Horizontal Mergers, Innovation and the Competitive Process

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1 Introduction

Recent European Commission merger decisions have revived the debate on the role of innovation in merger control. For example, in the merger decision on Dow/DuPont, the Commission found that the merger would have significantly lessened competition in part due a reduction in the R&D efforts by the merged entity. Similarly, in a number of recent high-profile cases, the US Department of Justice expressed concerns about the loss of innovation competition resulting from a merger between competitors.

The theory of harm put forward by competition authorities in these recent merger cases posits that a merger between rival innovators may lessen competition not only because of a reduction in (static) competition on current products, but also because of a lessening of (dynamic) competition on future products. According to the theory of harm, the loss of future competition may, at least in part, stem from a reduction in innovation.

Some commentators have argued that the findings reached by the competition authorities on the loss of innovation competition due to horizontal mergers are at odds with the insights from the economics literature, which allegedly suggests that the relationship between competition and innovation is ambiguous.

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2 Other recent merger reviews where the European Commission put forward an innovation theory of harm include Deutsche Boerse/NYSE; General Electric/Alstom; and GSK/Novartis Oncology.


4 Recent policy documents and briefs suggesting that the relationship between horizontal mergers and innovation is ambiguous include the GSMA/Frontier Economics report “European Mobile Network Operators Mergers”, 2014; and the RBB Brief “An innovative leap in the theoretical abyss: Dow/DuPont and the Commission's novel theory of harm”, 2017. For a recent summary of this debate see also: “Mergers and innovation: fewer players, more ideas?”. OXERA Agenda, 2017; and R De Coninck, "Innovation in EU merger control: in need of a consistent framework", Competition Law and Policy Debate, 2, 2016. For an earlier discussion of the insights from the literature on competition and innovation and its applicability to merger control, see A Oldale and J Padilla, "For welfare's sake? Balancing rivalry and efficiencies in horizontal mergers", Antitrust Bulletin, 55, 2010.
This article reviews the debate on the relationship between horizontal mergers and innovation. By way of background, Section 2 offers a succinct historical account of economic thinking on the relationship between competition and innovation, and of its relevance for competition policy. Section 3 reviews the insights from the current economic literature on the impact of horizontal mergers on innovation. Section 4 concludes, with some high-level policy implications.

2 Some history of economic thought: competition, rivalry and dynamic efficiency

2.1 From Smith to Arrow

An innovation theory of harm in merger control is premised on a view of competition as a process of rivalry between firms which generates a number of benefits to society and consumers. These benefits include not only static efficiency (i.e. lower prices, for a given set of products), but also productive efficiency (i.e. the attainment of efficient production, for a given set of products), as well as dynamic efficiency (i.e. the introduction of new products or technologies).

The proposition that rivalry between firms fosters dynamic efficiency has a long pedigree in the history of economic thought. It is a concept that can already be found in Adam Smith's *Wealth of Nations*, as noted by McNulty, and discussed by Vickers.5 Alfred Marshall too understood the importance of dynamics in competitive markets.6 Marshall posited that smaller firms were more likely to lead to the advancement of ideas than a system based on large firms ("in a multitude of independent undertakers there is more inventive energy"),7 and that a monopoly producer may not face the right incentive to discover ways to lower its price to the benefit of consumers.8

The idea that a key virtue of capitalism resided in its ability to deliver innovation (in the form of “creative destruction”) was famously discussed by Schumpeter.9 Schumpeter emphasized the importance of dynamic efficiency (in comparison to static efficiency), and noted the desirability of trading-off allocative efficiency with dynamic efficiency. Schumpeter’s central proposition was that the prospect of post-innovation profits (i.e. market power) drives the incentives to innovate in a competitive market. Successful innovation allows a firm to “escape” competition, and attain a situation where it

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6 A Marshall, *Principles of Economics*, 1890. Marshall famously noted that “The Mecca of the economist lies in economic biology rather than in economic dynamics. But biological conceptions are more complex than those of mechanics; a volume on Foundations must therefore give a relatively large place to mechanical analogies; and frequent use is made of the term “equilibrium” which suggests something of statical analogy. This fact, combined with the predominant attention paid in the present volume to the normal conditions of life in the modern age, has suggested the notion that its central idea is “statical,” rather than “dynamical.” But in fact it is concerned throughout with the forces that cause movement and its key-note is that of dynamics, rather than statics” (Preface to the 8th Edition).
8 “But, human nature being what it is, experience has shown that the breaking of a monopoly by the opening out of a competing line accelerates, rather than retards the discovery by the older line that it can afford to carry traffic at lower rates” (Marshall, supra note 6, Book V, Chapter XIV).
can charge a price that is in excess of cost (by restricting its output) and hence earn super-competitive profits. The incentive to innovate would be suppressed in an economy that sought to maximize static allocative efficiency (i.e. set prices equal to cost) at all points in time.\(^{10}\) A degree of temporary market power is therefore required to provide the appropriate reward for innovation. The trade-off between static and dynamic efficiency is the foundation for a system of Intellectual Property Rights.

Schumpeter’s thesis on the determinants of innovation is sometimes relied upon to suggest that increasing competition may reduce the incentives to innovate, by limiting the rewards captured by the successful innovator. The alleged tension between a view of competition as beneficial to innovation and Schumpeter’s arguments is frequently overstated. The primary causal relationship emphasized by Schumpeter flows from innovation to market power, rather than the converse. While it is well-accepted that a degree of static inefficiency is necessary ex-post (i.e. after an innovation is introduced) to stimulate dynamic efficiency, this does not imply that there is a trade-off between competition ex-ante (i.e. before an innovation is introduced) and dynamic efficiency. Schumpeter’s central thesis was that a degree of market power is the necessary reward for innovation, rather than its cause.\(^{11}\) The fact that Schumpeter’s work can be reconciled with a view of (ex-ante) rivalry between firms as beneficial to innovation, in particular if property rights are effective, has been noted by a number of commentators, including Porter, Vickers and Shapiro.\(^{12}\)

Other distinguished economists have argued that competitive markets stimulate productive and dynamic efficiency, including notably Hayek and Arrow.\(^{15}\) Hayek in particular emphasized the importance of competition as dynamic procedure of establishing

\(^{10}\) "A system – any system, economic or other – that at every given point in time fully utilizes its possibilities to the best advantage may yet in the long run be inferior to a system that does so at no given point of time, because the latter’s failure to do so may be a condition for the level or speed of long-run performance" (Schumpeter, supra note 9, Chapter 7).

\(^{11}\) See J Tirole, The theory of Industrial Organization, 1988, chapter 10. Tirole also notes that the other position that is sometimes attributed to Schumpeter (according to which “monopolies are natural breeding grounds for R&D”) is not only controversial, but also not necessarily linked to the existence of market power.

\(^{12}\) M Porter, “Competition and antitrust: towards a productivity-based approach to evaluating mergers and joint ventures”, The Antitrust Bulletin, Winter 2001. Porter notes that “A Schumpeterian focus on innovation is essential, and highly supportive of a move to productivity growth as an antitrust standard”; and “It should be noted that mergers are anti-Schumpeterian. Far from reflecting true innovations, they tend to entrench established companies and temper the rate of innovation occurring in an industry” (p.954).

\(^{13}\) J Vickers, “Competition policy and innovation”. A speech to the International Competition Policy Conference, June 2001. Vickers notes that “The fact that more competition to innovate requires limitation of a kind of product market competition – namely imitation – does not point to a tension between competition and innovation. The trade-off is between kinds of competition, not between competition and something else”; and “By preventing competition in consumption, property rights promote competition in production, which in turn expands the means of consumption” (p.2).

\(^{14}\) C Shapiro, “Competition and innovation. Did Arrow hit the Bull’s Eye?”. Chapter 7 in J Lerner and S Stern (eds.), The rate and direction of inventive activity revisited, 2012

facts and opportunities which otherwise would not be discovered (at least to the same extent).  

2.2 Two concepts of competition

The original notion of competition discussed by Adam Smith and other classical economists rests on a behavioural concept of rivalry between firms. Rivalry induces firms to improve their offering in order to attract customers at the expense of their competitors. Competition is an inherently dynamic process where firms try to gain an advantage over their rivals, generating benefits to consumers not only in the form of lower prices but also greater innovation. Innovation is thus one of the competitive parameters (just like price or quality) that firms can use to gain sales at the expense of their rivals, and to protect their existing sales from their rivals, in order to increase their profits. Competition increases both the rewards from innovating, and the threat from not innovating – thus increasing the overall incentive to innovate. This dynamic process of rivalry is beneficial for consumers, as it encourages firms to offer better deals (e.g. lower prices for existing products, or the introduction of new and improved products).

The notion of competition as a process of rivalry contrasts with a more static view of (perfect) competition as an end-state where allocative efficiency is promoted (i.e. price are close to cost). This alternative concept of competition is silent on whether and how competition contributes to productive and dynamic efficiency. The static view of competition has been historically criticized (notably by Schumpeter and Hayek), in part because of the greater importance that ought to be assigned to dynamic efficiency in comparison to static efficiency. Notwithstanding this criticism, the static notion of competition as an end-state has arguably received greater attention by modern formal economics than the more dynamic view of competition as process of rivalry.

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16 Arrow's seminal contribution on the relationship between competition in the product market and innovation incentives is reviewed in Section 3.2.
17 For a discussion of the notion of competition adopted by Smith and the classical economists see: GJ Stigler, "Perfect competition, historically contemplated", Journal of Political Economy, 65, 1957; PJ McNulty, “A note on the history of perfect competition”, Journal of Political Economy, 75, 1967; and McNulty, supra note 5 (who notes that the classical concept of competition was a ‘behavioural one, the essence of which was the effort of the individual seller to undersell […] his rivals in the market place” (p. 647)).
18 J Vickers, “Competition is for consumers”, A speech to the Social Market Foundation, February 2002. Vickers notes that “Competition is good for consumers for the simple reason that it impels producers to offer deals – lower prices, better quality, new products, and more choice”; and “[…] rivalry benefits consumers both directly in terms of better deals, and further over time as producers strive to increase their efficiency and to come up with new and better ways of doing things” (p. 4).
20 Schumpeter, supra note 9 (chapter 6); and F Hayek, “The meaning of competition”, 1948, reprinted in Econ Journal Watch, 13, 2016 (“‘perfect’ competition means indeed the absence of all competitive activities”, p. 364). The debate on the relative merits of static and dynamic analysis goes back a long way in the history of economic thought, as shown by the correspondence between David Ricardo and Robert Malthus in 1817, as reviewed by Keynes (JM Keynes, Essays in biography, 1951, p. 116-118).
21 Blaug, supra note 19; and M Blaug, Economic Theory in Retrospect, 5th edition, 1996 (Chapter 13, Section 31).
By contrast, competition policy has broadly embraced the “process-view” of competition as a driver of dynamic efficiency. This can be seen for example in how current merger guidelines treat the issue of innovation. The UK merger guidelines explicitly posit that rivalry between firms creates incentives to introduce new and better products. Similarly, the EC merger guidelines state that effective competition benefits consumers by promoting innovation, and that a merger may deprive consumers of this benefit. The US merger guidelines state that “competition often spurs firms to innovate”, and explain in detail how a horizontal merger may lead to a reduction in innovation, absent efficiencies. A similar approach is adopted in antitrust guidelines on horizontal agreements relating to R&D and intellectual property (this is not surprising given the analytical similarities between horizontal agreements and horizontal mergers). In the U.S., early antitrust jurisprudence also appears to have identified the promotion of innovation as one of the key benefits of competition. More generally, policy makers often refer to the promotion of growth and innovation as one of the key justifications not only for competition policy, but also for liberalization policies (e.g. trade liberalization; and deregulation of utilities).

3 Insights from modern economic theory: a tale of three externalities

The historical approach to competition as a dynamic process of rivalry suggests that greater (ex-ante) competition between rival innovators is likely to promote innovation. This stance is generally embraced by competition authorities in their guidelines for the

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22 CC/OFT Merger Assessment Guidelines, 2010 (“Competition is viewed by the Authorities as a process of rivalry between firms seeking to win customers’ business over time by offering them a better deal. Rivalry creates incentives for firms to cut price, increase output, improve quality, enhance efficiency, or introduce new and better products because it provides the opportunity for successful firms to take business away from competitors, and poses the threat that firms will lose business to others if they do not compete successfully” – paragraph 4.1.2). A similar approach is set out in OFT, “Competition and Growth”, OFT1390, 2011.

23 European Commission Horizontal Merger Guidelines, 2004 (paragraph 8).

24 US Horizontal Merger Guidelines, 2010 (Section 6.4).

25 For example, the 2011 EC Guidelines on horizontal co-operation agreements indicate that cooperation between rivals at the R&D stage may restrict competition in innovation, if there is only a limited number of competing alternative R&D “poles” (see Section 3). A similar concern is set out in the 2017 US Guidelines for the Licensing of Intellectual Property, and in the 2014 EC Guidelines on technology transfer agreements. The same is true for earlier version of analogous guidelines, including in the EC the 1984 Block Exemption on R&D Agreements (Regulation 418/85), and in the US the 1984 National Cooperative Research Act and the 1995 US Guidelines for the Licensing of Intellectual Property. For a comprehensive review of relevant guidelines and case practice in the US in the context of the debate the followed the publication of the 1995 US Guidelines for the Licensing of Intellectual Property, see FTC, “Anticipating the 21st Century. Competition Policy in the New High-Tech, Global Marketplace”, 1996 (chapter 7).

26 Hovenkamp finds support in the notion of innovation rivalry in a patent litigation that reached the Supreme Court in 1908 (Paper Bag) – see H Hovenkamp, “Harm to competition under the 2010 horizontal merger guidelines”, Review of Industrial Organization, 39, 2011. Katz and Shelanski refer to the Supreme Court decision of 1916 in Corn Prods. Ref. Co., where Judge Learned Hand wrote that “the consumer’s interest in the long run is quite different from an immediate fall in prices” and spoke of competition as a “proper stimulus to the maintenance of industrial advance” (see M Katz and H Shelanski, “Schumpeterian Competition and Antitrust Policy in High-Tech Markets”, Competition, 14, 2005).

27 See for example DTI, “Productivity and Enterprise, A World Class Competition Regime”, 2001 (which states that “Strong competition is closely linked to dynamic and efficient markets”, p. 2); European Commission, “A proactive competition policy for a competitive Europe”, 2004 (where it is stated that “Effective competition is key to growth in productivity and competitiveness”); and the Obama Executive Order “Steps to increase competition and better inform consumers and workers to support continued growth of the American economy”, 2016.
assessment of horizontal mergers and of horizontal agreements. Is this position supported by the current economic literature on the relationship between competition and innovation? Or is the literature more sceptical on the existence of a positive causal relationship flowing from competition to innovation, as commentators in competition policy sometimes suggest?

Given the extensive nature of the theoretical and empirical literature on competition, it is beyond the scope of this article to provide a comprehensive survey of this literature. It is however feasible to briefly highlight existing theoretical results from this literature that are specifically applicable to horizontal mergers, including the findings of several recent papers. The economic literature suggests that horizontal mergers are likely to affect innovation incentives predominantly through three channels, denoted below as innovation competition, product market competition and appropriability. Each channel corresponds to a distinct externality which may be at work between the merging parties: (a) a negative innovation externality, which the merger internalizes, reducing innovation incentives; (b) a negative pricing externality, which a merger also internalizes, with an ambiguous impact on innovation; and (c) a positive innovation externality (e.g. involuntary knowledge spillovers between rival firms), which would be internalized by a merger, increasing the incentives to innovate. Each channel is reviewed in turn below.

3.1 Innovation competition

Successful innovation enables firms to introduce new products or to improve their current products. This allows the innovating firm to become a more effective competitor, and to capture profitable sales from rival firms. If other firms have not innovated, successful innovation allows the innovator to capture some of the existing sales of its rivals and "escape" existing competition on current products. If other firms have innovated too, by innovating a firm can protect its existing sales from the greater competitive threat posed by its rivals and effectively "catch up" with its rivals. In this second case, product innovation allows a firm to divert profitable sales from rival firms, relative to a counterfactual where that firm does not innovate. Competition in innovation therefore gives rise to a negative externality between competing firms. By investing in innovation, a firm reduces the expected profits that its rivals can expect to make in the product market (for any given level of innovation by rivals).

A merger between rival innovators internalises the innovation externality between the merging firms. After the merger, the common owner of the two firms will take into account the fact that innovation by one of the two firms will reduce the expected profits of the other firm (and vice-versa). This diversion negatively affects both pre-innovation profits (on current products), and post-innovation profits (on future, improved products). This effect is internalized with the merger, increasing the opportunity cost of innovation for each of the merging parties. The higher opportunity cost of innovating unambiguously depresses the innovation incentive of the merging firms.

28 This article does not discuss the empirical literature on the relationship between competition and innovation. For a recent review of the empirical literature see Shapiro, supra note 14; and CMA, "Productivity and competition. A summary of the evidence", 2015.
29 A more complete account of this literature can be found in Annex 4 of the Commission decision on Dow/DuPont (M.7932, Commission Decision of March 27 2017).
30 It is therefore a broader concept than the "cannibalization" of pre-invention profits that is often discussed in the literature (e.g. Arrow, supra note 15).
The innovation externality is similar in nature to the well-known pricing externality behind unilateral effects in price. The main difference is that in the case of the innovation externality the strategic variable that generates the negative pre-merger externality is investment in innovation, rather than a reduction in prices. As for standard unilateral effects in price, the internalisation of the innovation externality is likely to have a more significant impact on innovation if the merger brings together two out of a limited number of significant innovators, and if the merging parties absent the merger would have been likely to divert future sales from each other by successfully innovating in related areas (i.e. the merging parties are "close" innovation competitors).

The observation that a merger dampens the incentives to innovate by suppressing competition between rival firms – and hence internalizing the innovation externality – is closely related to the concept of competition as a dynamic process of rivalry reviewed in Section 2. The internalization of the innovation externality that follows a merger of rivals directly underpins the approach to innovation that is set out in Section 6.4 of the US Horizontal Merger Guidelines, and in part it is also recognized in the EC Horizontal Merger Guidelines.31

The academic literature has identified the innovation externality in different settings, not all of these related to horizontal mergers. For example, the innovation externality is closely linked to the "business stealing" effect discussed by Tirole32, and the externalities noted by Reinganum33 in relation to the literature on patent races. The innovation externality is also at work in models of R&D cooperation – for example D’Aspremont and Jacquemin34 show in a duopoly setting that cooperation at the R&D level reduces innovation (absent knowledge spillovers and also assuming no cooperation in the product market). This reduction in R&D effort is due to the internalization of the innovation externality.

The fact that a merger reduces the incentives to innovate by internalizing an innovation externality is recognised in the recent policy literature on the effects of mergers on innovation. This effect is explicitly noted in Farrell and Shapiro, who rely on the concept of an "innovation diversion ratio" (defined as the fraction of additional profits earned by one of the merging parties when it invests in more innovation which comes at the expense of other merging party).35 This mechanism is also emphasized in several policy contributions on the relationship between competition and innovation.36

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31 The EC Horizontal Merger Guidelines recognise that a merger internalises a pricing externality between merging parties, hence leading to incentives to increase prices (paragraph 24). The guidelines also state that the expression "increased prices" is used as shorthand for other sources of competitive harm, including lower innovation incentives (paragraph 8).
32 Tirole, supra note 11.
33 JF Reinganum, "The timing of innovation", Chapter 14 in R Schmalensee and R Willig (eds.), Handbook of Industrial Organization, 1989. The literature on patent races suggests that greater rivalry in R&D stimulates innovation, but it does not explicitly model mergers.
Some recent papers also formally model the impact of internalization of the innovation externality, together with other possible effects of coordination between rival firms. These papers are reviewed in Section 3.3, which discusses the interaction between the innovation competition and product market competition channels.

3.2 Product market competition

Absent efficiencies, a horizontal merger reduces product market competition between rival firms, by allowing them to coordinate their pricing, and hence internalize the negative pricing externality that is at work pre-merger. The reduction of product market competition affects the incentives to innovate of each firm, working alongside the internalization of the innovation externality. Less intense product market competition increases the profits of the merging firms both if they do not innovate their products, and if they do. If the positive effect of less intense product market competition on pre-innovation profits is greater than its effect on post-innovation profits, a horizontal merger will reduce the incentives to innovate through its impact on product market competition (thus reinforcing the effect resulting from the internalization of the innovation externality). On the other hand, if less intense product market competition boosts post-innovation profits by more than it increases pre-innovation profits, then it increases innovation incentives, mitigating the impact of the innovation externality. The product market competition channel therefore has an ambiguous impact on the incentives to innovate.

The economic literature has analysed the nature of the product market competition channel in a variety of settings. To isolate this channel from the other possible effects of changes of competition on innovation (most notably those resulting from the innovation externality), some economic models have made the restrictive assumption that either there is no competition in innovation (i.e. there is only a monopoly innovator), or that a change in product market competition is not accompanied by changes in competition at the innovation stage. Modelling the product market competition effect in isolation from other possible effects of a merger on innovation can only provide a partial analysis of the impact of a merger between rival innovators. It is nonetheless useful to discuss the nature of the product market competition effect in isolation, in light of its prominence in the policy literature on the relationship between competition and innovation.

Arrow’s seminal contribution is an example of a paper that models the product market competition effect. Arrow considers a monopoly innovator, and compares its incentives to engage in process innovation under the two polar extremes of monopoly and perfect competition in a homogenous product market. In this set up, a switch from perfect competition to monopoly in the product market (i.e. effectively, a merger to monopoly) reduces the incentives to innovate. This follows from the fact that the change from perfect competition to monopoly increases pre-innovation profits by more than it increases post-innovation profits. In this set-up, the move to monopoly suppresses the incentive to innovate in order to "escape competition".

The Arrow result is however not general. For example, in a model with only one innovator and with horizontal product differentiation in the product market, Chen and


37 Arrow, supra note 15.
Schwartz show that a monopolist in the product market faces stronger incentives to introduce a new product in addition to an existing product, both relative to a firm that faces a perfectly competitive fringe in the existing product and (under some conditions) relative to a duopolist in the product market.

In interpreting these results in the context of a merger, it is important to recall that both the models by Arrow and by Chen and Schwartz consider a monopoly in innovation. The results are therefore not directly applicable to a situation where firms compete at the innovation stage, and not just in the product market.

An alternative framework that looks at the impact of changes in product market competition is the step-by-step innovation model due to Aghion, Howitt, and co-authors. Under this framework, two firms each engage in cost-reducing innovation, and then compete in the product market. The intensity of product market competition between the two firms is measured by an exogenous parameter. This modelling approach delivers different results on the impact of changes in the competition parameter on innovation. Aghion et al. (2001) find that, for reasonable numerical parameters, more product market competition stimulates innovation by increasing the incentives faced by firms to escape competition. By contrast, Aghion et al. (2005) find an ambiguous (inverted-U) relationship between competition and innovation. This ambiguous relationship established is due to the fact that under the model’s assumptions, greater product market competition reduces the post-innovation profits of firms that are technology followers, but does not affect their pre-innovation profits (which are assumed to be 0). Greater product market competition hence suppresses innovation incentives for technology followers. At intermediate levels of product market competition this effect dominates the escape-competition effect that firms experience when they share the same level of technology.

The work associated with Aghion and Howitt is frequently cited in the policy debate on competition and innovation as evidence that the relationship between competition and innovation is ambiguous. It is however not possible to draw implications for merger control from this strand of the literature. The Aghion-Howitt framework studies the impact of changes in competition only in the product market, whilst keeping the structure of competition at the innovation stage unchanged. This approach therefore does not incorporate the innovation competition channel (see Section 3.1), which is one of the key effects of a merger between rival innovators.

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41 In Aghion et al. (2001), supra note 40, the competition parameter measures the degree of differentiation between the products of the two competing firms, whilst in Aghion et al. (2005), supra note 40, it measures the extent of (tacit) collusion in the product market.
42 The specific assumptions on the nature of innovation used in the Aghion-Howitt framework and their applicability to competition policy have been criticised (see e.g. R Gilbert, "Looking for Mr. Schumpeter:
3.3 The combined effect of innovation competition and product market competition

A merger simultaneously affects innovation competition and product market competition. The suppression of competition between the merging firms at both stages of competition results in an increase of market power. In order to characterize the overall impact of a merger on innovation incentives through its effect on market power alone (i.e. absent other potential countervailing effects) it is necessary to consider both the innovation competition channel and the product market competition channel at the same time. A number of recent papers shed light on the combined impact of the two channels in the specific contexts of a horizontal merger and/or of coordination between competing firms.

A recent paper by Motta and Tarantino\textsuperscript{43} considers the impact of a horizontal merger on innovation, both in a simultaneous setting (where prices and innovation are set at the same time), and in a sequential set-up (where firms first invest in innovation, and then compete in price). Under a variety of cases, Motta and Tarantino show that – absent efficiencies - a horizontal merger reduces innovation by the merging parties, at the same time as suppressing price competition between them. The reaction by non-merging rivals is not sufficient to offset the reduction of innovation effort by the merging parties. This paper suggests that the combined effect of the innovation externality channel and the product market competition channel negatively affects overall innovation incentives.

A similar result is obtained in the paper by Federico, Langus and Valletti.\textsuperscript{44} This paper models the impact of merger in a sequential setting with uncertain product innovation, and explicitly separates the effects of internalising the innovation externality from the effect of the merger on product market competition. The paper finds, under a range of simulations using standard demand functions, that the product market competition effect stimulates innovation, when considered in isolation. However this effect is dominated by the innovation competition channel, implying that the merger lowers the incentives to innovate of the merging firms, and also reduces overall innovation (absent knowledge spillovers and other possible innovation-related efficiencies).\textsuperscript{45}

Lopez and Vives find analogous effects in a setting with partial coordination between firms due to overlapping ownership links.\textsuperscript{46} Absent knowledge spillovers, Lopez and Vives find that partial coordination between competing firms at both the R&D and product market competition stage, reduces innovation and consumer welfare. This result is consistent with the one obtained by D’Aspremont and Jacquemin in a simpler duopoly set-up.


\textsuperscript{45} See also G Federico, G Langus and T Valletti, “A simple model of mergers and innovation”, Economics Letters, 157, 2017, for a simpler reduced-form model that allows for the derivation of similar analytical results.

\textsuperscript{46} A Lopez and X Vives, “Cross-ownership, R&D spillovers, and antitrust policy”, CESifo working papers N.5935, 2016.
A number of other papers in the literature consider changes in innovation and product market competition more generally, without looking at the specific example of a horizontal merger or a horizontal agreement. For example, Vives considers the impact on innovation of varying the (exogenous) number of competing firms.\textsuperscript{47} A reduction in the number of firms in a market is however not the same as a horizontal merger between two existing firms (which do not cease to operate following a merger, but simply coordinate their activities). It is hence difficult to draw specific competition policy implications from papers on competition and innovation that do not explicitly consider the case of horizontal merger, or horizontal agreements.\textsuperscript{48}

The papers reviewed here suggest that horizontal mergers are likely to reduce the innovation incentives of the merging firms through their impact on market power. From a consumer welfare perspective (which is the traditional focus of competition policy), any harm to consumers due to a merger is not just the result of lower innovation, but also of higher prices. The product market competition channel, by increasing post-innovation prices, reduces the extent to which the benefits of innovation are passed-on to consumers (for any given level of innovation).\textsuperscript{49} Therefore, both the innovation competition and the product market competition channels contribute to the loss of future competition between the merging parties. The interplay of the two channels affects the nature of this loss of competition. It determines in particular whether the loss of future competition manifest itself only or primarily through higher future prices (i.e. a lower pass-on to consumers of the future benefits of innovation), or through a combination of lower innovation effort and less intense future product market competition. The existing economic literature suggests that the second scenario is the more likely one. That is, the merged entity has access to two instruments to internalize competition on future products, and it is likely to use both instruments (reducing innovation efforts \textit{and} increasing post-innovation prices).

\subsection*{3.4 Appropriability}

The third channel through which a merger of rivals may affect innovation incentives relates to the concept of appropriability. Appropriability is consistently defined in the economic literature as the ability by an innovator to capture the social value of its invention by limiting imitation by competing firms (e.g. by preventing knowledge spillovers).\textsuperscript{50} Greater appropriability enhances the incentives to innovate, by allowing the innovator to obtain a higher reward from its invention. By contrast, in an environment with low appropriability firms have an incentive to "free-ride" on each other's innovation, resulting in lower innovation incentives.

\begin{thebibliography}{9}
\bibitem{48} A similar consideration applies to the recent articles by Gilbert, Riis and Riis (R Gilbert, C Riis, and E Riis, "Stepwise innovation by an oligopoly", mimeo, 2017 – this paper extends the Aghion-Howitt framework beyond the duopoly case), and by Marshall and Parra (G Marshall and A Parra, "Mergers in innovative industries: the role of product market competition", mimeo, 2016).
\end{thebibliography}
A merger can affect the degree of appropriability by eliminating the risk of imitation between the two merging parties. Effectively, with imperfect appropriability, there may be a positive innovation externality at work pre-merger between the merging firms which is not being internalized (i.e. Firm A does not take into account the positive impact on Firm B’s profits resulting from its innovation, and vice versa). The merger internalizes this positive externality, thus increasing innovation incentives for the merged entity.

The effect of a merger on appropriability is conceptually distinct from its impact on the market power held by the merging parties. The effects of a merger on innovation due to its impact on market power are instead captured by the innovation and product market competition channels reviewed above.

The scope for mergers or R&D cooperation agreements to increase innovation incentives in the presence of knowledge spillovers is widely noted in the economic literature. For example, the paper by Lopez and Vives considers the case with knowledge spillovers (i.e. imperfect appropriability). The paper shows that if spillovers are sufficiently high cooperation between rival firms may increase innovation efforts and may also increase total welfare (but not necessarily consumer welfare). This result is in line with the earlier literature on R&D cooperation.

Similarly, Motta and Tarantino consider a case where the merger gives rise to "efficiency gains". These are modelled by assuming that the total cost of innovation of the merged entity is reduced (relative to the pre-merger level), by an amount which depends on the innovation effort of each of the merging firms. This can be thought of as a case with voluntary knowledge spillovers that are made possible by a merger, thus increasing post-merger appropriability. The results of the paper suggest that there is an initial threshold level of merger-specific efficiency gains above which a merger may increase innovation effort but still reduce consumer welfare; and a yet higher threshold level above which the merger is not anti-competitive. Effectively, in the latter case, the positive impact of a merger on appropriability offsets the anti-competitive effects of both the innovation and product market competition channels.

More generally, the policy literature has frequently emphasised the fact that the degree of appropriability prevailing in the absence of a merger is an important determinant of the effects of a merger on innovation. The literature notes that a merger of rivals is likely to reduce innovation if appropriability is high absent the merger (e.g. because of effective

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51 This is evident, for example, from the treatment of the issue of appropriability by Arrow, supra note 15: "The only ground for arguing that monopoly may create superior incentives to invent is that appropriability may be greater under monopoly than under competition. Whatever differences may exist in this direction must, of course, still be offset against the monopolist's disincentive created by his preinvention monopoly profits" (p.622).

52 Lopez and Vives, supra note 46.


54 The paper also shows that the presence of involuntary spillovers leads to similar results to the case with efficiency gains.
IP protection, or effective licensing arrangements).\textsuperscript{55} In this case, the merger is unlikely to enhance appropriability, and thus unlikely to increase the incentives to innovate through this channel. More generally, this literature suggests that competition policy and IP policy are complementary instruments to preserve and to promote innovation incentives.

Merger control can recognise the possible countervailing effect of greater appropriability on innovation incentives, as long as the increase of appropriability can be causally attributed to the merger (that is, it cannot be achieved by alternative and less anti-competitive arrangements). This approach is adopted in the US Horizontal Merger Guidelines, which consider the potential effects of a merger on appropriability as an efficiency.\textsuperscript{56} A similar approach is discussed by Gilbert specifically with respect to process innovation.\textsuperscript{57}

A merger may also give rise to pro-competitive effects on innovation that are not properly captured under the appropriability channel. For example, it may increase the productivity of R&D by bringing together complementary R&D assets and/or by enabling cost synergies.\textsuperscript{58} These potential pro-competitive effects are based on traditional efficiency arguments, which are not necessarily specific to innovation.

4 Conclusion: some policy implications

This article has reviewed some of the main insights from the economic literature on the relationship between horizontal mergers and innovation. Economic principles suggest that a merger between rival innovators may harm consumers through its negative impact on future competition (i.e. competition on future, improved, products), as result of both lower innovation effort by the merging parties and higher future prices. An innovation theory of harm in merger control is consistent with the "original" concept of competition as a dynamic process of rivalry, and it is also in line with the approach currently adopted by competition authorities in their policy guidelines. Under this notion of competition, rivalry between firms induces them to offer better deals to customers in the form not only of lower prices, but also of greater innovation. A horizontal merger, by eliminating competition between two rivals, can therefore reduce the incentive to innovate, and generally diminish dynamic competition.

Harm to future competition is more likely to be significant if a merger brings together two out of a limited number of effective innovators in the same R&D trajectory. Under these circumstances, without the merger the two merging firms would have been likely to divert profitable future sales from each other by investing and by competing in new or improved products. This future competition is suppressed by the merger, to the detriment of consumers. An innovation-based theory of harm is more likely to be applicable

\textsuperscript{55} See for example: Shapiro, "Antitrust, innovation and intellectual property", Testimony before the antitrust modernization committee, 2005; Gilbert, supra note 42; Baker, supra note 36; Shapiro, supra note 14; Gilbert and Greene, supra note 36.

\textsuperscript{56} US Horizontal Merger Guidelines, section 10, p. 31 ("The Agencies also consider the ability of the merged firm to appropriate a greater fraction of the benefits resulting from its innovations. Licensing and intellectual property conditions may be important to this enquiry, as they affect the ability of a firm to appropriate the benefits of its innovation").

\textsuperscript{57} See R Gilbert, "Competition and innovation", Chapter 26 in Wayne Dale Collins (eds.), Issues in Competition Law and Policy, ABA Antitrust Section, 2006; see also the discussion of innovation-related merger efficiencies in Gilbert and Greene, supra note 36.

\textsuperscript{58} See Shapiro, supra note 14; and Federico, Langus and Valletti, supra note 44.
if the merger does not give rise to countervailing pre-competitive effects - for example, if the merger does not increase appropriability, or does not lead to cost efficiencies in R&D. Consumer harm is also more likely if the market is characterised by high and durable barriers to entry and expansion in R&D, implying that the loss of dynamic competition due to the merger is unlikely to be mitigated by the response of competing firms (including new entrants).

Contrary to the interpretation that is sometimes put forward in debates on competition policy, economic theory does not suggest that the relationship between horizontal mergers and innovation is generally ambiguous, with no clear guidance for competition policy. On the contrary, the literature reviewed in this paper highlights general principles that can be used both to determine when an innovation theory of harm is more likely to be relevant, and to guide the identification and assessment of the relevant factual evidence. These principles suggest that several elements of the framework that is traditionally associated with the analysis of unilateral effects on prices can be broadly transposed to the assessment of the effects of a merger on innovation and future competition. In particular, concepts that are central to the assessment of static unilateral effects (e.g. market concentration; the degree of closeness between the merging parties; the existence of barriers to entry; and the presence of countervailing efficiencies) are also relevant to the evaluation of an innovation theory of harm. Economic theory also suggests that the impact of a horizontal merger on the appropriability of innovation effort should be an important element of the overall assessment.

An implication of the innovation theory of harm is that the static reduction of competition that follows a merger may understate the overall loss of competition, particularly in markets where innovation is an important competitive parameter. This means that to capture the full competitive impact of a merger, the competition assessment may need to look beyond the current overlaps between the merging parties, i.e. those in relation to existing products or clearly foreseeable future products (e.g. pipeline products in an advanced stage of development). The merger review may also need to consider the likelihood and nature of future competition between the merging parties, on the basis of their R&D activities and innovation capabilities, and those of actual or potential rivals. An understanding of the underlying competitive process that has generated past and current competitive overlaps between the merging parties may be informative to assess the likelihood and nature of possible future competitive overlaps.

Depending on the circumstances of the case, the assessment of the possible loss of dynamic competition due to a merger can be more complex and will by its nature be often less precise than the evaluation of the impact on static price competition. This calls for a careful case-by-case analysis and a degree of caution in reaching conclusions on the significance of the loss of innovation competition that may result from a merger. Key issues of the assessment should include the importance and closeness of the innovation activities of the merging firms, the number and nature of remaining innovators, the extent of barriers to enter innovation competition, and the impact of the merger on appropriability. Despite the potential difficulties of this assessment, in light of the central role played by innovation in stimulating growth and long-term welfare, the impact of a merger on dynamic competition deserves at least as much attention as its static effect on consumer harm.