectors where pushing the technology frontier depends increasingly on a judicious combination of scientific (incl. basic) research with the command over deep financial, organisational, and technological resources. Examples include information technology, biotechnology, advanced materials, aerospace and defence, automotive, and chemicals. Fewer than two out of ten registered partnerships are equity based. Especially in areas where technological trajectories are hard to predict, these alliances tend to take the form of flexible, non-equity agreements.

To the extent they are successful – and therein of course lies their promise – technology alliances may help solve the problems referred to above. From the 1980s, governments have acknowledged the role of collaborative relationships among firms for innovation, and accommodated them in a competition policy framework increasingly more tolerant of practices that earlier would have been suspected of collusion and would thus have been illegal. The situation in the US is a telling example of the relaxation. For example, the 1980 Baye-Dole Act made it legal for government contractors to exploit the fruits of research undertaken on behalf of the US government. The 1984 National Cooperative Research Act allowed firms to collaborate on generic, pre-competitive research. Since 1993 firms may additionally engage in collaborative production. Hence a critic's worries about "the shadow that neoclassical thinking [by which he meant the suspicion of horizontal agreements] casts over antitrust policy" seemed largely a thing of the past (Teece 1990, 23).

A similar liberalisation has informed competition policy in the European Union. And the EU aims to exploit private and public investments in the knowledge economy in its endeavour to increase its competitiveness (European Commission 2003). In sum, the strategic responses by firms to the increased complexity and speed of innovation are reflected at least in part by evolving competition rules and industrial policies that aim to facilitate technological change. It is this connection – between innovation, competition policy, and industrial policy – that this chapter addresses.

What we have said so far may suggest that all is well – firms pursue novelties in cooperative arrangements, governments marshal international competitiveness, pundits wax lyrical about the knowledge economy, and the challenge of innovation is what holds it all together. But it is not quite as easy as that.

The emphasis on innovation creates problems for theoretical analysis and policy practice in antitrust. Theoretically, the uncertainty surrounding technological change in highly dynamic sectors implies that it is difficult or impossible to evaluate the likely effect of inter-firm collaborations that are in principle open to anti-competitive practices. Also, even if overall R&D expenditure is lower in a cooperative set-up, the welfare effects *post*-innovation may still be positive provided the former R&D partners now compete in the product market and this market does not resemble what a long defunct pop group once lamented as *The Winner Takes It Aaaaall*... For policy practice, this means that antitrust officials do not have tried and tested general guidelines – or at least much less so than in the past – that would allow them to pronounce on the welfare implications of an alliance without facing the criticism of the firms involved, parts of the legal and economics profession, or ultimately the courts entrusted with oversight and litigation of the relevant cases.

Section 2 briefly reviews the rationale behind technological alliances and provides a snapshot of their role in global competition, especially insofar as it is based around intellectual capital. This chapter is not about technological alliances *per se*. But apart from their obvious link to innovation, they nicely illustrate the increased importance of horizontal agreements and thus establish the relevance of the topic. Section 3 discusses the organisation of industries in a dynamic context and draws out consequences for competition policy. Section 4 concludes with an outlook on the underlying tensions between technology alliances, competition policy, and industrial policy. In other words, the chapter starts with a perspective on firms, moves on to policy, and finally settles with a number of open questions that concern firms, policymakers, and researchers of innovation alike.

2 Technology alliances: rationale and importance

Technology alliances involve at least two partners from the public and/or private sector that collaborate around R&D or technology development. The terminology is somewhat loose; research partnerships and strategic technical alliances also frequently bounce around the literature and are in essence interchangeable. An alliance always involves

legally distinct entities and is thus different from a merged company. Technology alliances are a form of strategic alliance in that the involved parties share a common goal and agree on how to reach this goal by means of pooling resources and coordinating attendant activities (Teece 1992, see also Dunning 1997). Alliances are formed for many reasons besides issues surrounding technology and innovation, but evidence suggests that these are indeed among the most important. Research joint ventures (RJVs) are a subset of technology alliances; they may be entered into by firms and institutions from higher education or the science sector and, of course, imply control via equity (for an overview, see Caloghirou, Ioannides, and Vonortas 2003).

Technological knowledge is subject to externalities, uncertainty, and the danger of opportunistic behaviour. This results in underinvestment in knowledge creation in arm's-length markets unless firms can counter prohibitively high transaction costs resulting from incomplete contracts. Insofar as they limit the risk exposure of each participating firm while creating new or diffusing existing knowledge, technology alliances are a mechanism to achieve just that. This is especially so in high-tech sectors and in activities where technological change tends to be rapid and radical rather than incremental and gradual and where prospects for future market dominance are weak.

Globalisation is also a reason behind the growth in alliances. This is because of a growing mismatch between the kinds of knowledge firms require to be internationally competitive, and the technologies that are locally available. The distinct technological trajectories that countries travel over time evolve slowly, while markets converge globally at a higher speed. So for firms to keep up with what is going on internationally, they may opt to internalise the relevant knowledge through an alliance – especially when other forms of technology acquisition are unavailable (Narula 2003).

Strategic considerations complement the picture. Thus, firms may enter into a technology alliance in the pursuit of a first-mover advantage. The increased scope of activities from an alliance reduces the response time to new developments for its members who may consequently be faster onto the market. Alliances offer advantages in very complex technologies insofar as they allow firms to leverage their own capabilities with needed external competences they can acquire with a view to matching the innovative challenge of whatever it is they are after, with the requisite portfolio of human, technical, and managerial capital. In the process, firms can learn from each other, thus improving their capabilities along the way. In this view, working together is not so much aimed at reducing transaction costs as at ensuring access to and internalisation of external knowledge that would otherwise remain elusive (Hemphill and Vonortas 2003, Caloghirou, Ioannides, and Vonortas 2003).

Over time alliances can develop a reputation for the mutually beneficial character of relationships and thus bestow trust upon the firms involved. They can therefore act as a mechanism that allows firms to hedge their bets on future technologies with highly uncertain prospects without staying out of the game entirely. In other words, evolving

multi-market and multi-project alliances provide incentives for engaging with innovation "on the cheap".

Empirical research largely confirms these propositions concerning why technology alliances are formed in the first place and what difference they make (for an overview, see Hagedorn, Link, and Vonortas 2000). Over the last quarter of the past century, alliances have become a fixture of contemporary capitalism. 185 alliances were formed in 1980; by the 1990s the annual increase amounted to two to three times this figure (see Figure 1). Non-equity alliances dominated in all but two years in this period, and the ratio of non-equity to equity alliances increased significantly, especially from about the middle of the 1990s. Initially, the dominant sector was IT but in later years biotechnology attracted the highest number of new collaborative relationships. Most alliances involve US firms, followed by firms in Europe, and finally Japan.

[Figure 1. – International technology alliances by technology, 1980-2001]

However, technology alliances increasingly involve non-Triad economies as well, especially from East Asia (see Figure 2). Due to the increasing homogeneity of technology across countries and firms, alliances have become an important vehicle for technological learning and industrial upgrading in select latecomer countries (Narula and Sadowski 2002, see also Hobday 1995). Compared to alliances among firms from Triad economies, those involving firms in developing countries tend to be relatively more equity-based. Equity-based inter-firm relationships lend themselves to the transfer of existing knowledge (cf. Chen and Chen 2002). Typically they are asymmetric and may fail to achieve the expectations of the alliance partners for a host of reasons (Kuada 2002). But as these firms become more sophisticated, their share in non-equity based alliances rises along with their graduation from an industrial structure heavily steeped in mature sectors to one in which they increasingly engage with more high-tech activities to which non-equity forms of collaboration are more conducive (Narula and Sadowski 2002).

[Figure 2. – International technology alliances by regional ownership category, 1980-2001]

The comprehensive picture that emerges is thus one in which the Triad economies account for the bulk of alliances, especially in high-tech fields. Unsurprisingly, on the whole technology alliances therefore mirror the concentration of R&D spending by the OECD's major firms in fields such as pharmaceuticals and IT (OECD 2004). Firms from latecomer countries are fast making inroads, especially in more traditional sectors (Hagedoorn, Link, and Vonortas 2000, 577; Vonortas and Safioleas 1997). Cooperative agreements are therefore increasingly present in the global economy. This implies that it is important to understand their relevance for innovative activities, along with the treatment they receive in distinct regulatory regimes and industrial policy contexts in both developed and developing countries.

3 The organization of innovative industries: challenges for competition policy

3.1 Industrial policy and competition policy: substitutes or complements?

The relation of industrial policy with competition policy is old and has had surprising twists and turns. Old-fashioned industrial policy aimed at promoting particular firms (picking winners, creating national champions) and old-fashioned competition policy aimed at providing level playing fields for firms. Thus in principle the two sets of policy could clash. Sometimes they did. At times, however, competition has been used to conduct old-fashioned industrial policy, witness for example the American Robinson-Patman Act of 1936, the purpose of which was "to provide some measure of protection to small independent retailers and their independent suppliers from what was thought to be unfair competition from vertically integrated, multi-location chain stores." (Clark, 1995, 1).

In pre-World War II Europe, the absence of a competition policy was an integral part of industrial policy. Cartels were seen as an intelligent way of organizing industries, of avoiding "ruinous competition", and of slowing down innovations, creative destruction and chaotic competition. Prominent economists and courts supported these views (Neumann, 2001, 24-27).

In recent times, the debacle of transatlantic trade relations around the merger of McDonnell Douglas and Boeing provides an example of the conflict between the two policies. The two companies announced the merger December 1996. The EU Directorate General for Competition voiced its concerns about the merger in May 1997, while the US Federal Trade Commission decided to approve it in July.[1] The European Commission decided to go ahead and do an independent investigation of these two American companies. To assuage the EU Commission's concerns, Boeing sent a fax to Brussels in late July suggesting among others to limit the use of exclusive deal contracts with some of the world's biggest airlines. This was perceived by the EU to make future competition possible between the world's two largest producers of airliners, American Boeing and European Airbus, and the merger was subsequently approved.[2] However, the view differs on each side of the Atlantic as to whether the EU Commission's decision was a clear case of industrial policy in favour of Airbus or rather a clear competition decision.

Trade interventionists, such as Laura Tyson (1992), might see the competition concerns raised by the European Commission as nothing other than a pretext for getting a better deal for its pan-European company, otherwise why should the FTC have approved the deal? Another explanation is possible, however, following the line of thought of Barros and Cabral (1994). Since Boeing and McDonnell Douglas were large net exporters of airliners to Europe, a merger would have different welfare effects in the US and in the EU. While the resulting producer surplus could counteract the loss of consumer surplus in the

[1] Katz and Shelanski (2005, 145) emphasize that the FTC found that an analysis of the effects of the merger on innovation supported the merger. Technologically McDonnell Douglass had fallen behind their rivals and the acquisition by Boeing meant that their assets would be put to better use.

[2] See Aribaud (1997) for a brief European account of the case.

US, leading the FTC to approve the merger from an American point of view, such countervailing producer surplus would not be present in the EU. According to this view the European Commission was protecting its consumers against being exploited, it was not protecting Airbus against competition.[3]

3.2 New developments

Recent developments in technologies and industrial organization of innovative and high-tech industries have altered the way economists and competition authorities think of cooperation between firms, dominance, mergers and market definition. At the same time, their approach towards state aid has changed considerably – not least in the EU. European state aid control attempts to dismantle old-fashioned industrial policy, especially to the extent that the state aid distorts competition (see chapter 7.2 on State Aids and Policy Implications by Martin and Valbonesi in this volume. For a useful brief overview of legislative changes in the EU and the US since the 1980s, see Hemphill, 2003).

In addition, the focus of industrial policy has shifted from promotion of particular firms (picking the winners) to facilitation of industrial clusters or innovation networks (Halliday & Seabright, 2001). Sharing of knowledge, i.e. information flows between firms, and co-operation in R&D activities seem to be fundamental in creating the dynamic evolution of the markets: new products for the customers and new, improved, more cost-efficient processes. While competition policy welcomes the general shift in industrial policy, it struggles to find its feet when evaluating agreements, conduct, dominance, mergers and markets in the "new economy".

3.2.1 Industrial organization in the "new economy"

Traditional industrial economics and competition analysis focus on price competition and static efficiency. The benchmark is often taken to be that of welfare-maximizing perfect competition that ensures the lowest possible price in that a process of entry competes the price down to average costs in the long run. This means that no firm earns supra-normal profits in the long run; that consumers get the goods at the lowest possible unit cost; and that firms are forced to be efficient or else quit the industry.

Deviations from the benchmark are perceived as lowering welfare and therefore the target of competition policy. Such deviations could consist of increases of price due to collusion or market dominance. Market dominance in turn could be achieved trough mergers, predation and other exclusionary practices (exclusive contracts, tying and bundling). Such conduct is, however, not likely to succeed in creating market power unless accompanied by barriers to entry. In turn barriers to new competition may be the result of either government policies and regulation or the very same types of conduct (vertical restraints,

[3] A similar line of argument could be applied to the merger between two other American firms, General Electric and Honeywell that was prohibited by the European Commission in 2001. See Motta (2004, ch. 6.6.1) for a comprehensive discussion of this case.

mergers, predation and limit pricing). Herein lies the compromise that has been labelled the "new industrial organization" between the Harvard-based Structure-Conduct-Performance school that focused on barriers to entry that were erected by industry itself and the Chicago school that argued that the only barriers to entry that would survive market forces, were those created by government. See Martin (1993, ch. 1) for a richer discussion.

However, especially in the context of rapid innovation, the "new industrial economics" has come under attack from "Austrian" economists. If the rate of technological advance is fast, static welfare may be of less importance than dynamic welfare achieved through new technology, new products or new processes. In fact giving up static welfare and price competition as goals of competition policy may be necessary to get the more important innovations. New products are more important than low prices.[4]

In the following we focus on industries that are characterized by high rates of product or process innovation, driven by significant research and development costs. In addition, network effects could be important. This definition does not exclude old industries such as the pharmaceutical industry or, arguably, airlines (that certainly have a network element to their services).

Economic thinking about innovative or dynamic industries has developed rapidly during the last decade. Industrial economists have increasingly come to realize that while the static welfare standard (for example consumer surplus or the sum of consumer and producer surplus) that is used in traditional competition analysis may be adequate when analysing monopolization or cartelization of mature industries, it may be inappropriate when analysing industries characterized by significant innovation.

While competition policy for mature industries may focus on reducing price and thus profits for firms in the industry (preferably by reducing entry barriers), it would stifle innovation if imitating rivals eliminated all rewards to innovation. Thus, to the extent that innovation is important in a given industry, competition policy must allow supra-normal profits and thus prices in excess of marginal and average costs (Audretsch, Baumol and Burke, 2001). Evidently, this is why intellectual property rights (IPRs) and patent laws are in place, but IPRs represent inefficient ways of protecting the investment in R&D in many industries.[5] In those industries, competition authorities may have to allow behaviour such as horizontal cooperation that would be unacceptable in mature industries.

The first challenge to competition policy is then to identify how important innovation is in a given industry – i.e. whether old-fashioned competition policy suffices or whether new thinking is needed. This is difficult, since the assessment will often have to be done *ex ante*,

[4] See the special issue of *International Journal of Industrial Organization* 19(5) on *Competition Policy in Dynamic Markets,* guest-edited by David Audretsch, William Baumol and Andrew Burke, 2001.
[5] For an overview of institutions that provide incentives to innovate, see Schotchmer (2004).

i.e. before the result of the innovation is known.[6] The challenge is really to assess whether innovation is more important than price competition, since this entails deciding whether consumers would be better off with a new product that is priced above cost or with an old product that could be priced at (a lower) cost.[7]

Network effects represent another challenge for competition policy. Network effects (or demand side scale economies) mean that the value of the good or service to any customer increases in the number of other customers that also use the good. An often-quoted example is that of the telephone: the more people you can call, the more you will value the good. Less direct network effects may arise through the "hardware/software" externality: The larger the circulation of a particular piece of hardware (a game terminal, for example), the more profitable is it to develop software applications (games) for that type of hardware; and the more applications that are developed, the larger the circulation will be. Thus network effects describe some positive feedback mechanism on the user side that imply that there is a tendency that winners take it all or that markets tip in favour of one producer of e.g. hardware (Shapiro & Varian, 1999). This in turn, implies that such a producer could experience rapidly increasing market shares, once consumer expectations have homed in on a particular hardware (Katz & Shapiro, 1986 & 1994).

Network effects allegedly mean that consumers may be locked-in on the wrong (inferior) technology. An often-quoted example is that of the QWERTY keyboard that allegedly was introduced to slow down typing at the time of the mechanic typewriter so that they would not jam (David, 1985). There were competing keyboard layouts at the time of adoption, but in the end QWERTY won because all typists had to learn to type on that particular keyboard because that was the keyboard everybody else was using. Even when an allegedly superior Dvorak keyboard was developed, this superior technology was not adopted because of the switching costs of having to learn to type on a new keyboard. However, Liebowitz and Margolis (1990) contested this 'fable of the keys', arguing that the evidence that the Dvorak keyboard was superior to QWERTY is not convincing and that consumer lock-in does not represent a serious obstacle to the adoption of a new technology provided that it is sufficiently superior. Thus there is significant disagreement in the economics literature as to whether network effects and consumer lock-in represent problems that government policies need to resolve.

Whether due to advances in technology or network effects, competition in the industries that we think of here may thus involve rapid changes of market position. Pleatsikas and

[6] "There is no government which might be able to outguess the entrepreneurs regarding the potential of the future, and there is no government which, like a benevolent dictator, might be able to pursue economic welfare by adopting non-partisan policies." (Neumann, 1990, 563)

[7] In the EU, a requirement for an R&D collaboration to be exempt from normal competition rules is that it relates "to results which are protected by intellectual property rights or constitute know-how, which substantially contribute to technical or economic progress and the results must be decisive for the manufacture of the contract products or the application of the contract process." (European Commission, 2000, Art. 3(4)). For background on EU competition policy with respect to technology transfer and especially licensing agreements, see Peeperkorn, 2003).

Teece (2001, 668) argue that exactly because of this instability of market position, competition authorities should adopt a lenient policy towards high-tech industries. "Such intense competition generates high risk and requires higher than average returns to compensate. Yet high risk for the investor should translate to lower risk for the antitrust authorities, as incumbent positions may be fragile even in the short- to medium-term and, frequently, competitive forces are sufficiently powerful to undo monopoly power, should it arise."

In the following we organize the exposition around four different tasks that are typically carried out by competition authorities:

1. *Co-operative agreements*: Horizontal agreements are a no-no of traditional competition policy but to the extent that network externalities are important for R&D, output, alliances and joint-ventures between competitors may be justified. If R&D collaboration affects price competition, the challenge for competition policy is to strike the right balance between dynamic and static welfare.
2. *Market delineation*: The definition of the relevant market is a pivotal point of many competition cases. The definition of markets in innovative industries must take into account that competition (to some degree) is carried out along different dimensions, viz. innovation and non-price competition in general rather than price competition.
3. *Monopolization and abuse of dominance*: Dynamic markets are typically also dynamic in terms of market shares. Due to network effects, markets may tip so that a firm acquires a dominating position in a short span of time, while its competitors are equally quickly reduced to small fringe firms or driven entirely out of the market. To assess whether such an outcome is the result only of (benign) network effects or (also) of exclusionary conduct is a challenge to competition authorities.
4. *Mergers & acquisitions*: Again usual considerations of assessing market shares of merging firms do not make sense if these market shares may change rapidly, for example due to network effects.

3.2.2 Cooperative agreements between firms

Traditionally, competition authorities have been wary of co-operation between firms. Horizontal cooperation, i.e. cooperation between providers of substitutes (competitors), was (and still is) seen as attempts to restrict quantities and raise prices. Vertical cooperation, i.e. cooperation between providers of complements in a supply chain, was initially treated with the same suspicion, but economic analysis has changed that thinking radically: while parties to a horizontal agreement share an interest in raising each others' prices, parties to a vertical agreement provide complements and would rather have the other party reduce its price. Thus typically, vertical cooperation increases the efficiency of the supply chain or the distribution channel and it is only when third parties (consumers, rivals, potential rivals) are hurt that competition authorities feel the need to take action.

Firms in innovative industries often seem to be interested in forming networks and alliances. These pose a new challenge to competition policy: more often than not, members of a network supply both complements and substitutes. Consider, for example, airline alliances (e.g. OneWorld, SkyTeam, Star Alliance or Qualiflyer). Each member has a hub and spokes of regional routes, some of which connect to the hubs of the "co-opetitor". Such routes that connect hubs are substitutes and the alliance may result in less competition both in terms of price and frequency of the service. However, by organizing in an alliance the customer gets coordinated access to a bigger set of destinations[8] since the set of complements has expanded. In evaluating the alliance (or a corresponding merger), the competition authority must trade off the negative impact of reduced competition around the substitutes against the positive impact of increased choice relating to the complements. Evidently, industrialists and management consultants assure us that "[a]lliances are not even distant cousins of cartels. On the contrary, if properly designed, alliances provide companies with their best chance to compete in the global market place by improving skills, gaining access to new markets, and increasing scale. Alliances can make companies *and* markets more competitive and give companies a unique opportunity to learn" (Henzler, 1993, 265).

However, cooperative agreements regarding research and development do worry competition authorities. Their concern is that the agreement will not stop at the R&D level but extend to production and marketing, thus creating a cartel. Thus a traditional view is that R&D collaboration is permissible but firms must behave non-cooperatively in the post-innovation market (Jorde & Teece, 1990, p. 81; Martin, 2001, ch. 5). For this reason, both in the US and the EU, R&D collaboration is judged to form a potential problem if the participating firms hold a (jointly) dominating position (Neumann, 2001, 132). In the US, the National Cooperative Research Act (NCRA) subjects R&D collaboration to a rule of reason[9];[10] in the EU, Commission Regulation 2659/2000 provides a block exemption for R&D agreements from the general prohibition of anti-competitive agreements provided that the combined market share of the firms does not exceed 25 percent. If not, the R&D agreement is subject to a rule of reason in the sense that it must comply with Article 81(3) to be granted individual exemption (European Commission, 2000). Japan takes an even more benign view on joint innovation arrangements including joint commercialization (Jorde & Teece, 1990, 87-88).

However, even if the firms behave non-cooperatively in the post-innovation market, R&D collaboration may affect prices and welfare adversely. Martin (1995) combines a traditional repeated game explanation of product market collusion with the possibility of R&D joint ventures between the oligopolists. If the R&D joint venture makes static competition more profitable to the participating firms, firms that engage in tacit collusion

[8] This may be perceived as a product innovation!

[9] A rule of reason allows the court to assess whether a certain business conduct promotes or harms competition on a case by case basis. It is the opposite of a *per se* rule according to which the conduct is considered harmful without further analysis.

[10] The regulation has been liberalized through the National Cooperative Production Amendments of 1990 (H.R. 4611), see Jorde and Teece (1990, 90).

may share an understanding that deviation from the agreed prices or quantities will mean not only a reversion to the Nash equilibrium of the stage game but also the end of R&D collaboration. Since this threat is harsher than Nash reversion alone, this will make it easier for the firms to sustain collusion (i.e. they will be able to sustain tacit collusion for a lower value of the discount factor).

Jorde and Teece (1990) argue that the view of the innovation process of which Martin's (1995) model may be an example is linear or sequential: research precedes development that is then commercialized. They argue that increasingly today innovation is rather a simultaneous, continuous interplay between the various stages, and that innovation often requires lateral or horizontal linkages in addition to vertical relations. "For innovations to be commercialized, the economic system must somehow assemble all the relevant complementary assets and create an interactive and dynamically efficient system of learning and information exchange." (Jorde & Teece, 1990, 79).

Jorde and Teece (1990) go on to argue, much in the Austrian tradition that is proposed also by Audretsch, Baumol and Burke (2001), that intellectual property rights in many cases are not strong enough to prevent free riding by imitation or reverse engineering so that it is no surprise that social returns to innovation are greater than private returns. This leads to underinvestment in innovative activities unless R&D joint ventures, alliances or mergers combining many potential competitors are allowed to "bolster its market position and its stream of rents by other strategies and mechanisms. These mechanisms include building, acquiring, or renting (on an exclusive basis) complementary assets and exploiting first-mover advantages. We use the term *complementary assets* to refer to those assets and capabilities that need to be employed to package new technology so that it is valuable to the end user. Broad categories of complementary assets include complementary technologies, manufacturing, marketing, distribution, sales and service." (Jorde & Teece, 1990, 83).

Thus Jorde and Teece (1990) argue that competition policy should allow alliances[11], joint ventures and horizontal agreements also in commercialization as well as exclusive practices and other conduct that is normally taken to signify monopolization or abuse of dominance.

Shapiro and Willig (1990) as well as Brodley (1990) take an opposing view, arguing that Jorde and Teece (1990) exaggerate the benefits of relaxing competition policy towards R&D joint ventures and underestimate the costs in terms of reduced competition. Adopting a linear or sequential view on the innovation process, they argue that if antitrust rules allow collaboration to extend to production, for example as a production joint venture, the joint venture could set the price so high that the effect would be as if the parent companies engaged in a cartel even if they acted independently in distribution and marketing. Hence it is reasonable that competition policy restricts collaboration to the

[11] Jorde and Teece (1990, 85) further argue that "[t]he case for planning and industrial policy recedes if a degree of operational and strategic coordination can be attained through private agreements."

R&D stage. Similarly they argue that R&D joint ventures may in fact in and of themselves reduce the pace of innovation by preventing a patent race. (Ordover and Willig 1985). In an analysis of US RJVs formed between the mid-1980s and mid-1990s, Vonortas (2000) finds evidence of multi-project and multi-market contact between the mostly large and diversified firms that undertake RJVs. Insofar as they learn about each other's strategies, firms then have an incentive to collude and a mechanism to police shirking. On the other hand, the participation of non-US firms in the RJVs, the uncertainty characteristic of the markets on which these RJVs focus, and the turnover of these inter-firm agreements militate against anti-competitive outcomes. Vonortas suggests that the empirical understanding of the overlap between multi-market and multi-project contacts is incomplete.

Shapiro and Willig (1990) conclude that a rule of reason towards the assessment of R&D collaboration is warranted and that this should be made clear in (American) antitrust legislation. They also acknowledge that the risk parties to joint ventures face of having to pay treble damages in the American antitrust system might inhibit benevolent R&D collaboration and thus find that the detrebling of damages permitted by the NCRA is justified and that it should be extended to production joint ventures.

3.2.3 Market delineation in the context of rapid innovation

The definition of the relevant market is the starting point (and often also the end point) of almost all competition cases. Traditionally, competition authorities focus on product markets and (then) on geographic markets. The purpose of market delineation is to identify the goods (or services) that exert a competitive pressure on the product under scrutiny. The most used framework is that of the 'hypothetical monopolist' or SSNIP (Small, Significant Non-transitory Increase of Price): if a hypothetical monopolist could profitably increase the price by a small but significant amount (5-20%) for a certain minimum period of time (a year or two), then the product under consideration constitutes its own market; if not, the analysis is extended to include the closest substitute, and the method continues iteratively until the smallest set of goods that satisfy the 'hypothetical monopolist' test is found. Very often, however, competition authorities rely on a less vigorous method of quantitative or qualitative indicators supplemented with anecdotal evidence, such as interchangeability of use, (alleged) sensitivity of revenues to price changes, customer assessments, characteristics of the product, the existence of distinct groups of customers, price differentials and specialized distribution channels (Pleatsikas & Teece, 2001, 673).

Pleatsikas and Teece (2001) argue that these traditional ways of delineating product markets are particularly ill suited in the context of rapid innovation. Price tests such as SSNIP fall foul of gauging the wrong kind of competition, since non-price competition on the performance of the product is much more important than the often non-existent price competition. If customers care about price at all it is the price/quality or price/performance relationships they value, not price as such. Similarly, price differentials may exist and persist because of significant product differentiation and patents or other

protection of proprietory information. Specialized distribution channels are often used to ensure specialized after-sales service or to supply specific complementary assets. Pleatsikas and Teece (2001) recommend the use of a hedonic framework to assess the price/performance relationship along the lines of Hartman *et al.* (1993) and Teece and Coleman (1998) or the analysis of market shares over time to assess whether these have the dynamic features expected of rapid innovation.

Increasingly, competition authorities and industrial economists have come to realize that market delineation in innovative industries must take into account that competition (to some degree) is carried out along different dimensions, viz. innovation and non-price competition in general rather than price competition. Recognizing that the entry barriers to innovation activities may be very different from entry barriers relating to product markets or geographical markets, US antitrust authorities have invented the concept of "innovation markets", i.e. a separate market for innovation efforts consisting of the R&D (and its close substitutes) targeted at a particular product or process innovation (Gilbert & Sunshine, 1995; Glader, 2004, 6). The underlying thinking seems to be that the innovation market should include the various combinations of assets and scientific personnel that have the technological capability of contributing to R&D in a certain area.

Jorde and Teece (1990, 89) similarly argue that market delineation should be modified to take innovation into account by focusing "primarily on the market for know-how", presumably since it is in this market that barriers to entry arise. Geographically they argue that the market a priori should be taken to include the entire world and that antitrust authorities should lift the burden of proving otherwise.

The usefulness of the concept of innovation markets was discussed extensively in the Antitrust Law Journal's 1995 symposium on "a critical appraisal of the 'innovation market' approach" (for a more complete summary, see Glader, 2004, 93-97). Hay (1995) argues that in the end, it is product markets that are important, not innovation markets and from a legal point of view Hoerner (1995) concurs that since R&D is typically not traded in the market, innovation markets are not defined in terms of lines of commerce as required by the Clayton Act. Rapp (1995, 12) argues that the innovation market approach "represents a leap into the unknown, with a potential for harm to economic welfare as great as any potential benefit" but Glader (2002, 86-87) counters that innovation markets serve to supplement the 'potential competition doctrine' that asserts that if entry into a certain product market is probable and imminent then the potential entrants exert a competitive pressure on the market that must be included in the market definition. However, since R&D is an uncertain and lengthy endeavor, where "R&D is directed to a completely new product for which no product market yet exists at all, the potential competition doctrine may seem misplaced. The innovation market approach was designed to remedy this gap."

3.2.4 Abusive practices and innovation

Dynamic markets are typically also dynamic in terms of market shares. Due to network effects or rapid innovation markets may tip so that a firm acquires a dominating position

in a short span of time, while its competitors are equally quickly reduced to small fringe firms or driven entirely out of the market. Competition is Schumpeterian and *for* the market, rather than traditional price competition that takes place *in* the market. The Microsoft cases on both sides of the Atlantic show that the assessment as to whether such an outcome is the result only of (benign) network effects and innovation or of exclusionary conduct is a challenge to competition authorities. Evans and Schmalensee (2002) argue that competition policy should allow for considerable short-run market power and sequential monopolies. Predation is even more difficult to analyse in the context of tipping markets, since all competitors that fail to get critical mass will be run out of the market anyway. In addition comparing price with variable costs makes little sense when these are zero for practical purposes since first-copy costs or R&D outlays are the important sunk costs; and how to distinguish penetration pricing from predatory pricing? Similarly, bundling or tying by including extra features in a product is part of the innovation process, and should not be treated as *per se* illegal.

To survey the Microsoft cases and the relevant economic literature on those cases would demand the size of a book.[12] However, the cases are illustrative of a number of problems relating to innovation and network effects and so deserve brief treatment.

In 1998, the US DOJ filed a complaint regarding Microsoft relating to its internet browser, Internet Explorer (IE), which competed with Netscape Navigator. Two years later the District Court found Microsoft guilty of maintenance of monopolisation in the market for Intel-compatible operating systems (OS); attempted monopolisation of the internet browser market; and tying of its Windows with IE. The court ordered Microsoft to split up into two vertically separate entities, one relating to OS and one to applications. However, Microsoft filed an appeal, and the Court of Appeal decided in 2001 that Microsoft was guilty of monopolisation of the market for OS, but not of attempted monopolisation of the browser market and that alleged tying should be analysed under a rule of reason rather than the lower court's *per se* rule.

The appeals court argued that network effects constitute a significant barrier to entry that protects Microsoft's dominant position in the OS market: "That barrier – the 'applications barrier to entry' – stems from two characteristics of the software market: (1) most consumers prefer operating systems for which a large number of applications have been already written; and (2) most developers prefer to write for operating systems that already have a substantial consumer base. … This 'chicken-and-egg' situation ensures that applications will continue to be written for the already dominant Windows, which in turn ensures that consumers will continue to prefer it over other operating systems" (*US v. Microsoft*: 20). Thus Microsoft was found to have a monopoly position. In addition, the appeals court found that it was guilty of monopolisation through restrictive clauses in the contracts with OEMs (prohibiting them from removing system features relating to IE and from changing the appearance of the desk top), through the integration of IE and Windows and through exclusive contracts with internet access providers such as AOL.

[12] For a very good, brief summary of the US v. Microsoft case, see Motta (2004, ch.7.5).

Similarly, in the EU case, Microsoft has been accused of integrating its Windows Media Player (WMP) to the detriment of rival Real Player. The European Commission has requested that Microsoft supply a version of Windows without WMP. When Microsoft complied it first suggested that the new version be called "Windows XP Reduced Media Edition", but the European Commission rejected that as unappealing to customers and the parties later settled for "Windows XP Professional Edition N". Microsoft was also requested to licence protocols to software developers that would then allow these to develop software that interoperates well with Windows. Microsoft feels that de-tying and other government interference with their design of the bundled products (Windows/IE/WMP) is restricting its freedom to innovate and has set up a lobbying web page by that name: Microsoft Freedom to Innovate Network.[13]

In a (vertically) related case, the FTC accused Intel of monopolizing the market for general purpose microprocessors by preventing three computer manufacturers (including Compaq) from enforcing their patents. The alleged misconducts included the termination of information flows needed to incorporate Intel processors in a response to e.g. patent infringement litigation. The FTC concluded that by so doing, Intel expropriated the other firms' intellectual property rights. Intel countered that the conduct would not affect R&D due to cross-licence agreements with other competitors. The case was settled through a consent agreement that prohibited that Intel deny customers access to such information. (Glader, 2004, 181-185)

3.2.5 Mergers, acquisitions and technological change[14]

The debate on how market structure and concentration affect R&D (and presumably thus innovation) is an old one in industrial economics. While Schumpeter (1942) advanced the hypothesis that big firms or firms with market power are more likely to shoulder costly R&D, Arrow (1962) pointed out that monopolists have a smaller incentive to innovate than competitive firms, since monopolists would cannibalize profits earned with old technologies by introducing new ones, while the competitive firm would reap the entire benefit (provided that it could protect the invention from imitation by other competitive firms). Later theories have revealed that oligopolies might have the biggest incentive to innovate (e.g. Kamien and Schwartz (1975)) and there has been some empirical support to corroborate this finding (Scherer, 1965). However, in a survey of the evidence, Cohen and Levin (1989) conclude that concentration does not seem to have a significant impact on innovative behaviour and performance: "Perhaps the most persistent finding concerning the effect of concentration on R&D intensity is that it depends upon other industry-level variables. … The conclusion that market concentration may exercise no independent effect on R&D intensity suggests that there may be no Schumpeterian tradeoff between innovation and the ex ante market power conferred by concentration." (Cohen and Levin,

[13] http://www.microsoft.com/freedomtoinnovate/

14 This section just introduces this area in broad terms. For a more detailed discussion, see chapter 7.3 of this volume on Mergers and Concentration Policy by Hans Schenk and Katz & Shelanski (2005) that also contains an interesting overview of U.S. merger cases.

1989, 1076-1078) These findings mean that merger policy that aim at regulating the industry structure find little advice of a general nature in the economics literature and that a case-by-case approach is necessary.

Rapp (1995) argues that a policy to block mergers by reference to its effect on innovation must rest on two assumptions: (1) that an increase in (R&D) concentration would diminish the amount of R&D; and (2) that the reduction in R&D would in turn diminish innovation. Carlton and Gertner (2002) add to this the assumption that (3) the amount of R&D and/or innovation is not already supra optimal. The latter possibility is theoretical (Reinganum, 1989) but is dismissed by Katz and Shelanski (2005, 135)[15] as a general, empirical concern.

Katz and Shelanski (2005) point to two criteria for evaluating innovation in relation to merger policy; the innovation incentives criterion and the innovation impact criterion. The innovation incentives criterion is of importance when the merger affects the incentives to innovate (positively or negatively). For example, if innovation cannot be protected from imitation by free-riders this may lead to a waiting game that postpones innovation unless the parties are allowed to merge. On the other hand, the merger might end product-market competition. This discussion is akin to our discussion of R&D cooperation above and indeed such R&D cooperation may constitute the relevant benchmark (rather than a non-cooperative scenario) for the merger. The advantage of R&D cooperation is that, at least in theory, the companies may be independent in their marketing behaviour, thus preserving product-market competition. The innovation impact criterion is important when innovation alters post-merger product competition (for example through winner-takes-it-all competition) so that pre-merger market structure is less useful as an indicator of the effects of competition. In this case post-merger competition is not in the market but for the market, but may be fierce nonetheless.

Katz & Shelanski (2005, 152-153) conclude that a merger policy for innovation-driven markets should realize that a case-by-case approach (rule of reason) is necessary but that competition authorities could prepare an improved basis for decisions through (1) the development of "guidelines on drawing inferences of potential product-market competition from evidence on ongoing innovation"; (2) the consideration of merger cases where the concern is with potential (rather than actual) R&D; (3) the acquisition of industry-specific expertise to assist the assessment of welfare trade-offs resulting from mergers in R&D intensive sectors; and (4) the systematic use of decision and probability theory to deal with the uncertainty created by different scenarios for innovation. In essence, only detailed industry studies can shed light on the relationships between innovation and firm behaviour. This is easier said than done and, importantly, must be undertaken over time. If a competition authority blocks a merger because of an alleged reduction in socially optimal investment in R&D, the *ex ante* situation – likely efficiency benefits from a well structured settlement – should be compared to the discounted benefits of R&D consumers enjoy (or not) thanks to the blocked merger. Hence *ex post* industry evolution is a good guide to whether or not competition policy decisions turned

[15] Referring to Griliches (1992) and Jones and Williams (1998).

out to be desirable, even if the learning effects that result from it are unlikely to resuscitate deals that were forbidden but with hindsight should not have been, or vice versa; at the very least, they can inform future decisions (Carlton and Gertner, 2002).

4 Conclusion

Perhaps it is easiest to begin our summary of the discussion by emphasising what it does *not* mean. First, we do not live in an "age of innovation". Of course, ICT, new materials development, nano- and biotechnology produced technologies that were unimaginable – and much less existed – until just a few decades ago. But a higher rate of technological change in some areas exists side by side with very little change in others. Those taking a long view might dismiss claims that ours is an era of exceptional technological development as hyperbolic. This means that not everything tried and tested concerning the efficient operation of markets should go into the rubbish bin of history. Hard-core cartels are alive and kicking, and their insidious pursuit has nothing to do with innovation (OECD, 2000). Hence, in many areas of economic activity old-style competition policy that guards against and sanctions horizontal agreements is very much needed.

Second, although we know that, *in theory*, when R&D externalities are involved or when technology trading between firms promotes the economy-wide diffusion and adoption of knowledge, the long-run welfare effects of competition in innovation may differ spectacularly with short-run effects of competition around prices, *in practice* it is impossible to accord these trade-offs any degree of certainty. Disagreements in the economics and legal profession about innovation markets illustrate this poignantly. It is particularly evident when competition authorities haul companies to court and both sides use perfectly valid arguments to claim the rule of reason for their side. The crux is that not only is the significance of innovation markets unclear in an aggregate sense, but case-by-case considerations are controversial as well. This is despite the fact that by definition they make no pretence at judging welfare implications on anything but the merit of the case at hand. And it lies in the nature of innovation that even if there were general consensus about the desirability of a horizontal agreement among the firms involved and their competitors and anti-trust officials, some or all of them might have to review their position with hindsight.

Third, the inherent tension between the dynamic complexity of future technological developments on the one hand and the need to produce rules and guidelines for firm behaviour that are unambiguous and easy to follow does not mean that competition authorities should stick to what they know and stay away from things uncertain until the course of history and theoretical and empirical advances have improved the lacunae in our understanding of what is going on, and why. Too much is at stake in innovation markets to take the chance that what is best for firms will always necessarily be best for consumers as well.

These three "non-conclusions" raise a number of issues for public policy and academic research. The first relates to the uncertainty innovation introduces to economic activity.

Competition policy and industrial policy are means to an end. In abstract terms the end is relatively clear – a dynamically efficient market – although what that actually means in Silicon Valley or Grenoble where the global technology frontier is being pushed is often different from what it means in Bangalore, Gauteng, or Brasilia where most rapid technological change is devoted to catching up. But what all these markets have in common is that market prices do not fully reveal the profitability of resource allocations that have yet to materialise. Firms must discover this cost structure to figure out how and where to compete. In the face of uncertainty, this involves taking bets and hedging against risk through pooling resources with other firms. The likely effects of such cooperation are the stuff of competition policy. Overcoming the information externality especially when inter-firm agreements are not in the cards, is the stuff of industrial policy. (Martin & Scott, 2000; Martin, 2003)

Section 2 showed that technical alliances are prevalent in the Triad. It also showed that they are on the rise in select latecomer countries, but they do not as yet greatly impact the developing world. Where competition policy in developed countries grapples with accommodating the strategic responses of firms to uncertainty, enlightened industrial policy in developing countries is a "process of discovery", involving government and the private sector, of what stands in the way of economic change and industrial upgrading, and how it might best be removed (Rodrik 2004). A caricature of the difference would be that public policy in the North is primarily concerned with the strategic response to uncertainty by the private sector whereas governments of latecomer countries in the South actively help the private sector to internalise information and coordination problems and thus to share the burden of uncertainty. But the parallels are obvious.

The difference between the relationship between competition policy and industrial policy on the one hand and technological innovation on the other is that competition policy is necessarily rule-bound. By contrast, industrial policy can afford to be much more eclectic: what works, works. The story of memory chip production in Korea is different from that in Costa Rica, but also from other experiences of technological upgrading in Korea itself. Hence there is no one-size-fits-all.

And thus the second issue refers to what one might call reflexive policy regimes. As bad as it is to make decisions that with hindsight turn out to be wrong, in an uncertain world it is impossible to avoid mistakes. The important point is to learn from them. Competition authorities might gain for themselves and improve on their mandate if after taking a decision on the merits of a horizontal agreement or after a successful court battle, they continued to monitor the firms concerned in the evolving innovation market. Forecasting what happens in markets a few years or decades from now can only be helped by understanding what went on in these markets in the past. Perhaps the relevant directorates should employ a few economic historians among their analysis staff.

Finally, the third issue concerns academic research. Industrial organisation has pretty much staked out the theoretical issues. Section 3 has shown what they are and where there is disagreement. The verification which interpretations of innovation markets are more

apposite requires a better empirical understanding of where technological trajectories, especially in the new sectors, are heading. Economists and lawyers are unlikely to figure this out unless they receive help from engineers and other technology specialists.

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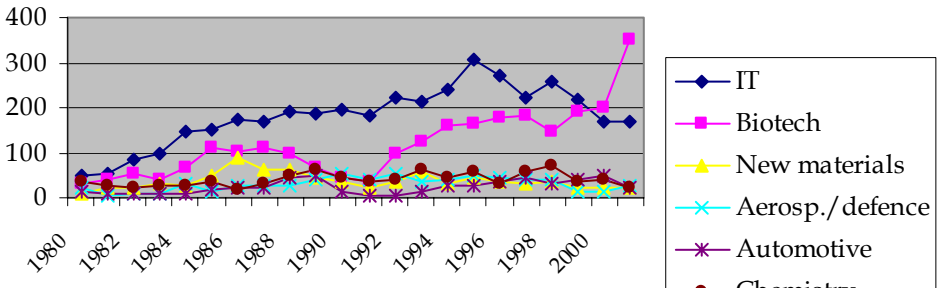
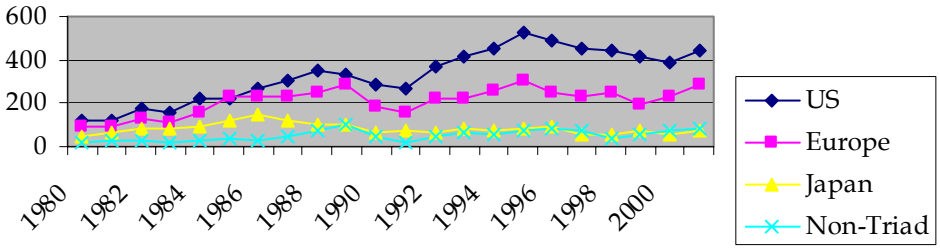
Figure 1. -- International technology alliances: sectors



Source: National Science Foundation (2004, Appendix table 4-42)

Figure 2. -- International technology alliances: ownership



Source: National Science Foundation (2004, Appendix table 4-42)