

INNOVATION CONSIDERATIONS IN HORIZONTAL MERGER CONTROL

Ioannis Kokkoris* & Tommaso Valletti†

ABSTRACT

This paper focuses on the assessment of mergers, and in particular on unilateral effects analysis where innovation plays an important role. The paper discusses the economic theories behind innovation, how we move from the traditional product-by-product market definition to pipeline competition and innovation competition, and discusses the concept of innovation space. The paper provides a structural analysis of unilateral effects in such markets analyzing how competition authorities should assess a transaction where the main theory of harm is based on innovation considerations.

JEL: K21

I. INTRODUCTION

This article focuses on the assessment of mergers in markets where innovation plays an important role. This issue is becoming prevalent in merger enforcement in many jurisdictions and sectors ranging from pharmaceuticals¹ to airport security² and the agrochemical sector.³ Competition authorities as well as the legal community are still developing their approach on considering innovation in light of recent caselaw where innovation was an important consideration for the assessment of the transaction.

New technologies that displace existing markets are also commonly referred to as a form of ‘dynamic competition’ and are contrasted with ‘competition in the market’ or ‘static competition’ where competition mainly takes place on the basis of price and output.⁴ Katz and Shapiro⁵ argue that in those markets where innovation plays a role, the tendency for the market to exhibit rapid innovation means that new products will emerge which can and do upset and even replace the status quo. This tendency is the fuel to the fire of innovation that drives such markets.

Since the authors of this article have mainly worked in Europe, this will also be our focus. But of course the cases we consider are often global in nature, and therefore our considerations extend well beyond the boundaries and case law of Europe. Innovation considerations have always been on the radar of the European Commission (“Commission”) but came to the limelight with recent decisions in the agrochemical sector.⁶ Innovation has been argued to play a fundamental role in the Commission’s goal of increasing growth and investments.⁷ A significant amount of literature has developed over the last few years mainly analyzing the economics of innovation

* Professor, Chair in Law and Economics, Queen Mary University London. Email: i.kokkoris@qmul.ac.uk.

† Professor of Economics, Imperial College Business School. Email: t.valletti@imperial.ac.uk. Tommaso Valletti served as Chief Competition Economist at the European Commission in 2016-19. The opinions expressed in this article are those of the authors alone and do not represent the views of any institution they are affiliated to. The authors would like to thank two anonymous referees as well as Dr Maria Ioannidou (Queen Mary University London) and Professor Pablo Ibanez Colomo (London School of Economics) for their helpful comments and suggestions. All mistakes are solely of the authors.

¹ Indicatively Case COMP/M.7559 *Pfizer/Hospira*, <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32015M7559>; Case COMP/M.7326 *Medtronic/Covidien*, OJ (2015/C 82/01); Case COMP/M.1846 *Glaxo Wellcome/Smithkline Beecham*, OJ (2000/C 170/06); Case COMP/M.7275 *Novartis/GlaxoSmithKline’s Oncology Business*, <https://eur-lex.europa.eu/search.html?qid=1557923373482&text=COMP/M.7275&scope=EURLLEX&type=quick&lang=en>; Case COMP/M.1806 *AstraZeneca/Novartis*, OJ (L 110, 16.4.2004), p. 1–72; Case COMP/M. 8523 *BD/Bard*, <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1557923493717&uri=CELEX:32017M8523>; Case COMP/M.5865 *Teva/Ratiopharm*, <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32010M5865&qid=1557923549459&from=EN>; Case COMP/M.6613 *Watson/Actavis*, <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32012M6613&qid=1557923593436&from=EN> and Case COMP/M.7379 *Mylan/Abbott*, <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1557923652692&uri=CELEX:32015M7379>.

² Indicatively Case M.8087 *Smiths/Morpho*, <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1557923652692&uri=CELEX:32015M7379>.

³ Indicatively Case COMP/M.7932 *Dow/Dupont*, <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1557923732483&uri=CELEX:32017M8440>; Case COMP M.2547 *Bayer/Aventis Crop Science*, OJ (L 107, 15.4.2004), p. 1–136; Case COMP/M.8084 *Bayer/Monsanto*, OJ (C 459, 20.12.2018), p. 10–23; Case COMP/M.7962 *ChemChina/Syngenta*, OJ (C 186, 10.6.2017), p. 8–12.

⁴ Graef I., S. Y. Wahyuningtyas and P. Valcke, *How Google and others upset competition analysis disruptive innovation and European competition law*, 25th European Regional Conference of the International Telecommunications Society (ITS), Brussels, Belgium, 22-25 June 2014, <http://hdl.handle.net/10419/101378>.

⁵ Katz M., and C. Shapiro, *Systems Competition and Network Effects* 8(2) *Journal of Economic Perspectives*, 93 (1994).

⁶ Case COMP/M. 7932 *Dow/Dupont*; Case COMP M.2547 *Bayer/Aventis Crop Science*; Case COMP/M.8084 *Bayer/Monsanto*; Case COMP/M.7962 *ChemChina/Syngenta*, *supra* note 3.

⁷ *Priority Jobs, Growth And Investment Stimulating Investment For The Purpose Of Job Creation (European Commission, 2017)* https://ec.europa.eu/commission/priorities/jobs-growth-and-investment_en.

considerations in merger enforcement.⁸ Between 2015 and 2017 the Commission intervened in 73 cases out of 1070 merger notifications with innovation concerns being identified in 10 cases, usually in addition to static price concerns.⁹ In this limited, albeit influential caselaw, we can identify an innovation theory of harm.

The remainder of the article is organized as follows. The first two sections of the article will discuss the economic theories behind innovation and the recent debate in the economic literature on the effects of a merger on innovation incentives. The following two sections will discuss the introduction of innovation in enforcement guidelines and the approach the Commission has taken in its enforcement. The article will then discuss how we move from the traditional product-by-product market definition to pipeline competition and innovation competition. The focus will then turn on providing a structural analysis of unilateral effects in such markets analyzing also how competition authorities should assess a transaction where there is no product or pipeline overlap. Finally, the article will discuss the appropriate type and scope of remedies in such mergers and how an efficiency defense can incorporate technological spillovers that can arise from innovation.

II. ECONOMIC LITERATURE ON THE IMPACT OF COMPETITION ON INNOVATION INCENTIVES

The economic literature has identified forms of innovation such as product and process innovation.¹⁰ Product innovation relates to when specific goods or services are introduced in the market for the first time or are significantly improved from the ones pre-existing in the market with respect to their characteristics or intended uses. Process innovation is the implementation of a new or significantly improved production or delivery method.¹¹

Schumpeter¹² claimed that innovation increases when there is a prospect of market power. He argued that decreased competition in a market *ex post* leads to more innovation *ex ante*.¹³ He dismissed perfect competition at every point time as a system that can spur innovation, stressing the importance of *temporary* market power as a reward to successful innovation. Schumpeter thus focused on the market structure *after* innovation. Arrow¹⁴ in turn concentrated the analysis on the situation *before* innovation, and showed that competitive pressure in the market leads to innovation growth since companies in a competitive market would intend to generate better or more cost-efficient products to attract customers. A monopolist instead has an interest in protecting the status quo and is less likely to be the initiator of a disruption. This is different from a company investing on innovation that would be able to attract market share from its rivals, and hence increase its innovation incentives. Arrow thus argued that an increase in competition in the market leads to more innovation.¹⁵

Although there are many schools of thought on the relationship between innovation and competition, the two most influential contributions in the recent debate are possibly Aghion's and Shapiro's. Aghion's work with co-authors¹⁶ distinguishes between neck-and-neck firms which are technologically on par such that the sector is "levelled", and an "unlevelled" sector where a technologically advanced firm is one step ahead of a laggard firm.

Aghion et al.'s theory results in an inverted 'U' curve between competition and innovation.¹⁷ If competition in the sector is initially very low, an increase in product market competition will induce faster growth (i.e. higher rates of innovation). In a low competition environment, the industry will be mostly in a levelled state. If the industry is unlevelled, innovation will increase rapidly, and the industry will return to a levelled state. Conversely, if competition is initially high, a further increase in competition will slow the innovation rate. Here, the industry will be in an unlevelled state in equilibrium since there is little incentive for a laggard firm to innovate, and if the industry is levelled, the large incremental profits from innovation will spur innovation and return the industry to an unlevelled state.

⁸ The article will discuss below the most influential literature.

⁹ Mosso C.E., *Innovation in EU Merger Control*, Remarks prepared for the 66th ABA Section of Antitrust Law Spring Meeting, Washington. Six cases related the pharmaceutical and medical devices industries: Case COMP/M. 8523 *BD/Bard*, *supra* note 1; Case COMP/M.8401 *J&J/Actelion*, <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1557929326550&uri=CELEX:32017M8401>; Case/COMP M.7917 *Boehringer Ingelheim/Sanofi Animal Health Business*, <https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1557929392115&uri=CELEX:32016M7917>; Case COMP/M7275 *Novartis/GSK Oncology Business*; Case COMP/M.7559 *Pfizer/Hospira*; Case COMP/M.7326 *Medtronic/Covidien*, *supra* note 1. Two were industrial mergers: Case COMP/M.7278 *General Electric/Alstom*, OJ (2017/C 139/04), and Case COMP/M. 7477 *Halliburton/Baker Hughes*, OJ (2016/C 17/01); Case COMP/M.7932 *Dow/DuPont*, *supra* note 3; and Case COMP/M. 8222 *Knorr-Bremse/Haldex*, OJ (2017/C 332/01).

¹⁰ Competition Directorate-General of the European Commission, *Competition policy brief* (2016) [hereinafter DG COMP *Competition policy brief*]

<http://ec.europa.eu/competition/publications/cpb/2016/2016_001_en.pdf. See also Scotchmer S., *Innovation and Incentives*, MIT Press, 2006

¹¹ *Id.*

¹² Schumpeter J.A., *Capitalism, Socialism and Democracy* (1st ed., 1942).

¹³ *Id.*

¹⁴ Arrow K., *Economic Welfare and the Allocation of Resources for Invention in The Rate and Direction of Inventive Activity* (R.R Nelson ed., Princeton University Press, 1962).

¹⁵ DG COMP *Competition policy brief*, *supra* note 10.

¹⁶ Aghion, P., N. Bloom, R. Blundell, R. Griffith and P. Howitt, *Competition and Innovation: An Inverted-U Relationship*, Quarterly Journal of Economics 120(2): 701–28 (2005).

¹⁷ *Id.*

Shapiro's work¹⁸ on innovation is based on three main principles. *First*, markets must be contestable for innovation to flourish. This creates incentive for firms to innovate and increase or establish their presence in the relevant markets. Drawing on Schumpeterian thought and the notion of market evolution and competition relating to a process of so-called "creative destruction" that threatens the very basis of survival and existence of market participants (firms),¹⁹ it stands to reason that drastic innovation makes market leadership highly contestable.²⁰

Market contestability in turn is predicated on the following factors: low sunk costs, low switching costs, low brand loyalty and access to technology for new entrants. To determine whether the market that we are concerned with is contestable competition authorities can look at the following factors:

- Are sunk costs typically high in the industry?
- What are the switching costs?
- Are there persistently supernormal profits?
- What is the extent of brand loyalty?
- What is the extent of vertical integration which may impede new firms from entering?
- Is there sufficient access to technology for new firms entering the market?
- How easily do companies license their technologies to each other?
- What incentives are there to cross-license and to license to new market players?

The degree of contestability affects the ability of the firm to take market share away from its competitors. If a new product can draw market share, then the market exhibits a degree of contestability. The Commission notes that a merger between two rival innovators in a concentrated market would lower contestability rather than increase the ability of a firm to capture value from its innovations, as the rivalry between the two innovators is lost, and will thus harm the innovation incentives of the parties.²¹ In the absence of rival pressure on innovation efforts, the impact of cannibalization is likely to reduce the innovation efforts. This reasoning appeared in several cases including *Seagate/Samsung*,²² *Western Digital/Viviti*,²³ *Deutsche Borse/NYSE*,²⁴ *Halliburton/Baker Hughes*,²⁵ *Applied Materials/Tokyo Electron*²⁶ and importantly, *Dow/DuPont*.²⁷

Second, increased appropriability (which denotes the ability for a firm to capture value from its innovation and the ability to protect the competitive advantage associated with it) increases innovation. Shapiro's second principle is that successful R&D must be sufficiently protected by intellectual property laws to allow the inventor to reap benefits or attain some form of competitive advantage as a result of that R&D activity. Appropriability therefore refers to the ability of firms to capture rents stemming from innovative products as an incentive for firms to innovate. The Commission notes that a merger between two of a limited number of firms that compete to introduce rival innovative products would typically not increase appropriability. This is because appropriability is dictated by the regime of intellectual property rights, which is largely invariant to a proposed merger transaction, while the rivalry between the two innovators is lost with a merger, thereby harming innovation incentives.²⁸

Third, synergies arising from complementary R&D assets enhance the ability to innovate. The previous two principles are concerned with the *incentives* to innovate, while the synergies principle is concerned with the *ability* to innovate. This principle is particularly important in industries where value is created by systems that incorporate multiple components or where some firms cannot innovate in isolation. In these scenarios, horizontal mergers may improve the ability of the merged entity to innovate in particular if they bring together assets that are complementary, and whose complementarity could not be exploited absent the merger.

The overarching aim of Shapiro's analysis is to determine whether the decreased incentives to innovate post-merger are outweighed by an increased ability to innovate. Although synergies are likely to arise, defining them is inherently challenging. Since it is generally difficult for parties to prove that there will be an increased ability to innovate post-merger, the parties will have to show that there is not going to be a significant decrease in incentives to innovate. The work by Aghion and Shapiro outlined above has provided the bedrock of the analysis of innovation considerations. Although Aghion and Shapiro's approaches might appear at times in tension with each other, both represent a movement away from a narrow, pipeline-to-product market competition assessment approach. There have been a number of extensions in the analysis of innovation that has led to more recent papers

¹⁸ Shapiro C., *Competition and Innovation: Did Arrow Hit the Bull's Eye?*, in The Rate and Direction of Inventive Activity Revisited 361 (J. Lerner and S. Stern eds., 2012).

¹⁹ Schumpeter J.A. *supra* note 12, at 84.

²⁰ Geradin D. and C. Ahlborn and V. Denicolò, and J. Padilla, *DG Comp's Discussion Paper on Article 82 Implications of the Proposed Framework and Antitrust Rules for Dynamically Competitive Industries* (March 2006), at. 15, available at SSRN <<http://ssrn.com/abstract=894466>>.

²¹ Case COMP/M. 7932 *Dow/Dupont*, *supra* note 3, at paragraph 2112.

²² Case COMP/M.6214 *Seagate/ HDD Business of Samsung*, (summary) OJ (C 154, 31.5.2012), p. 8–12.

²³ Case COMP/M.6203 *Western Digital Ireland/ Viviti Technologies*, (summary) OJ (C 241, 22.8.2013), p. 11–18.

²⁴ Case COMP/M.6166 *Deutsche Borse/NYSE*, (summary) OJ (2014/C 254/06).

²⁵ Case COMP/M.7477 *Halliburton/Baker Hughes*, *supra* note 9.

²⁶ *Applied Materials/Tokyo Electron*, <https://www.justice.gov/opa/pr/applied-materials-inc-and-tokyo-electron-ltd-abandon-merger-plans-after-justice-department>.

²⁷ Case COMP/M. 7932 *Dow/Dupont*, *supra* note 3.

²⁸ *Id.*, paragraph 136.

that have advanced the debate on innovation and have expanded our understanding of how competition authorities should incorporate innovation in their merger assessment. These are reviewed next.

III. THE RECENT DEBATE AMONGST ECONOMISTS

The debate around mergers and innovation has been much revamped recently amongst economists, also in the context of current merger waves in mobile telecommunications and in the agrochemical industry. Papers have emerged formalizing the main economic forces at play that will be discussed in this section. Possibly, the most important point made by this latest literature is to re-focus the attention on mergers. While the earlier literature that we reviewed in the previous section is of course relevant to think about related issues, such as innovation and market structure, it has become apparent that one could not generalise those results easily in a merger context.²⁹

Recent contributions in the economics literature do precisely this: they shy away from more general but also generic characterizations and ask instead the more specific question of what happens in an industry, before and after a merger, when innovation is an important parameter of competition alongside other choice variables such as prices. In this sense, there is an effect on innovation competition that is very much like the diversion effect that is at the heart of the analysis of unilateral effects on price competition.³⁰ If additional investment in R&D by a firm, say, reduces the expected profits of a rival (and vice versa), because it drives customers away, then a merger between these two firms internalizes this negative externality, leading to less investment in R&D. This is not the only effect, though an important one, as discussed by the contribution that we review below.³¹

Motta and Tarantino (2017)³² consider the effects of mergers on innovation using different models. In their approach, innovation is deterministic, and they consider process innovation: higher expenditures lead to a certain reduction in the costs of production. In their main model, firms play a simultaneous game where prices and investments are chosen at the same time. In this setting results are clear. R&D investment follows quantities in the final product market: as a merger typically increases prices and reduces output, R&D will fall as well. This result is valid for the merger insiders, while the outsiders react to this by increasing their R&D and output, but not enough to compensate for the adverse effects coming from the insiders. When R&D and prices are chosen sequentially instead of simultaneously, the analysis gets more involved. By way of employing some specific demand functions and a range of parameter values, they show that R&D investment and consumer surplus is also reduced by a merger in this extension of their framework. They also show that, in case efficiencies are achieved by a merger, and in case these are substantial, the result can be reversed.³³

Federico et al. (2017, 2018)³⁴ reach very similar conclusions in a different model of probabilistic (stochastic) product innovation. Federico et al. (2017) consider a model where innovation is ex novo, and all firms can eventually produce the very same product if they are successful.³⁵ Federico et al. (2018) extend this framework to

²⁹ For instance, the theoretical framework of Aghion et al. (2005) when considering changes in the intensity of competition, basically varies some uniform conduct parameter which is common industry-wide. While this could be relevant, for instance, in the case of coordinated effects, this is not the typical starting point in a merger assessment. In a merger, a fundamental channel comes from the unilateral effects of the merging parties, as opposed to the outsiders to the merger. Therefore, it is very difficult to distil the merger implications from Aghion et al. (2005), which instead should be read more as a contribution which is informative to think, for instance, about the strength of IPRs, or the effects of globalisation. See Aghion, P. et al., *supra* note 16. Similarly, Aghion et al. (2001) proxy competition by a symmetric change in an industry-wide parameter of product differentiation. See Aghion, Philippe, Christopher Harris, Peter Howitt, and John Vickers *Competition, Imitation and Growth with Step-by-Step Innovation*, *Review of Economic Studies* 68:467–92 (2001). See also Vives, *Innovation and Competitive Pressure*, *Journal of Industrial Economics* 61:419–69 (2008), and Lopez and Vives, *Overlapping Ownership, R&D Spillovers, and Antitrust Policy*, *Journal of Political Economy* (2018), for approaches along these lines.

³⁰ Farrell and Shapiro, *Antitrust Evaluation of Horizontal Mergers: An Economic Alternative to Market Definition*, B. E. *Journal of Theoretical Economics* 10, Article 9, (2010).

³¹ We cannot review the entire economics literature but focus on the papers that have spurred the most recent debate. We also nevertheless mention here important contributions by Chen and Schwartz, *Product innovation incentives: monopoly vs. competition*, *Journal of Economics & Management Strategy*, 22 (3): 513–528 (2013), who compare a monopoly with a duopoly, and of Letina, *The Road not Taken: Competition and the R&D Portfolio*, *RAND Journal of Economics* 47(2): 433–460 (2016) who shows that a merger decreases the amount of duplicative research and also the variety of developed projects, harming consumers. As for empirical contributions, M. Igami and K. Uetake, *Mergers, Innovation, and Entry-Exit Dynamics: Consolidation of the Hard Disk Drive Industry, 1996–2016*, (2019), *Review of Economic Studies*, consider a dynamic merger framework that is applied to recent mergers in the hard-disk drive industry. They find that mergers in concentrated industries reduce R&D. Related research by Cunningham et al. (2019) document the phenomenon of “killer acquisitions”, whereby incumbent pharmaceutical companies buy smaller target companies just to discontinue the target’s innovative pipeline and prevent future competition. Cunningham, C., F. Ederer and S. Ma, “Killer Acquisitions” (2019). For a discussion more specific to the tech sector, see Motta, M. and M. Peitz (2020), “Big Tech Mergers,” CEPR Discussion paper 14353.

³² Motta, M. and E. Tarantino, *The effect of horizontal mergers, when firms compete in prices and investments*, Working Paper 1579, Department of Economics and Business, UPF (2017).

³³ The paper of Motta and Tarantino (2017) is particularly specific to mobile mergers. In this context, they show that, when efficiencies can also be achieved by contractual solutions such as network sharing, the merger could still be challenged as less restrictive contractual solutions would be available to reach the efficiency gains without reducing price competition.

³⁴ Federico, G., G. Langus and T. Valletti, *A simple model of mergers and innovation*, *Economics Letters*, 157: 136–140 (2017) [hereinafter Federico et al., *A simple model*]; Federico, G., G. Langus and T. Valletti, *Horizontal mergers and product innovation*, *International Journal of Industrial Organization*, 59: 1–23 (2018) [hereinafter Federico et al., *Horizontal Mergers*].

³⁵ See also Gilbert, R., *Competition, Mergers and R&D Diversity*, *Review of Industrial Organization* (2019) for a related model.

a setting where firms start with baseline existing differentiated products that can be improved by innovating. In both contributions, innovation is probabilistic, in the sense that by spending increasingly more a firm can improve the probability of achieving a successful innovation. Firms play a two-stage game, where price competition follows an initial stage where innovation is chosen. The difference between the expected profits a firm will realise in the second stage if it innovates and the expected profit it will get if it does not, drives the marginal gains from R&D in the first stage.³⁶

Federico et al. (2017, 2018) show that the overall impact from a merger on innovation will arise from two effects. First, there is an “innovation externality” (or business stealing effect). In their models, an increase in R&D expenditures by one firm always reduces the expected profits of its rivals. This negative externality would be internalized following a merger, leading unambiguously in a reduction in post-merger R&D efforts, all else equal.

Second, merged firms will be able to coordinate the prices of the portfolio of goods they have. However, this is true over their entire set of products, including those where the merging firms do not innovate. Federico et al. (2018)³⁷ call this the “price coordination” effect. If the merger increases pre-innovation profits in the product market by more than it increases post-innovation profits, price coordination introduces a downward pressure on the merging firms’ incentive to innovate. If the converse is true, it exerts an upward pressure. Thus, in theory, this effect could go either way as far as innovation is concerned.³⁸ Federico et al. (2018)³⁹ use demand functions such that this price coordination channel effect is always positive, so that – again in theory – it could be a proper countervailing force to the innovation externality (this positive price coordination effect after a merger is assumed at the outset in Federico et al., 2017⁴⁰). The model has complexities, and Federico et al. (2018)⁴¹ resort to numerical parameterization: for the parameter ranges that they consider, they find that the innovation externality prevails and outweighs the price coordination channel. R&D investment by the rivals increases, but never enough to compensate the loss arising from the merged parties. Finally, and similar to Motta and Tarantino (2017),⁴² Federico et al. (2018)⁴³ show that the innovation result can be reversed if there are sufficiently high merger-related efficiency gains (in particular, they consider improvements in the effectiveness of innovation and reductions in R&D costs). As for consumer surplus, since the merger always comes with higher future prices, these efficiency gains have to be strong to flip the result.

Denicolo’ and Polo (2018)⁴⁴ and Bourreau et al. (2018)⁴⁵ have responded with rejoinders whose purpose is, to some extent, to cast doubts on the general validity of the findings of Federico et al. (2017 and 2018).⁴⁶

Denicolo’ and Polo (2018)⁴⁷ take stance with Federico et al. (2017)⁴⁸ but do not refer to Federico et al. (2018).⁴⁹ In particular, they question the R&D cost function employed by Federico et al. (2017),⁵⁰ which is assumed to be sufficiently convex, that is, innovation becomes progressively harder and more expensive to achieve. For instance, going from a 10% to a 20% likelihood of success implies that the firm should considerably more than double its expenditures in R&D. If instead the cost function does not rise very fast, it is possible that there could be R&D coordination between the merging parties such that “corner” instead of “interior” equilibria could arise after a merger. For instance, instead of carrying two research labs doing their research in parallel, a merged firm could shut down one lab, and concentrate all its efforts on one lab only, even going above the pre-merger level of R&D expenditures. This is an interesting point, and we elaborate below on its practical implications.⁵¹ We note however several words of caution about the approach of Denicolo’ and Polo (2018).⁵² First, they analyze only a merger to monopoly, and it is not clear how their result generalizes beyond this limiting

³⁶ The sequential setting where investment is chosen first, followed by price competition, arises from the long-term nature of investment decisions and seems a more natural setting than games with simultaneous choices of investment and prices. The latter however could be relevant when investment choices are unobserved by rivals.

³⁷ Federico et al., *A simple Model supra* note 34.

³⁸ Instead, consumers are always worse-off after a merger, for a given level of innovation, because prices will go up.

³⁹ Federico et al., *Horizontal mergers supra* note 34.

⁴⁰ Federico et al., *A simple model supra* note 34.

⁴¹ Federico et al., *Horizontal mergers supra* note 34.

⁴² Motta, M. and E. Tarantino *supra* note 32.

⁴³ Federico et al., *Horizontal mergers supra* note 34.

⁴⁴ Denicolo’ V. and M. Polo, *Duplicative research, mergers and innovation*, Economics Letters, 166: 56-59 (2018).

⁴⁵ Bourreau, M., Jullien, B. and Y. Lefouili, *Mergers and Demand-Enhancing Innovation* (2018), mimeo.

⁴⁶ These authors have also published quite vocal policy papers that we do not review here. They disclose that all their work has been funded by law firms and economic consultancies working for the industry.

⁴⁷ Denicolo’ V. and M. Polo *supra* note 44.

⁴⁸ Federico et al., *A simple model supra* note 34.

⁴⁹ Federico et al., *Horizontal mergers supra* note 34.

⁵⁰ Federico et al., *A simple model supra* note 34.

⁵¹ We note that the relevance of asymmetric outcomes on R&D effort has been long discussed in the literature on R&D joint ventures that started with d’Aspremont, C. and A. Jacquemin, *Cooperative and noncooperative R&D in duopoly with spillovers*, American Economic Review, 78(5): 1133-1137 (1988). While there is a debate as to when interior versus corner equilibria apply in practice (see, e.g., Leahy, D. and J.P. Neary, *Symmetric research joint ventures: cooperative substitutes and complements*, International Journal of Industrial Organization, 23: 381-339 (2005)), this discussion has sharpened our understanding but certainly not diminished the importance and policy impact of the seminal work of d’Aspremont and Jacquemin (1988).

⁵² Denicolo’ V. and M. Polo *supra* note 44.

case. This is a fundamental point, as with more than two firms the R&D coordination effect for the merged parties becomes much diluted. Second, they completely mute the price competition channel as they assume that all firms in the industry are colluding, so there is no price reduction benefit for consumers. Third, they look only at the impact of the merger on innovation, while one should ultimately be interested in the overall effect on consumers, that they do not consider. Fourth, they actually show that the results of Federico et al. (2017)⁵³ hold generally true if the R&D cost function is sufficiently convex.

Bourreau et al. (2018)⁵⁴ investigate the impact of horizontal mergers on firms' incentives to invest in demand-enhancing innovation in a rather general framework. Their work is more directly related to Federico et al. (2018),⁵⁵ although they consider a simultaneous rather than a sequential move setting. They show that the results of Federico et al. (2018)⁵⁶ actually generalize to some rather wide class of models that are customarily employed in the literature in Industrial Organization: hedonic price model, quality-adjusted models, and CES. Results instead change when they introduce a "demand expansion effect". This means that R&D efforts conducted by one firm would actually *increase*, rather than decrease, the demand for the products of its rivals. In this case, their setting is one with *positive* instead of negative R&D externalities among firms which, after the merger, get internalized. It is therefore not surprising that, after a merger, there can be more innovation.⁵⁷

Given the novelty of the contributions just discussed above, in the Annex we present a simple stylised pedagogical model of a merger from a duopoly to monopoly that illustrates analytically several of the points discussed above.

Having reviewed the economics literature, can one summarise the findings from the economics debate? While it is difficult to be unbiased, as one of the authors to this article is a co-author of articles that have recently ignited the debate and caught the attention of the antitrust community, we believe it is nevertheless possible to highlight the areas of agreement and disagreement amongst economists.

First, it seems untenable to claim, as done by some commentators, that simply the prospect of higher prices following a merger will be enough to have a positive effect on innovation.

Second, it is equally untenable that R&D, being by definition an uncertain process, cannot and should not be assessed. A different variation of this claim is that authorities should only look, for instance, at pipelines in pharmaceutical mergers that are very likely to be developed into final products (the "D" leg in R&D), while one should stay away from basic research that is highly uncertain (the "R" leg in R&D). Essentially this is equivalent to the claim that innovation should not ever be assessed. Instead, we believe that there is no economic rationale for not looking into it. While there are additional difficulties of course with the measurement and with the standard and burden of proof, in some industries innovation is at the very core of competition and therefore should be part of a merger assessment. The key concept that has to be understood is that authorities are not predicting winners, or successful products. Rather, they should assess how innovative efforts affect expected profits, and this can be sufficient to conduct a meaningful analysis. If, for instance, basic R&D has a small but predictable probability of being successful, say 10%, then expected profits can be calculated on this basis, as well as the impact on ex ante innovation competition in light of such expected profits.

Third, the economic framework has identified two main channels that capture the economic forces at play: the innovation externality channel (which is always negative for a merger compared to pre-merger) and the price coordination channel (which may reinforce or dilute the former).

Fourth, innovation is important, but one should never forget that ultimately it is the impact on consumers that needs to be evaluated. When the price coordination channel spurs innovation after a merger, this ex post increase in price makes it unlikely that consumers will be able to reap the benefits from higher innovation as a good part of their surplus will be extracted by the merging parties.

Fifth, one should distinguish between models where R&D drives profits *away* from rivals, as opposed to models where innovation instead *expands* profits of rivals. It is important not to confound differences in results arising from these very fundamental different approaches to modelling innovation. An important source of such complementarities is the one of knowledge spillovers. These are likely to play a role where protection of IPRs is weak, or where licensing is very imperfect.

Sixth, and related to the previous point, various efficiencies can improve the merger effects (but of course, they would need to be merger specific). One of such efficiencies could be the ability to organize internally R&D more efficiently (as long as this cannot be achieved, say, by licensing). This is the point of Denicolo' and Polo (2018).⁵⁸ Our personal view is that their result (which, as discussed above, is based so far on an example not easily generalizable) depends on a detailed knowledge of the concavity of the R&D cost function. We can hardly imagine

⁵³ Federico et al., *A simple model supra* note 34.

⁵⁴ Bourreau et al. *supra* note 45.

⁵⁵ Federico et al., *Horizontal mergers supra* note 34.

⁵⁶ *Id.*

⁵⁷ Bourreau et al. (2018), see *supra* note 45, make this point by way of a Hotelling example with two firms that is not easy to generalise beyond duopoly.

⁵⁸ Denicolo' V. and M. Polo *supra* note 44. See also Denicolo' and Polo, *The Innovation Theory of Harm: An Appraisal*, *Antitrust Law Journal* (2019).

how this cannot be part of the usual efficiency defense, with the burden of proof been shifted to the merging parties. It is something that deeply depends on inside industry knowledge that only the parties can have and should therefore be able to demonstrate in front of competition authorities.

Ultimately, there is no unique presumption from the economics literature that mergers are bad for innovation and consumers. Still, the economics literature can guide enforcers in their policy choices. On balance of the available literature that has emerged in recent years, we conclude that it is reasonable for competition authorities to begin their analysis with the guiding principle that, in the absence of merger-related efficiencies or uninternalized positive externalities, a horizontal merger is unlikely to have positive effects on innovation incentives. Conversely, they should not be receptive with the starting argument that mergers are good for innovation, even if there are no merger-related efficiencies. This is overall a very unlikely occurrence.

IV. UNILATERAL EFFECTS ANALYSIS IN MERGERS IN INNOVATION MARKETS

The EU Horizontal Merger Guidelines (“EU Guidelines”)⁵⁹ explicitly mention innovation as a potential benefit of competition and one that can be harmed by a merger.⁶⁰ In the EU Non-Horizontal Merger Guidelines similar considerations are included⁶¹ as is the case with the US and UK Horizontal Merger Guidelines.⁶² Thus, the approach in both US and EU is very similar when it comes to the assessment of mergers in innovative markets. A difference in the scope between the EU and US guidelines is that the effects on competitors’ innovation incentives or the concerned industry’s competition and innovation dynamics are not mentioned in the US merger guidelines.⁶³

Broadly speaking, competition authorities will be concerned about mergers that would reduce actual and/or potential competition in an existing market, as well as mergers that could reduce competition in a future market, one that at the moment of the assessment does not yet exist. Even if the current products of the two merging parties do not overlap, each of the parties may still be an important innovator in a market where the other is an existing or a potential supplier and with that there is a negative externality of business stealing from innovation between the merging parties.⁶⁴ Mergers where the parties will compete on the basis of their innovation efforts arise when there is a link between the R&D efforts and a specific product/service. Mergers in the pharmaceutical sector is an example of such cases where what matters is the impact on innovation and the resulting future competition rather than actual competition.⁶⁵ In these cases, a merger will eliminate competitive constraints between the parties in relation to an existing product/service but will also impact their innovation efforts for a future product/service.

If innovation competition is important in a market, the future competition of the merging parties can be in products that do not currently exist in their portfolios. A merger between two innovators that leads to a discontinuation of a research pipeline leads to an adverse impact in the post-merger market as on the one hand the variety and choice is reduced from the discontinuation of the research activities but also due to the lack of price competition in the post-merger market. It may be the case that merging parties exert a significant competitive constraint on each other in a market for the commercialized product of their respective innovation efforts and as a result of the merger they will reduce the combined innovation efforts or eliminate one of the R&D streams.⁶⁶ Parallel research paths accelerate innovation if there is uncertainty about the solution to a specific technological program.⁶⁷

⁵⁹ Guidelines on the assessment of horizontal mergers under the Council Regulation on the control of concentrations between undertakings, OJ (C 31, 5.2.2004), p. 5–18.

⁶⁰ *Effective competition brings benefits to consumers, ...innovation. Through its control of mergers, the Commission prevents mergers that would be likely to deprive customers of these benefits by significantly increasing the market power of firms. By "increased market power" is meant the ability of one or more firms to... diminish innovation ...* The EU Guidelines explicitly outline an innovation theory of harm and also incorporate a “maverick” consideration relevant for innovation markets by stating that *a firm with a relatively small market share may nevertheless be an important competitive force if it has promising pipeline products.* According to the EU Merger Guidelines a “maverick” firm has a history of preventing or disrupting coordination, for example by failing to follow price increases by its competitors, or has characteristics that gives it an incentive to favour different strategic choices than its coordinating competitors would prefer. Similar features apply to a firm that adopts a strong competitive position in a market. A merger/acquisition that affects this dynamism can be harmful for competition irrespective of its potential small market share in the market. In such circumstances, the market share of a firm understates its dynamism and its beneficial impact to sustaining competition in the market.

⁶¹ Guidelines on the assessment of non-horizontal mergers under the Council Regulation on the control of concentrations between undertakings, OJ C 265, 18.10.2008, paragraphs 10 and 26.

⁶² U.S. Horizontal Merger Guidelines, August 2010, § 6.4 (<https://www.justice.gov/atr/horizontal-merger-guidelines-08192010>); Merger Assessment Guidelines (A joint publication of the Competition Commission and the Office of Fair Trading), CC2 (Revised) / OFT1254, September 2010.

⁶³ Haucap J., *Merger Effects on Innovation: A Rationale for Stricter Merger Control?* Concurrences: Competition Law Review 4-2017, 16-21

⁶⁴ Case COMP/M. 7932 *Dow/Dupont*, *supra* note 3, at Annex 4 paragraph 43.

⁶⁵ De Coninck R., *Innovation in EU Merger Control: In Need of a Consistent Framework*, 2(3) Competition Law & Policy Debate 41, 43 (2016).

⁶⁶ The second theory of harm was in fact the focus of the Commission’s remedy in Case COMP/M.7275 *Novartis/GSK Oncology*, *supra* note 1.

⁶⁷ Case COMP/M. 7932 *Dow/Dupont*, *supra* note 3, at Annex 4 paragraph 39.

In *Astra Zeneca/Novartis*,⁶⁸ while the analysis focused on future competition in clearly delineated product markets, the Commission noted that without the merger, competition would have developed between the three companies on the basis of their innovative products. It added that the fact that one of these innovators is removed from the market may reduce the incentives to further innovate.⁶⁹ Thus, competition would be reduced due to the termination of the overlapping pipeline R&D streams. The adverse impact of the merger in this case would not be limited to an increase in market power but also to a reduction in the number of potential products that could have been developed a result of the distinct innovation efforts of the parties. In *Bayer/Aventis Crop Science*,⁷⁰ the Commission considered that the parties' R&D capabilities and incentives have to be taken into account as regards the potential elimination of future competition in current product markets and future markets.⁷¹

Cases have shown that there are two channels through which the curtailment of innovation can occur, namely reduced incentives to continue current product development, and reduced incentive to begin the development of new products. Less innovation by the merging parties can take the form of lower development for product innovations that have already been discovered through discontinuation and/or delay of early pipeline products as well as lower discovery (research) efforts for new products. A decrease or elimination of the efforts of an innovator to develop a product is more likely to occur the higher the opportunity cost (i.e. the development costs and the costs from the commercialization of the product) relative to the revenues from its commercialization and the higher the cannibalization of the existing and future products of the merged entity (the sales which the pipeline product would take from these products). The Commission has noted that cannibalization can affect the likelihood with which a merger harms innovation, because the cannibalized sales represent an additional opportunity cost of innovation, making thus innovation efforts less profitable. A merger may reinforce this mitigating effect on innovation because the merged entity may have a larger portfolio of existing products whose sales a successful innovation outcome can cannibalize.⁷² If product market competition is intense, firms, individually, likely realize low margins thus they face weaker cannibalization effects when introducing new products.⁷³

The *Dow/DuPont* decision⁷⁴ followed this pattern.⁷⁵ First, the Commission investigated whether there would be a lack of incentives to continue ongoing parallel innovation. Looking at the R&D pipelines of the parties, the Commission found that the two are competing head-to-head in a number of important herbicide, insecticide and fungicide innovation spaces. After the merger, they would have an incentive to discontinue some of these costly development efforts to avoid duplication. In addition, a merger may also result in reduced incentives for the parties to invest in new research efforts for the development of new pipeline products.

An interesting question for the authorities is whether the reduction in the combined R&D efforts may lead to rationalization and repositioning of the R&D for additional research pipelines, thus overall, the merged entity will be more efficient. There is therefore a trade-off between competition in innovation spaces and coordination across innovation spaces.⁷⁶ This trade-off is not always straightforward to be assessed. A merger may stimulate innovation if it enables the merging parties to better appropriate the social value of their innovation,⁷⁷ to boost their innovation by internalizing involuntary knowledge spill-overs as well as by bringing together complementary R&D assets, and by allowing for greater scale economies in process innovation, as well as enabling cost efficiencies in R&D.⁷⁸ A merger may increase both the pace of innovation and prices in the short run. Thus, assessing a merger based on static price effects may not be appropriate for a merger in a dynamic market. For the merger to increase consumer surplus, the dynamic benefits of a greater rate of innovation must compensate for the negative price effects created by the merger. The Commission notes that a potential countervailing effect of a reduction in product market competition on innovation is unlikely to outweigh the direct adverse effect due to the loss of innovation competition between rivals in a concentrated market.⁷⁹

This article focuses primarily on the unilateral effects theory of harm in horizontal mergers. Turning briefly to a theory of harm based on coordinated effects focusing on innovation as one of the main factors that drive competition in a market, the stochastic nature of R&D investment as well as the secrecy with which companies are operating in such markets in relation to their R&D streams render potential coordination unlikely as the identification of a focal coordination point is also unlikely, the competition in most cases is "for the market" rather than competition for part of a market where the rivals may have considered it profitable to adopt a coordinated

⁶⁸ Case COMP/M.1806 *AstraZeneca/Novartis*, *supra* note 1.

⁶⁹ *Id.*, at paragraph 219.

⁷⁰ Case COMP M.2547 *Bayer/Aventis Crop Science*, *supra* note 3.

⁷¹ *Id.*, paragraph 18.

⁷² Case COMP/M. 7932 *Dow/Dupont*, *supra* note 3, at paragraph 2087. The Commission notes that even if innovation were to involve no cannibalization of the sales of existing products, a merger between two out of a limited number of innovators could reduce innovation incentives, by leading to the partial internalization of the impact of innovation competition between the merging parties. *Id.*, at paragraph 2108.

⁷³ *Id.*, Annex 4, at paragraph 67.

⁷⁴ *Id.*

⁷⁵ *Id.*, at paragraph 44.

⁷⁶ Petit N., *Innovation Competition, Unilateral Effects and Merger Control Policy*, Competition Policy International, February 8, 2018,

⁷⁷ Mosso C.E., *supra* note 9.

⁷⁸ *Id.*

⁷⁹ Case COMP/M.7932 *Dow/DuPont*, *supra* note 3, at paragraph 2045.

behavior. Thus, the incentives of firms in innovative markets are more likely focused on adopting a “winner takes all” approach whereby the successful invention will be protected by IPRs and will allow the inventor to reap monopoly rents without the need to coordinate each conduct.

V. THE COMMISSION’S MERGER ENFORCEMENT IN INNOVATION MARKETS

Laitenberger, the former Director General of DG COMP, has emphasized that the Commission aims to protect industries from mergers and anti-competitive methods that may harm their attempts to innovate.⁸⁰ The mitigation of innovation by a merger may be caused by decreased incentives to maintain an existent research and development stream or lessened incentives to develop new streams.

If the process of innovation is structured in such a way that it is possible at an early stage to identify R&D streams directed towards a certain new product or technology, and the substitutes for that R&D, the Commission shall assess if there will be a sufficient number of R&D streams left.⁸¹ This approach is reflected through the Commission’s recent merger assessment cases, including innovation related cases.⁸² We discuss below the approach of the Commission in the cases prior to 2015 where concerns on the negative impact of mergers on innovation featured explicitly as well as the development of the Commission’s approach to an innovation theory of harm in the more recent caselaw.

A. The Earlier Case Law

The caselaw has developed over time. In the earlier cases such as *Universal/EMI*⁸³ where the Commission concluded that the proposed merger of two major recording companies would harm consumers by increasing Universal’s bargaining power and ability to impose onerous licensing terms on digital platforms, in particular small and emerging innovative music platforms.⁸⁴ This would lead to a reduction in innovation and choice of the consumer. In the appeal to the prohibition decision *Deutsche Borse/NYSE*,⁸⁵ Deutsche Borse claimed that the Commission’s finding that the operation would reduce innovation was ‘manifestly incorrect and unsubstantiated’ but the General Court rejected those claims.⁸⁶ The Commission identified significant concerns in relation to a near-monopoly position of the post-merger entity in fixed income instruments (bonds and repurchase agreements) as well as in the trading and clearing of single stock equity derivatives. In addition to such non-innovation related concerns, as this case shows, the Commission will be concerned if the merger makes the post-merger entity the sole owner of important assets for the innovation in the sector, and this has been clearly illustrated in various sectors including a number of cases in the pharmaceutical sector.⁸⁷ In *Glaxo Wellcome/ Smithkline Beecham*⁸⁸ the Commission argued that the merger may deter any R&D trial by other parties to improve anti-viral medications and would lead to a reduction in the overall R&D potential. The EU Commission concluded that the merger can be cleared as there were similar products in the anti-migraine market being developed by other competitors.

The approach was similar in non-horizontal mergers such as *TomTom/TeleAtlas*⁸⁹ where the Commission accepted the relevance of innovation related efficiencies but did not go as far as to clear the merger on that basis.⁹⁰ In *Intel/McAfee*,⁹¹ the Commission was concerned about the fact that the innovation could be affected negatively by the foreclosure which would have been created by *Intel* by complying its central processing units and chipsets solely with *McAfee*’s software service and thus curtailing endpoint security solutions for rivals of *McAfee*. The pre-merger market structure was more conducive to innovation than the post-merger market, characterized by the competitive advantage enjoyed by *McAfee* over its rivals.⁹² The remedies offered by *Intel* reflect this idea. The

⁸⁰ Laitenberger J., *Competition And Innovation, CRA Annual Brussels Conference* http://ec.europa.eu/competition/speeches/text/sp2015_04_en.pdf.

⁸¹ The guidelines continue that “starting point of the analysis is the R & D of the parties. Then credible competing R & D poles have to be identified. In order to assess the credibility of competing poles, the following aspects have to be taken into account: the nature, scope and size of possible other R & D efforts, their access to financial and human resources, know-how/patents, or other specialised assets as well as their timing and their capability to exploit possible results. An R & D pole is not a credible competitor if it cannot be regarded as a close substitute for the parties’ R & D effort from the viewpoint of, for instance, access to resources or timing”.

⁸² DG Comp Competition Policy Brief, *supra* note 10.

⁸³ Case COMP/M.6458 *Universal Music Group / EMI Music*.

⁸⁴ Directorate for Financial and Enterprise Affairs Competition Committee, *Roundtable on the Role and Measurement of Quality in Competition Analysis*, http://ec.europa.eu/competition/international/multilateral/2013_june_roundtable_quality_en.pdf.

⁸⁵ Case COMP/M. 6166 *Deutsche Borse/NYSE Euronext*, *supra* note 24.

⁸⁶ Case T-175/12 *Deutsche Borse AG v European Commission* [2015] EU:T:2015:148 paragraph 171.

⁸⁷ Case COMP/M.1795 *Vodafone Airtouch/Mannesmann*, OJ (2000/C 141/07).

⁸⁸ Case COMP/M.1846 *Glaxo Wellcome/Smithkline Beecham*, *supra* note 1.

⁸⁹ Case COMP/M.4854 *TomTom/TeleAtlas*, (Summary) OJ (2008/C 237/12).

⁹⁰ *Id.*

⁹¹ Case No COMP/ M.5984 *Intel/McAfee*, OJ (2011/C 098/01).

⁹² Colomo P.I., *Restrictions on innovation in EU competition law*, E.L. Rev. 2016, 41(2), 201-219 (2016).

merger was cleared after behavioral remedies committing Intel to procure services from competitors of McAfee. In *Intel/Altera*,⁹³ the Commission assessed if Intel would have the ability and incentive to foreclose Altera's competitors by foreclosing access to its proprietary technologies that connect the central processing unit to the FPGA chips that Altera was manufacturing. In the vertical merger in *Telefonica UK/Vodafone UK/Everything Everywhere JV*,⁹⁴ the Commission raised concern on the competitive harm of a joint venture created by three out of four UK mobile network operators to develop a secure mobile payment system. The Commission concluded that innovation would not be affected as new initiatives and the emergence of a variety of possible commercial and technical evolutions was likely in the future.⁹⁵ In cases where the Commission is content with the availability of competing innovation efforts and technologies, the concentration will likely be approved.

The concept of innovation is at times difficult to quantify.⁹⁶ Proxies that have been used include number of patents, number of new products and R&D spending. However, the correlation is not necessarily significant as the final products arising from R&D may underestimate the investment on innovation.

This caselaw indicates that mergers involving important innovators in largely concentrated industries with high barriers to entry and with no history of innovation from companies outside the sector are likely to be problematic from a merger control point of view. Such mergers are likely to lead to an overall reduction in innovation efforts and, to a reduction in the number and quality of new products. Ibanez Colomo⁹⁷ argues that as long as there is a limitation of competitive constraints arising from a transaction, then a theory of harm based on innovation is welcome.⁹⁸ He also adds that *it is sufficient for the Commission to show, to the requisite legal standard, that a transaction will lead to a significant reduction of the competitive pressure faced by the parties...the Commission can rely upon quantitative and/or qualitative evidence, including, in particular, the factors identified in the Guidelines on horizontal mergers*⁹⁹ which includes price and non-price factors and refer explicitly to innovation as one of these factors.

B. The Recent Approach to Innovation

In recent years, we have witnessed a more explicit attempt to incorporate explicitly innovation in merger assessment. In *Dow/Dupont*,¹⁰⁰ Commissioner Vestager argued that: “We need to make sure that the proposed merger does not lead to higher prices or less innovation for these products.”¹⁰¹ In this case, the Commission investigated whether there would be lack of incentives to continue ongoing parallel innovation. The Commission in *Dow/DuPont* found specific evidence pointing toward lower incentives and lower ability to innovate post-merger. According to these findings, the merged entity would cut back on R&D spending.

The merger was conditionally cleared provided that the parties divested a significant part of DuPont’s existing pesticide business including its global research and development organizations and its pipeline projects, including both tangible and intangible assets so that it enables the purchaser to become a global integrated research and development competitor.¹⁰² Thus, the merger was approved after significant divestments that were focused on maintaining the innovation in the market. This is a very prominent case where we see that significant degree of remedies in relation to innovation.

In a debated case, *GE/Alstom*¹⁰³ the Commission was concerned about reduced innovation and higher prices in the market for a technology vital to meeting climate change. The Commission argued that the merger would bring together two of the three main competitors in the market. This would eliminate a significant innovator,

⁹³ Case M.7688 *Intel/Altera* 2015, OJ (2015/C 408/3).

⁹⁴ Case COMP/ M.6314 *Telefónica UK/Vodafone UK/Everything Everywhere/JV*, (Summary) OJ (2013/C 066/04).

⁹⁵ *Id.*, at paragraph 595.

⁹⁶ Kokkoris I., H. Shelanski, *EU Merger Control: A Legal and Economic Analysis* (1st ed, Oxford University Press 2014) paragraph 12.19.

⁹⁷ Colomo P. I *supra* note 96.

⁹⁸ In a recent post Colomo notes that *innovation considerations may be used as a substitute for a robust assessment of the impact of the practice on competition (what I call the direct introduction of innovation considerations). Such a move would not only be at odds with the case law but would lack a basis in mainstream economics (to be clear: the analysis in cases like Dow/DuPont is entirely uncontroversial from my perspective).* <https://chillingcompetition.com/2018/10/01/my-contribution-to-shaping-competition-policy-in-the-era-of-digitisation-available-on-ssrn/>

⁹⁹ Colomo P.I., Competition Law and Innovation: Where Do We Stand?, *Journal of European Competition Law & Practice*, Volume 9, Issue 9, November 2018, Pages 561–562.

¹⁰⁰ Case COMP/M.7932 *Dow/Dupont*, *supra* note 3.

¹⁰¹ European Commission - Press release, *Mergers: Commission opens in-depth investigation into proposed merger between Dow and DuPont* (11 August 2016), http://europa.eu/rapid/press-release_IP-16-2784_en.htm.

¹⁰² Case COMP/M. 7932 *Dow/Dupont*, *supra* note 3. The remedy taker is FMC.

¹⁰³ Case COMP/M.7278 *General Electric/Alstom*, *supra* note 9.

diminish competitive pressure on other rivals and reduce rival's incentive to invest in innovation. Alstom had to divest parts of the heavy-duty gas turbines business to Ansaldo as a remedy.¹⁰⁴

In *Pfizer/Hospira*,¹⁰⁵ and *Medtronic/Covidien*¹⁰⁶ the Commission cleared both transactions with divestments as one of the merging companies was in the process of selling a drug, while the other company was in the late-stage of developing potential competing product, and the merger would risk the elimination of the product in development.¹⁰⁷

The Commission will assess innovation and the impact of the merger on innovation even if the R&D is still in its early stages. In *Novartis/GlaxoSmithKline's (GSK) oncology business*,¹⁰⁸ the Commission assessed all research in development and not just the ones in the later stages of development and thus more likely to be successful. The Commission raised concerns that GSK has similar pipeline projects with Novartis and the transaction was cleared after the submission of remedies. Haucap and Stiebale, conducted a survey on 65 mergers that were cleared, and argued that mergers in the pharmaceutical sectors impede innovation not only between the merged firms but on the non-merging parties as well.¹⁰⁹

The caselaw in merger enforcement is therefore now clear. The Commission shall analyse whether a merger will pose a threat to such non-price competition as less innovation can prove detrimental to consumer welfare and tends to be more acute than it seems. Thus, the Commission will assess closely a merger between two innovators that are active in similar pipeline products or research efforts, and the transaction would eliminate an important competitive force and strengthen its dominant position. Remedies in such cases usually aim to introduce new innovative competitor into the market to impose competitive constraints to prevent price increase and preserve innovation.¹¹⁰ Even if innovation may not be the sole consideration, it is still an influential add-on with implications on the design of the remedies.¹¹¹ An effective remedy can cover not only an actual overlapping process or product (the "Development" element in R&D), but also the thinking behind it and the ability to create an overlapping process or product (the "Research" element in R&D).

Following the analysis of the developing approach towards innovation in merger enforcement, the article will turn now to analysing some controversial issues in incorporating innovation considerations in merger analysis. The article will look first at the concept of innovation spaces which can provide the framework for a more accurate depiction of competitive dynamics. The article will then look at whether competition authorities should adapt their analytical approach in mergers where innovation plays an important role.

VI. THE TRADITIONAL MARKET DEFINITION CONCEPTS AND INNOVATION SPACES

The recent caselaw has illustrated that investment on innovation potentially covers a group of different products that can be commercialized as a result of this innovation. Thus, a product or a geographic market is a separate concept than innovation space.¹¹² The former is a somewhat static perspective of the market and the competition therein while the latter is a dynamic, current but also forward-looking assessment of the competition in innovation. A product market defined on the basis of a commercialized product can be much narrower than the space within which innovation competition takes place that will lead to this commercialized product.¹¹³ When considering both the downstream product markets and the upstream technology markets, innovation should not be understood as a market on its own right, but as an input activity for both the upstream technology markets and the downstream markets.¹¹⁴ The assessment of innovation competition requires the identification of those companies

¹⁰⁴ The parties had to divest products that were likely to be discontinued, as well as existing upgrades, and pipeline technology for a future upgrade of the relevant product. Alstom committed to release a significant share of its long-term servicing agreement for the GT26 turbine, divest its test facilities for its turbines and its R&D engineers, to enhance the viability of the purchaser.

¹⁰⁵ Case COMP/M.7559 *Pfizer/Hospira*, *supra* note 1. The Commission was concerned about future innovations for biosimilar drugs, which are equivalent with the biological pharmaceuticals. The Commission argued that *Pfizer* would have either delayed or even stopped the development of *Samsung Bioepis* and only consider *Hospira's* existing *inflimax* (co-marketed with *Celltrion*), or would have left *inflimax* to *Celltrion*.

¹⁰⁶ Case COMP/M.7326 *Medtronic/Covidien*, *supra* note 1. In the *Medtronic/Covidien* case, *Medtronic* was the market leader in the drug-coated balloons market. *Covidien* had a drug-coated balloon named *Stellarex*, which was a last stage pipeline product. The Commission argued that innovation in relation to *Stellarex* would have been prevented.

¹⁰⁷ The divestment related to the product in development

¹⁰⁸ Case COMP/M.7275 *Novartis/GlaxoSmithKline's Oncology Business*, *supra* note 1.

¹⁰⁹ Haucap J. and J. Stiebale, *Research: Innovation Suffers When Drug Companies Merge*, Harvard Business Review, 3 August 2016, <https://hbr.org/2016/08/research-innovation-suffers-when-drug-companies-merge>. See also Haucap J., A. Rasch and J. Stiebale How mergers affect innovation: theory and evidence, International Journal of Industrial Organization, vol. 63, pp. 283-325.

¹¹⁰ De Coninck R., *supra* note 65.

¹¹¹ *Id.*

¹¹² Case COMP/M. 7932 *Dow/Dupont*, *supra* note 3, at paragraphs 348-350. The concept "innovation space" was mentioned once in the Deutsche Borse decision, *supra* note 24, paragraph 923.

¹¹³ In the *Dow/Dupont* the Commission said that *a given discovery target is based on lead crops and lead pests and may thus comprise AIs that can be used in several downstream formulated product markets (for example chewing Lepidopteran insecticides, broadleaf herbicides). The spaces where innovation competition takes place are thus broader than an individual downstream crop protection market, but are nonetheless small.* Case COMP/M. 7932 *Dow/Dupont*, *supra* note 3.

¹¹⁴ *Id.*, at paragraph 216.1

which do have the assets and capabilities to discover and develop new products which, as a result of the R&D effort, can be successfully commercialized. It is also relevant to identify and analyze those spaces in which innovation competition occurs in the industry. Companies investing in innovation do not innovate for all the product markets composing the entire industry at the same time. They also do not innovate randomly without targeting specific spaces within the industry.¹¹⁵

According to Gilbert and Sunshine¹¹⁶ we can define innovation spaces by focusing on the overlapping R&D activities of the parties, including particular assets that are necessary for these activities, and then identify competing activities as well as competing assets. Innovation space came into the limelight with the Dow/Dupont decision. In *Dow/DuPont*,¹¹⁷ the parties had to offer remedies that eliminated all horizontal overlaps in the crop protection business in the downstream markets as well in the innovation spaces where the Commission identified concerns.¹¹⁸ However, the concept of innovation space is not new. The 1995 US Antitrust Guidelines for licencing of intellectual property introduce the concept of innovation market, and define it as “the research and development directed to particular new or improved goods or processes, and the close substitutes for that research and development.”¹¹⁹ The 2017 US Antitrust Guidelines for the Licensing of Intellectual Property¹²⁰ (US IP Guidelines) refer to the concept of technology markets. According to these guidelines technology markets refer to intellectual property that is licensed as well as to technologies or goods that are close enough substitutes to constrain significantly the exercise of market power with respect to the intellectual property that is licensed.¹²¹ A particular substance/process that is used for the production of a good competes not only with other substances and processes that are used for this good but also for substances/processes that are relevant for the production of other goods with which this good competes. The US guidelines also define R&D markets as consisting of *the assets comprising research and development related to the identification of a commercializable product, or directed to particular new or improved goods or processes, and the close substitutes for that research and development*.¹²²

The concept of an innovation space incorporates the “discovery stage” where firms invest early “lines of research” to discover new business areas, concepts and lines.¹²³ Innovation is a costly and uncertain investment as companies will invest in multiple lines of research hoping one or a few of them will materialize in commercialized products which will compensate them for the initial investment. It may take 10 years from the date of patent application to commercialize a product, and the holder of a patent can benefit from approximately 15 years of exclusivity from the time its formulated product first obtains authorization to be placed on the market in the EU.¹²⁴

An innovation space is wider than a downstream product market and harm arising in an innovation space can be wider than harm in a specific downstream product market. The Commission in the Dow/Dupont decision confirms¹²⁵ that innovation should not be understood as a distinct market but as an input activity for both the upstream technology markets and the resulting products/processes in downstream markets. The Commission adds that the first step is to identify the companies that have the assets and capabilities to discover, develop and commercialize new products which then extends to the assessment of the space within which competition for innovation takes place.¹²⁶ The Commission considers a line of research to comprise the set of scientists, patents, assets, equipment and chemical class(es) which are dedicated to a given discovery target whose final output are successive pipeline AIs targeting a given innovation space.¹²⁷ The Commission in Dow/Dupont expanded the scope of the merger review to early stage R&D efforts, where products are several years away from reaching the market.

The assessment of innovation competition is different than the assessment of a product market or the assessment of technology markets, even though technology is used as part of the innovation efforts to commercialize products and services. An analysis of the ability and the incentives of firms to innovate in the process of defining markets is a more accurate depiction of the competitive dynamics in innovative industries, especially where competition takes place on the basis of innovation rather than on the basis of price. In addition,

¹¹⁵ *Id.*, at paragraphs 348-350.

¹¹⁶ Gilbert R.J. and S.C. Sunshine, *Incorporating Dynamic Efficiency Concerns in Merger Analysis: The Use of Innovation Markets*, 63 Antitrust L.J. 569, 597-601 (1995).

¹¹⁷ Case COMP/M. 7932 *Dow/Dupont*, *supra* note 3.

¹¹⁸ Berg W. and M. Mudrony, *Innovation and procedure - EU merger control 2017* E.C.L.R. 2018, 39(6), 250-265. When examining specific innovation spaces which can be narrower than the industry level, the Commission in Dow/Dupont found that concentration was even higher than at industry level as not all five globally integrated R&D firms are present in each space. Alix Partners, *The New Frontier for Merger Control and Innovation*, (2018), www.iclg.com.

¹¹⁹ Case COMP/M. 7932 *Dow/Dupont*, *supra* note 3, at section 3.2.3.

¹²⁰ U.S. Antitrust Guidelines for the Licensing of Intellectual Property (2017), <https://www.justice.gov/atr/IPguidelines/download>.

¹²¹ Case COMP/M.7932 *Dow/Dupont*, *supra* note 3, at section 3.2.2.

¹²² *Id.*, at section 3.2.3

¹²³ Petit N., *supra* note 76.

¹²⁴ Case COMP/M. 7932 *Dow/DuPont*, *supra* note 3, at paragraph 200.

¹²⁵ *Id.*, at paragraph 348.

¹²⁶ *Id.*, at paragraph 350. The Commission in the context of Dow/Dupont adds that *the R&D players do not innovate for all the product markets composing the entire crop protection industry at the same time. They also do not innovate randomly without targeting specific spaces within that industry. When setting up their innovation capabilities and conducting their research R&D players have specific discovery targets ([...]).*

¹²⁷ *Id.*, at paragraph 1958.

such an approach is forward looking and encapsulates potential developments in markets that can arise as a result of R&D and innovation activity. Thus, the combination of standard market definition with the definition of innovation space is more prudent in assessing concentrations as it allows us not only to assess impact of the concentration in products/services but also in the innovation behind the development and commercialization of such products and services. This approach will allow competition authorities to assess the impact of a concentration also in markets where there is no final product yet for which companies compete. As the US IP Guidelines note, competition authorities will *delineate a research and development market only when the capabilities to engage in the relevant research and development can be associated with specialized assets or characteristics of specific firms*.¹²⁸

Following the analysis of innovation markets and the relevance and analytical use of innovation spaces, the article now turns to the analysis of unilateral effects.

VII. A “LOOK INTO A CRYSTAL BALL” OR A WELL-STRUCTURED ASSESSMENT?

Having reviewed the economics literature and recent case law, where does one stand when it comes to the assessment of innovation in mergers control? Here we propose practical ways to structure an innovation assessment.

An assessment of the impact of a transaction on future markets needs is almost inevitably more speculative than an equivalent assessment in existing markets. However, the rationale is very similar in both situations. Assessing the impact in a future market is addressed in paragraphs 58-60 of the EU Guidelines where the Commission discusses mergers with potential competitors. As the EU Guidelines state, a merger with a potential competitor can have an adverse impact in the market when the potential competitor already exerts a significant constraining influence or is very likely it will do so in the future.¹²⁹ In addition, the number of other potential competitors must be limited thus the merging parties will not face sufficient competitive pressure after the merger.¹³⁰ Potential competition was the framework of analysis in *Pfizer/Hospira*.¹³¹ In this case, Hospira was already present on the market via a licensed product, and Pfizer was developing an alternative biosimilar drug.

Esteva Mosso outlines the main types of cases where competition concerns arise in innovation markets. Mergers that involve overlaps of 'pipeline-to-existing products' as well as 'pipeline-to-pipeline' overlaps where the relevant pipeline products are usually quite developed, likely to be commercialized, and already known to target a specific product market, are assessed as a merger with a potential competitor.¹³² If the merger leads to the elimination of only one product from the market then it would be unlikely to have a strong impact if there are many other alternatives. He also describes mergers where the Commission will assess the effects on innovation at earlier stages, on early stage innovation efforts of the parties which have not yet taken shape of concrete products, or which do not yet have a high probability of successful commercialization.¹³³ Thus, reduced innovation incentives are likely to lead to a reduction of incentives to continue with existing innovation efforts in the case of overlapping lines of research and early pipeline products between the parties, as well as reduced incentives to develop in the longer term the same number of new products as the combined targets of the parties before the transaction.¹³⁴

In assessing mergers in innovation markets, a challenge for competition authorities is the uncertainty that relates to whether the R&D efforts will be successful. Even if innovation is a somewhat stochastic process, a merger between firms with competing innovation projects can adversely affect the incentives of innovating in competing innovation spaces. The outcome of any given innovation effort may be uncertain, but there may still be legitimate competition concerns in relation to innovation efforts.¹³⁵

From the analysis done by the Commission in the *Dow/Dupont* case we can summarise its approach to the assessment of innovation in merger enforcement as incorporating the following features:

- i. Innovation effects are required to be assessed post-merger when there is a competitive landscape with a limited number of R&D players at industry level and even fewer players at the level of individual innovation spaces (e.g. insecticides for a given crop and pest in the *Dow/Dupont* case).
- ii. Whether the merging parties are important innovators. This can be assessed by looking at the parties' expertise and assets, targets in terms of R&D efforts (input) and new AIs (output), track record of bringing

¹²⁸ Case COMP/M. 7932 *Dow/Dupont*, *supra* note 3, at section 3.2.3.

¹²⁹ See paragraph 60 of the EU Guidelines. Evidence of the potential competitor's plans to enter the market could help the Commission reach such a conclusion. Commission Decision 2001/98/EC in Case IV/M.1439 *Telia/Telenor*, OJ (L 40, 9.2.2001), p. 1, points 330-331, and Case IV/M.1681 - *Akzo Nobel/Hoechst Roussel Vet*, point 64.

¹³⁰ See paragraph 60 of the EU Guidelines. Case IV/M.1630 *Air Liquide/BOC*, point 219; Commission Decision 2002/164/EC in Case COMP/M.1853 *EDF/EnBW*, OJ (L 59, 28.2.2002), p. 1, points 54-64.

¹³¹ Case No COMP/M.7559 *Pfizer/Hospira*, *supra* note 1.

¹³² Mosso C.E. *supra* note 9.

¹³³ *Id.*

¹³⁴ Berg W., and M. Mudrony *supra* note 122.

¹³⁵ Mosso C.E. *supra* note 9.

new AIs on the market, and strength of patent portfolios.¹³⁶ The number of successful registrations of new products indicates the ability of companies to successfully innovate, hence, to create products outcompeting the industry standards.

- iii. Barriers to entry must be analysed. High entry barriers imply innovation may be likely left to a limited number of large firms. In mergers not involving innovative markets the Commission will usually consider entry to be likely if such entry will occur within 2-3 years. However, in innovative markets the Commission will assess the impact of a future product/service along a longer timeline as R&D efforts can be lengthy and of course less certain than an existing product.
- iv. Any direct evidence of the suppression of R&D efforts post-merger must be factored in.
- v. The strength and closeness of the merging parties in innovation areas must be considered,¹³⁷ e.g. the number of pipelines, which is an indicator of the size of a market player's input capacity as well as the number of molecular markers, which gives an indication of the capacity of market players to reduce the time needed to develop new pipelines. This is particularly the case of markets where the merging parties have products that are recently launched or about to be launched and are expected to acquire a significant market share from rivals.
- vi. The closeness of competition between the merging parties' products/services. The authorities can examine the degree of substitutability between the merging parties' products, and the importance of rivalry between them for competition in the market.
- vii. The availability of effective alternatives to the parties' products/services, taking into account differing demand characteristics and product offers.
- viii. Overlaps within the R&D activities of the parties will be considered; as well as
- ix. Past evidence on the relationship between concentration and innovation efforts.¹³⁸

In *Dow/Dupont* the Commission focused on the potential loss of innovation and examined the likely effects on innovation by assessing the parties' incentives to continue overlapping innovation projects, as well as in the long term whether merger would reduce the incentives of the parties to invest in R&D efforts in relation to new products in areas where the parties had significant overlapping R&D capabilities.¹³⁹

The Commission's approach is premised on factors such as contestability of markets, the existence of rivalry between the competitors in a market, the possibility of cannibalization that will make a merger mitigate the incentives to innovate of the merging parties, the existence and protection that IPRs give to innovation efforts that can ensure appropriability, as well as the lack of efficiencies.¹⁴⁰ Mergers between important innovators in a concentrated market, with lack of actual or potential entry of competing innovations are likely to lead to an adverse impact on competition through the reduction or elimination of innovation efforts of the merging parties. Esteva Mosso identifies conditions where a merger involving innovation at earlier stages may have adverse effects as a result of discontinuation of overlapping R&D pipelines as well as delay or re-orientation of R&D efforts. He notes that *innovation can be stifled by mergers which bring together important and close innovators with similar R&D capabilities, in a sector where innovation is an important parameter of competition, the number of effective innovation players can be reliably identified and is limited, and the barriers to entry are high.*¹⁴¹

In determining whether the merger is likely to reduce innovation, looking for overlaps in R&D pipelines of the merging parties is the most easily quantifiable method which may explain why competition authorities are more frequently focusing on it.¹⁴² In a number of recent cases¹⁴³ the Commission has used patents as a measure of market power of the parties in relation to the innovation capacity. Although often considered a proxy for innovation activity, the size and, in particular, the quality of a company's patent portfolio is also a good proxy for its technological capacity. The Patent Asset Index (PAI) is an indication of the quality of a portfolio of patents. The PAI is based on the combination of technology relevance and market coverage summed over each patent in a selected portfolio.¹⁴⁴ Technology relevance in this context refers to worldwide citations received from later patents which are then adjusted for age, patent office practices and the particular technology field. Market coverage refers to the size of the geographic market protected by an active patent or pending patent application, weighted by the GDP of each geographic market protected. Patents with high values for technology relevance and market coverage

¹³⁶ *Id.*

¹³⁷ As we discussed in this paper this relates to the risk of cannibalization.

¹³⁸ Johannes Laitenberger, *EU competition law in innovation and digital markets: fairness and the consumer welfare perspective*, MLex / Hogan Lovells event Brussels, 10.10.2017, available at http://ec.europa.eu/competition/speeches/text/sp2017_15_en.pdf

¹³⁹ Mosso C.E. *supra* note 9.

¹⁴⁰ Case COMP/M.7932 *Dow/DuPont*, *supra* note 3, paragraph 2001.

¹⁴¹ Mosso C.E. *supra* note 9.

¹⁴² Oxera, *Mergers and Innovation: Fewer Players, More Ideas?*, Oxera Agenda (February 2016) 4; Stucke M. and A. Grunes, *An Antitrust Review of a Bayer-Monsanto Merger*, Konkurrenz Group (2016).

¹⁴³ Case COMP/M.7932 *Dow/DuPont*, Case COMP/M.8084 *Bayer/Monsanto*, *supra* note 3.

¹⁴⁴ Technology relevance in this context refers to worldwide citations received from later patents which are then adjusted for age, patent office practices and the particular technology field. Market coverage refers to the size of the geographic market protected by an active patent or pending patent application, weighted by the GDP of each geographic market protected. Patents with high values for technology relevance and market coverage tend to be more frequently opposed (i.e. attacked and defended or enforced in court) and are more likely to be commercialized.

tend to be more frequently opposed (i.e. attacked and defended or enforced in court) and are more likely to be commercialized. It is important to note that using patents as a proxy for innovation is by no means a fool-proof method. The Commission in *Dow/Dupont* assessed the parties' shares of the number of patents as well as evidence on patent citations, which are an indicator of the quality of a patent, the more widely cited a patent the higher its quality.¹⁴⁵

The Commission's practice focuses on the impact of a merger in early pipeline products.¹⁴⁶ It explicitly states in *Dow/Dupont* that "*these correspond to products which are intermediate results of lines of research. These are products which have already been selected among leads, but are still in the discovery or predevelopment stage, where most of the innovation costs have still not been incurred, and with a lower likelihood of success than development products. This is in contrast with pipeline products in the development stage whose likelihood of being successfully launched is between 80 to 90%.*"¹⁴⁷ In assessing innovation concerns the Commission has referred to the third level of the Anatomical Therapeutic Classification (ATC)¹⁴⁸ in previous decisions in the pharmaceutical sector,¹⁴⁹ but, in a number of cases, especially concerning generics,¹⁵⁰ the Commission adopted a narrower approach to market definition, including at the ATC4 level or at the level of the "molecule" (i.e. AI) or group of molecules that can be interchangeable from a therapeutic perspective and there are substitutable thus imposing competitive constraints on one another.¹⁵¹ In merger cases involving existing overlaps the market definition was based on ATC3, ATC4 and/or molecule level. In mergers involving pipeline products the Commission considered R&D projects that were at the latest stage, where either both parties had a pipeline, or where one party had a commercialized product and the other one an R&D pipeline for a similar product.¹⁵² In the Novartis/GSK oncology merger, the Commission assessed earlier phase I and phase II pipeline projects, thus taking a longer term perspective in the assessment of potential harm arising from R&D efforts.¹⁵³

The Commission will assess whether the parties overlap within and across different stages of the innovation process, including discovery and early/late development.¹⁵⁴ If there is a risk that the specific overlapping R&D pipelines of research and early pipeline projects would be cancelled, delayed or re-oriented due to the increased risk of cannibalization, then the Commission will identify potential harm resulting from a merger. The products resulting from innovation by one of the merging party would cannibalize the profits of the innovation drive of the other merging party and, the internalization of this effect that is brought about by the merger, is likely to lead to a reduction to the incentives to innovate.

Similar to the concept of diversion ratio in merger assessment based on price competition¹⁵⁵ Farrell and Shapiro define the "innovation diversion ratio" which is the equivalent concept for innovation-based competition. "If Firm A devotes more resources to improving its products, it will (on average) increase its operating profits (gross of its R&D expenditures) and reduce Firm B's profits. This simple logic leads to the "innovation diversion ratio," which is distinct from the usual (pricing) diversion ratio. The innovation diversion ratio to Firm A from Firm B is the fraction AB of the extra gross profits earned by Firm A when it devotes more resources to innovation that come at the expense of Firm B."¹⁵⁶ They add that "the innovation diversion ratio in a given case may well be hard to estimate. The impact of the proposed merger on innovation incentives really does depend on the extent to which Firm A's pre-merger rewards from innovation come at the expense of Firm B, and on merger efficiencies relating to innovation."¹⁵⁷ In relation to this diversion ratio the Commission notes that the merged entity will now take into account the fact that innovation by each of the merging firms would result in a loss of expected profits by the other merging party. This diversion of sales represents an opportunity cost of innovation for the merged

¹⁴⁵ Alix Partners *supra* note 122.

¹⁴⁶ Case COMP/M. 7932 *Dow/Dupont*, *supra* note 3.

¹⁴⁷ *Id.*, at paragraph 1960.

¹⁴⁸ *Classification devised by the European Pharmaceutical Marketing Research Association (EphMRA) and maintained by EphMRA and Intercontinental Medical Statistics (IMS)*. In the Anatomical Therapeutic Chemical (ATC) classification system, the active substances are divided into different groups according to the organ or system on which they act and their therapeutic, pharmacological and chemical properties. Drugs are classified in groups at five different levels. ATC 1st level: the system has fourteen main anatomical or pharmacological groups (1st level). ATC 2nd level: Pharmacological or Therapeutic subgroup. ATC 3rd& 4th levels: Chemical, Pharmacological or Therapeutic subgroup. ATC 5th level: Chemical substance. The 2nd, 3rd and 4th levels are often used to identify pharmacological subgroups when that is considered more appropriate than therapeutic or chemical subgroups. *World Health Organization*, http://www.who.int/medicines/regulation/medicines-safety/toolkit_atc/en/

¹⁴⁹ Case COMP/M.7645 *Mylan/Perrigo*, OJ (2015/C 286/01), at paragraph 11.

¹⁵⁰ Case COMP/M.5865 *Teva/Ratiopharm*, Case COMP/M.6613 *Watson/Actavis* and Case COMP/M.7379 *Mylan/Abbott*, *supra* note 1.

¹⁵¹ Case COMP/M.7645 - *Mylan/Perrigo*, *supra* note 153, at paragraph 11.

¹⁵² De Coninck R. *supra* note 65.

¹⁵³ The remedies included early pipeline projects as the Commission was concerned that Novartis would discontinue its clinical trials for a particular drug combination. De Coninck R. *Id.*

¹⁵⁴ Mosso C.E. *supra* note 9.

¹⁵⁵ The diversion ratio from product A to product B measures the proportion of the sales of product A lost due to a price increase of A that are captured by product B. Paragraph 29 of EU Guidelines (Guidelines on the assessment of horizontal mergers under the Council Regulation on the control of concentrations between undertakings, *supra* note 59, p. 5–18).

¹⁵⁶ Farrell J. and C. Shapiro, *Antitrust Evaluation of Horizontal Mergers: An Economic Alternative to Market Definition*, B. E. Journal of Theoretical Economics 10, Article 9, (2010).

¹⁵⁷ *Id.*, at 34.

entity and following the merger, this opportunity cost leads to lower incentives to innovate absent merger-specific efficiencies.¹⁵⁸ This is in effect the concept of cannibalization that determines the impact of a merger between two innovators on their unilateral incentives to innovate.

The article shall now turn to the type of remedies that are appropriate for mergers in innovation markets.

VIII. MERGER REMEDIES IN INNOVATION MARKETS

The requirements for appropriate remedies in innovation cases are not different from those involving other type of competition concerns.¹⁵⁹ The legal basis for acceptance of remedies is outlined in Recital 30 of the EUMR¹⁶⁰ according to which:

“Where the undertakings concerned modify a notified concentration, in particular by offering commitments with a view to rendering the concentration compatible with the common market, the Commission should be able to declare the concentration, as modified, compatible with the common market. Such commitments should be proportionate to the competition problem and entirely eliminate it”.

As the above paragraph illustrates, commitments should be proportionate to the competition problem and entirely eliminate the anticompetitive impact with structural remedies and in particular divestitures being preferred to behavioral ones.¹⁶¹

Mergers in innovation markets require an adequate scope and scale of any divestment remedy to ensure competition in innovative markets. At the same time, we should take into account, before intervention is deemed justified, that remedial action has an impact on firms’ incentives to invest and innovate.¹⁶²

Esteva Mosso argues that the divestment should encompass standalone R&D organizations/units and any reverse carve-outs should be limited to prevent undermining its viability and competitiveness. To ensure the effectiveness of the divestment assets such as R&D facilities, IP rights, data, test results, documentation, know-how, as well as all necessary personnel including scientists, regulatory experts, technicians etc. The divestment package may also include necessary inputs as well as existing products, if they are needed to support the activities of the divested assets. Behavioral remedies in such markets ensuring access to necessary inputs is not necessarily an acceptable remedy due to the fact that sharing may affect the incentives of the remedy taker to invest in R&D.¹⁶³

Remedies in innovation markets is not a recent phenomenon. In *Pfizer/Hospira*¹⁶⁴ a remedy was requested for a biosimilar pipeline in addition to certain sterile injectable drugs. In the *GE/Alstom* merger,¹⁶⁵ which concerned gas turbines used to generate electricity the Commission requested a remedy package aimed at ensuring that innovation would not be reduced. In *BD/Bard*,¹⁶⁶ the Commission accepted the divestment of the existing business as well as development projects related to core products to ensure choice and innovation in the markets at issue as a suitable commitment.¹⁶⁷ In *ChemChina/Syngenta*¹⁶⁸ (as well as *Dow/DuPont*¹⁶⁹) the parties divested research pipelines. In this case, the Commission assessed competition for off-patent crop protection products and whether off-patent products constitute viable alternatives to patented products. The Commission decided that generic players like Adama represented only a partial constraint on R&D players as they did not generally compete on the more profitable part of an R&D player’s portfolio.¹⁷⁰ In *Johnson&Johnson/Actelion*,¹⁷¹ instead of proposing to divest one of the two programs, J&J committed to take several structural measures ensuring it would not have the

¹⁵⁸ Case COMP/M.7932 *Dow/DuPont*, *supra* note 3, at Annex 4, paragraph 17.

¹⁵⁹ Mosso C.E. *supra* note 9.

¹⁶⁰ Council Regulation (EC) No 139/2004 of 20 January 2004 on the control of concentrations between undertakings (the EC Merger Regulation) (2004) OJ L 24/1.

¹⁶¹ Mosso C.E. *supra* note 9.

¹⁶² Colomo P. I. *supra* note 96.

¹⁶³ Mosso C.E. *supra* note 9.

¹⁶⁴ Case COMP/M. 7559 *Pfizer/Hospira*, *supra* note 1.

¹⁶⁵ Case COMP/M. 7278 *GE/Alstom*, *supra* note 9.

¹⁶⁶ Case COMP/M. 8523 *BD/Bard*, *supra* note 1.

¹⁶⁷ *Id.*

¹⁶⁸ Case COMP/M.7962 *ChemChina/Syngenta*, *supra* note 3.

¹⁶⁹ Case COMP/M.7932 *Dow/DuPont*, *supra* note 3.

¹⁷⁰ Berg W. and M. Mudrony *supra* note 122. Error! Reference source not found. Error! Reference source not found. Error! Reference source not found. Error! Reference source not found. Error! Reference source not found. Error! Reference source not found. Error! Reference source not found.

¹⁷¹ Case COMP/M. 8401 *Johnson&Johnson/Actelion*.

availability to influence any of the two pipeline drugs.¹⁷² In *Bayer/Monsanto*¹⁷³ the Commission assessed the markets for (1) crop protection; (2) seeds and traits; and (3) environmental science. The Commission concluded that the transaction as notified would have significantly reduced competition on price and innovation in a number of different markets asked for divestments of various groups of assets to BASF.

The identity of the purchaser also needs careful assessment as the purchaser will need to have the necessary expertise and capacity to maintain and enhance the innovation drive lost as a result of the merger. Remedies in mergers in innovation markets that necessitated careful assessment of the purchaser's criteria and features include cases such as: *GSK/Novartis Oncology Business*,¹⁷⁴ *General Electric/Alstom*,¹⁷⁵ *Dow/DuPont*,¹⁷⁶ *Bayer/Monsanto*.¹⁷⁷ Esteva Mosso adds that mergers in innovation markets do not necessarily entail broader remedies than in other types of markets. He notes that it is a standard requirement to include in the divestment business all the assets which are necessary to ensure its viability and competitiveness, both at present and in the future, and the same approach was followed in recent mergers in innovation markets where in addition to divestment of existing products, the parties had to divest their pipeline products, R&D facilities and employees to ensure that the transferred businesses/assets remain competitive in the long run.¹⁷⁸

The US authorities have followed a similar approach in remedies in mergers in innovative markets. In the case *Re American Home Products Corporation*¹⁷⁹ the transaction related to a number of markets related to tetanus and diphtheria vaccines and asked for divestment of the tetanus and diphtheria vaccine businesses to approved purchasers, but only required a non-exclusive license to the Rotavirus vaccine research, to an entity approved by FTC. In *Re Glaxo PLC*¹⁸⁰ the acquisition of Wellcome would lead to adverse effects in the innovation on drugs related to migraines. The FTC asked Glaxo to divest all assets of Wellcome that related to that research.

In determining whether the merger is likely to reduce innovation, looking for overlaps in R&D pipelines of the merging parties is the most easily quantifiable method which may explain why competition authorities are more frequently focusing on it.¹⁸¹ The authorities have highlighted the importance of protecting head-to-head innovation competition and it is therefore likely that where there are pipeline overlaps, divestitures will be required. In some cases, divestitures have included entire research facilities, including staff.¹⁸² In *Bayer/Aventis Crop Science*, the Commission was concerned with the "grouping of companies with strength in R&D and innovation". The analysis conducted in this case focused on the companies' R&D capabilities and incentives in specific current product market as well as future product markets. In *Syngenta/Monsanto's Sunflower Seed Business*, the Commission once again took a more granular approach by focusing on germplasm in particular, and whether or not the merger would prohibit smaller competitors from innovating in the market for sunflower hybrids in Spain and Hungary.¹⁸³

IX. TECHNOLOGICAL SPILLOVERS AND SYNERGIES AS EFFICIENCY DEFENSE

The Commission can assess innovation as an efficiency defense with the onus being on the parties to prove the relevant Horizontal Merger Guidelines criteria.¹⁸⁴ Similarly, according to the Non-Horizontal Merger Guidelines the Commission will also assess innovation noting that vertical and conglomerate mergers are more likely to create efficiencies than mergers between competitors in the same market.¹⁸⁵

Synergies are particularly important in industries where value is created by systems that incorporate multiple components and relate to the *ability* to innovate. Suppose that Firm A is considering investing in R&D to develop an improved process that will lower its unit costs. Suppose also that Firm A does not expect to expand its unit sales much as a result of these lower costs. If the merger will enable the process innovation to be applied to Firm B's output, and if Firm A would not license its process innovation to Firm B in the absence of the merger, the merger

¹⁷² See Berg W. and M. Mudrony *supra* note 122. J&J committed to eliminate its minority shareholding in one of the pipeline businesses and to bear all the costs of the Phase II development. In relation to the second pipeline drug, J&J committed to limit its shareholding to an extent that would not allow it to exercise any control rights and J&J committed not to appoint board members or to access any confidential information.

¹⁷³ Case COMP/M.8084 *Bayer/Monsanto*, *supra* note 3.

¹⁷⁴ Case COMP/M. 7275 *GSK/Novartis Oncology Business*, *supra* note 1.

¹⁷⁵ Case COMP/M. 7278 *GE/Alstom*, *supra* note 9.

¹⁷⁶ Case COMP/M. 7932 *Dow/Dupont*, *supra* note 3.

¹⁷⁷ Case COMP/M. 8084 *Bayer/Monsanto*, *supra* note 3.

¹⁷⁸ Mosso C.E. *supra* note 9.

¹⁷⁹ *Re American Home Products Corporation* <https://caselaw.findlaw.com/tx-supreme-court/1323472.html>

¹⁸⁰ *Re Glaxo PLC*, <https://www.ftc.gov/enforcement/cases-proceedings/0010088/glaxo-wellcome-plc-smithkline-beecham-plc-matter>

¹⁸¹ *Oxera* *supra* note 146; *Stucke M. and A. Grunes* *supra* note 146.

¹⁸² See, for example, COMP/M. 7275 *GSK/Novartis Oncology Business*, Case COMP/M. 7559 *Pfizer/Hospira*, Case COMP/M. 7278 *GE/Alstom* and COMP M.2547 *Bayer/Aventis Crop Science*, *supra* notes 1, 3 and 9.

¹⁸³ Case COMP/M.5675 *Syngenta/Monsanto's Sunflower Seed Business*, *supra* note 81.

¹⁸⁴ *Laitenberger J.* *supra* note 84.

¹⁸⁵ Guidelines on the assessment of non-horizontal mergers under the Council Regulation on the control of concentrations between undertakings, *supra* note 61.

can enhance Firm A's incentives to develop this process innovation.

Some firms cannot innovate in isolation. This is particularly the case where innovation value is created using multiple components. Furthermore, Buehler and Federico¹⁸⁶ argue that horizontal mergers can improve the ability of the merger entity to innovate if they combine complementary assets, as capabilities do not overlap.

The question is how one measures overlaps in R&D capabilities. In *Dow/Du Pont*,¹⁸⁷ the EC used patents weighted by citations, as this was also regularly used by the parties to monitor, among other things, the competitive landscape. But in other industries this may not be so straightforward and not easy to quantify, which brings to the standard of proof to be used. Ibanez Colomo (2018)¹⁸⁸ argues that, as confirmed by the General Court in *Deutsche Börse AG v Commission*,¹⁸⁹ as a matter of law, a significant impediment to effective competition can be established by proxy. In other words, it is sufficient for a competition authority (in Europe, at least) to show, to the requisite legal standard, that a transaction will lead to a significant reduction of the competitive pressure faced by the parties. When conducting this assessment, the Commission can rely upon quantitative and/or qualitative evidence, including, in particular, the factors identified in the Guidelines on horizontal mergers (such as the closeness of competition between the parties, customers' switching opportunities or rivals' ability to expand production). In this sense, the assessment of innovation is not any different compared to more standard assessment of price effects in a merger.

Showing efficiencies remains subject to a very high standard of proof.¹⁹⁰ Efficiency arguments need to be quantifiable, merger specific and verifiable, criteria that, as caselaw has illustrated, are not easily met. At the same time, arguing that a significant reduction of competitive pressure can be pro-competitive is an exceptional claim that contradicts the very premises of competition law. It is therefore quite natural that the efficiency defense is unlikely to succeed in practice and thus has to meet a high standard of proof. In the context of innovation, many efficiency channels could be relevant in practice. For instance, the opportunities to reallocate R&D efforts to reduce duplicative efforts, or the internalization of involuntary knowledge spillovers. Since they depend on industry-specific detailed knowledge, it would seem very natural that it should be for the merging parties to provide evidence showing that, in spite of the prima facie finding of a significant impediment of effective competition, the efficiency gains resulting from the merger will outweigh its likely negative impact.

In the Annex we present an economic framework to assess the magnitude of the efficiencies that would be needed in order for a merger to have a positive impact on consumers. We concentrate on a duopoly described by Bertrand competition where innovations are substitutes for each other and there are merger-specific cost synergies that increase ex post profits (so that they would stimulate innovation). As our analysis shows, when thinking about the impact of a merger on consumers, one has to take into account both the impact on innovation and the impact on future prices. The condition for a merger to have a positive effect overall on consumers is more stringent than the condition to have a positive effect on innovation alone. This is because – whatever the innovation levels – the merger stifles future price competition, harming consumers.

X. CONCLUDING REMARKS

Reduction in competitive pressure in a market, following a merger, can not only affect prices and output but is equally harmful to innovation as well. Dynamic and innovative industries warrant caution when they are examined with a view to performing a competitive assessment.¹⁹¹ Geradin et al. further point out that whilst in some industries, competition takes place primarily through standard price competition and, possibly, also via incremental innovations, in innovative and dynamic industries the primary and distinguishing feature lies in the fact that market participants (undertakings) engage in dynamic competition *for* rather than *in* the market.¹⁹²

Galloway argues¹⁹³ that we should not adopt a *per se* approach or tough sanctions in dynamic innovative markets, as there are clear reasons to approach innovative and novel practices with caution. Galloway rightly points out that the risk of over-enforcement (Type I errors) should be preferable to under-enforcement (Type II errors), in dynamic markets, in the absence of sector regulation. However, several commentators¹⁹⁴ also argue that there

¹⁸⁶ Buehler B. and G. Federico, *Recent developments in the assessment of efficiencies of mergers in the EU*, 2016, Competition Law & Policy Debate, 2:1, at 64-75.

¹⁸⁷ Case COMP/M. 7932 *Dow/Dupont*, *supra* note 3.

¹⁸⁸ Colomo P. I. *supra* note 96.

¹⁸⁹ Case COMP/M.6166 *Deutsche Borse/NYSE*, *supra* note 24.

¹⁹⁰ In the context of Article 102, in the Microsoft judgment the General Court criticized Microsoft for not offering concrete, specific and verifiable arguments to support the efficiency claim it was making in relation to its innovation efforts. “*The Court finds that, ..., Microsoft, ... did not sufficiently establish that if it were required to disclose the interoperability information that would have a significant negative impact on its incentives to innovate...Microsoft merely put forward vague, general and theoretical arguments on that point*”. See further: T-201/04 *Microsoft Corp v Commission* [2007] ECR II-3601, paras. 697 and 698.

¹⁹¹ Geradin D. et al., *supra* note 20.

¹⁹² *Id.*, at 15 et seq. See also on disruptive innovation Graef I. et al. *supra* note 4.

¹⁹³ Galloway J., *Driving Innovation a case for targeted competition policy in dynamic markets*, [World Competition](#), vol. 34, issue 1, pag. 73-96, 2011.

¹⁹⁴ Easterbrook F., *The Limits of Antitrust*, (1984) 63 Texas L. Rev. 1.

are greater social costs with Type I errors than Type II errors, as the market should self-correct Type II errors more readily than Type I errors.¹⁹⁵ This self-correction, however, is questionable in markets where entry has not occurred for decades. For example, in pharmaceutical markets where entry of new competitors is not frequent,¹⁹⁶ self-correction is unlikely to take place.

the overarching aim of Shapiro's analysis is to determine whether the decreased incentives to innovate post-merger are outweighed by an increased ability to innovate. Shapiro focusing on Aghion's analysis notes that innovation, broadly defined, is spurred if the market is contestable; that is, if multiple firms are vying to win profitable future sales.¹⁹⁷

Our paper assessed the approach that the European Commission takes in concentrations that take place in innovative markets and identified the challenges that some of these cases posed. The concept of innovation is difficult to quantify and hence factoring it as a non-price factor in merger assessment becomes tougher for competition regulators.¹⁹⁸ Proxies that have been used include number of patents, number of new products and R&D spending.

There is an ever increasing body of caselaw related to the assessment of the impact of a concentration on innovation. The approach the Commission took in the earlier cases such as the ones in the pharmaceutical sector that illustrates a cautious and gradual attempt to explicitly incorporate innovation concerns as a factor in the assessment. In the more recent cases, the Commission expanded from antitrust markets to antitrust innovation spaces, that may involve a group of antitrust product markets that are characterized by similar innovation efforts. Thus, the remedies in the latter cases appear to be more expansive than the ones in the former cases.

Our discussion gives a *roadmap* and a set of *limiting principles* that can be used to assess when innovation concerns arise in the context of a merger.

- Innovation must be an important parameter of competition. Conversely, if firms spend very little on R&D, an innovation angle will not be relevant.
- There should be a limited number of significant innovators in certain innovation spaces. For instance, in Dow/Du Pont the firms in question had very specific targeted markets, so that there could be a mapping between R&D and expected future markets and profits. In other sectors, instead, the ultimate uses for discoveries may be not so clear, so that there may be many more competitors that could eventually be considered as potential threats.
- Related to the previous point, the concepts of closeness and overlaps in capabilities of firms to innovate are applicable. A merger will be more of a concern if it puts together two close competitors that have the same capabilities. It is essential here to understand where such capabilities of the firms come from whether, for instance, from specific scientists and scientific areas, or from general purpose technologies that could be employed by rivals too. Also note that the analysis of current (static) product or pipeline overlaps may not be sufficient to fully capture the reduction of competition arising from a merger.
- The possibility of entry is very important, where concerns are higher the less prospects there are for future entry in case the markets gets monopolized (for instance, because of the time lags for regulatory approvals). Here the recent history of the industry should be very important to show patterns of entry and exit.
- A very key aspect when looking at innovation is the extent of its appropriability. This means to evaluate the extent to which, when a firm innovates, it is able to retain the gains from such innovation. Can this firm get a patent? Or can it easily licence to other users? If the answer is yes, that is, the industry is subject to a rather efficient regime of IPRs, then the merger concerns, *ceteris paribus*, are higher. If instead the industry is subject to uninternalized involuntary spillovers, that is, the benefits of innovation will accrue also to rivals without the innovator having direct benefits, the converse will be true.
- A different way of expressing the previous point is to look at the nature of innovation. If innovators, protected by IPRs, produce substitute products, this is when we would expect the negative innovation externality to be at play. If instead innovation brings demand expanding effects for rivals or other complementarities which cannot be achieved by other contractual arrangements, then a merger will be beneficial to innovation.

¹⁹⁵ Galloway J. *supra* note 204.

¹⁹⁶ The trend is for new drug introduction from incumbents rather than new entry. Developed markets continue to stagnate and emerging markets are becoming more important as a source of revenue growth for multinational pharmaceutical companies. Mc Kinsey and Company, *Accelerating access in emerging markets: Pharma's next big launch challenge* https://www.mckinsey.com/~/media/McKinsey/Industries/Pharmaceuticals%20and%20Medical%20Products/Our%20Insights/Pharmas%20next%20challenge/Pharmas_next_challenge.ashx

¹⁹⁷ Shapiro C., *supra* note 18.

¹⁹⁸ Kokkoris I. and H. Shelanski, *supra* note 100, paragraph 12.19.

XI. ANNEX

We now provide a very stylized representation of their approach. The purpose of this model is illustrative only and it serves the purpose of highlighting the main economic forces described in the recent literature.

We consider a simplified setting with two firms only, denoted as firm 1 and firm 2. Each firm can devote resources to increase the probability of obtaining an innovative product. More specifically, to obtain a probability of success denoted by p , a firm must spend $p^2/2$. The quadratic cost specification captures decreasing returns to innovation, i.e., increasing marginal cost of innovating; we will make sure that probabilities obviously cannot exceed 1.

We now discuss payoffs. If a firm is not successful, it earns zero. If it is the only successful innovator, it earns a profit (gross of R&D costs) normalized to 1. If two firms are jointly successful in their R&D efforts, and they compete against each other, they earn d each. We are not modelling competition explicitly, but one can assume that, in the normal case where products are substitutes, it must be $0 < d < 1/2$, since it is not imaginable that firms would make *more* profits when they compete against each other compared to the case when there is no competitor. The extreme case $d = 0$ corresponds to a situation of pure Bertrand competition between identical products. For the benefit of the discussion, we also consider the case where $1/2 < d < 1$, so that products are very differentiated and/or investments are complementary, and total industry profits ($2d$) actually increase when both firms are successful innovators.¹⁹⁹

Turning to the merger case, the merged entity will have two plants at its disposal (the former firms 1 and 2). We denote the total profit earned by the merged entity in case both plants are successful in their independent research efforts by m . The plausible case where the investments result in substitute products is $m = 1$, since the profits are the same if there is one or more identical products in the market. We also consider the case where there can be differentiation or complementarities which is described when $1 < m < 2$.

The following table summarizes gross payoffs.

Table 1. Gross Payoffs of Firm 1 & 2

	Firm 2	Successful	Unsuccessful
Firm 1			
Successful		Duopoly: d, d Merger: m	Duopoly: $1, 0$ Merger: 1
Unsuccessful		Duopoly: $0, 1$ Merger: 1	Duopoly: $0, 0$ Merger: 0

Market structure induced by a merger matters only in the top left corner, as in the other cases either there is no product, or an uncontested monopoly both with or without a merger.

We consider first the case of duopoly competition, that is, the case prior to a merger. The payoff of firm 1 is

$$\pi_1 = 1 \cdot p_1(1 - p_2) + d \cdot p_1 p_2 + (1 - p_1) \cdot 0 - \frac{p_1^2}{2}$$

and a similar expression also holds true for firm 2 simply by inverting the subscripts.

The first-order condition becomes²⁰⁰

$$\frac{\partial \pi_1}{\partial p_1} = 1 - (1 - d)p_2 - p_1 = 0$$

In a symmetric equilibrium where $p_1 = p_2$ we have that, in a duopoly, each firm's probability of success is

$$p^D \equiv p_1 = p_2 = \frac{1}{2 - d}$$

which is always between 0 and 1 because of the restriction $0 < d < 1$.

Let us turn to the case of a merger to monopoly. Imagine the two firms merge their research facilities and form a new firm that we denote as M . The new entity will then maximize

$$\pi_M = 1 \cdot [p_1(1 - p_2) + p_2(1 - p_1)] + m \cdot p_1 p_2 - \frac{p_1^2}{2} - \frac{p_2^2}{2}$$

The first-order condition becomes²⁰¹

$$\frac{\partial \pi_M}{\partial p_1} = 1 - (2 - m)p_2 - p_1 = 0$$

and a similar expression also holds true for the other research lab simply by inverting the subscripts.

¹⁹⁹ This is the case considered by Bourreau et al. (2018) when they introduce a "demand expansion effect". See Bourreau M. et al. *supra* note 45.

²⁰⁰ The second-order condition is satisfied.

²⁰¹ The second-order conditions are satisfied. In our example, it is never optimal for the merged entity to shut down completely one of the two plants. Hence the criticism of Denicolo' and Polo does not apply; see Denicolo' V. and M. Polo *supra* note 58.

In a symmetric equilibrium where $p_1 = p_2$ we have that, after a merger to monopoly, each lab's probability of success is

$$p^M \equiv p_1 = p_2 = \frac{1}{3 - m}$$

which is again between 0 and 1, as $1 < m < 2$.

A. Effect of the Merger on Innovation

The comparison between the two first-order conditions in the two cases is telling about what changes after a merger, compared to duopoly competition. On the one hand, if both research efforts are successful (with probability $p_1 p_2$) the merged entity will earn m instead of d (this is the price coordination effect). On the other hand, the merger entity also anticipates that, if it innovates with a plant (e.g., plant 1 with probability p_1) it will cannibalize the profits it would have got from the other plant (e.g., plant 2) in case this is also successful (in the monopoly first-order condition, there is an extra negative term equal to $-p_2 \cdot 1$). This is the business stealing (or innovation externality) effect.

Comparing the relevant expressions, it is immediate to find that the probability of a successful innovation (and hence R&D spend) will be *lower* after the merger when the following condition applies

$$p^D > p^M \leftrightarrow d > m - 1$$

Some immediate conclusions can be drawn from this stylized analysis.

Let us start from the obvious and relevant case where the innovative products would be perfect substitutes for each other (that is, $m = 1$). Then the condition simplifies to $d > 0$. Hence, we obtain a first result: *it is never possible that a merger to monopoly increases total investments*.

If instead the merger generates synergies, or the innovative products are somehow differentiated, it is indeed possible that the merger is beneficial for investments. Namely, this would happen when $m > d + 1$. Note, however, that it is not sufficient that synergies (or differentiation) exist, but they also have to be sufficiently strong. If these synergies (or differentiation) come from investment complementarities, it is also likely that they would exist under duopoly competition (unless the synergies/complementarities are uniquely merger-specific). In this case, it follows that also d is high in a duopoly, hence m has to be particularly high. In other words, *complementarities are a necessary but not sufficient condition for a merger to have a positive effect on investments*.

B. Effect of the Merger on Consumer Surplus

The ultimate effect to be assessed is not limited to innovation. Rather one has to evaluate what happens to consumer surplus, after a merger. The following table summarizes consumer surplus in each of the possible state.

Table 2. Consumer Surplus in the various scenario

	Firm 2	Successful	Unsuccessful
Firm 1			
Successful		Duopoly: CS^d Merger: CS^{m2}	Duopoly: CS^m Merger: CS^m
Unsuccessful		Duopoly: CS^m Merger: CS^m	Duopoly: 0 Merger: 0

CS^m indicates consumer surplus when only one firm is successful (and therefore it will be an uncontested monopolist), CS^d denotes consumer surplus when there are two successful innovators competing against each other and CS^{m2} indicates consumer surplus when there are two successful innovators and the market is monopolised. Without any innovation, consumer surplus is normalised to zero. The ranking between these variables is as follows: $CS^m \leq CS^{m2} < CS^d$. The last inequality is strict, as consumers must benefit (in the absence of merger-specific efficiencies) from competition between two competing firms, compared to a monopoly, when they are offering the very same set of products. Instead, the first inequality may not be strict. If the two innovations are perfect substitutes ($m = 1$), then it will also be $CS^m = CS^{m2}$.

Prior to the merger, expected consumer surplus is

$$CS^D = p^{D^2} CS^d + 2p^D(1 - p^D)CS^m$$

After the merger, expected consumer surplus is

$$CS^M = p^{M^2} CS^{m2} + 2p^M(1 - p^M)CS^m$$

We cannot venture into a general analysis here, as we have put little structure on consumer preferences. Still, we can make some simple but important observations. We take the benchmark case where innovations are perfect substitutes ($m = 1$).

First, note that it then becomes from the previous analysis $p^D > p^M \leftrightarrow d > 0$, which always holds true for any $d > 0$. Second, exploiting the fact that $CS^m = CS^{m2}$, we can write:

$$CS^D - CS^M = p^{D^2}CS^d - p^{M^2}CS^m + [2p^D(1 - p^D) - 2p^M(1 - p^M)]CS^m$$

The difference between the first two terms ($p^{D^2}CS^d - p^{M^2}CS^m$) is certainly positive, as both $p^D > p^M$ and $CS^d > CS^m$. As for the last term, the sign depends on the bracket $[2p^D(1 - p^D) - 2p^M(1 - p^M)]$. As long as probabilities of success are below 50% (which is standard in cases with highly uncertain innovations), then $p^D > p^M$ ensures that also this term is positive. Consumers then lose twice, both because there are less innovations overall, and because, once innovations would have occurred simultaneously, they do not benefit from future price competition.

The comparison becomes even more evident if we consider the case of perfect competition in a duopoly, when d approaches 0. In this case the two probabilities p^D and p^M converge to each other. The last term vanishes, and we are left with:

$$CS^D - CS^M = p^{D^2}(CS^d - CS^m) > 0$$

In this extreme case, the merger has no effect on innovation. Still, consumers are worse off because they do not get any benefit from ex post competition. The main implication is that there are two effects one has to consider when thinking of the effect of a merger on consumers: whether the merger has any *impact on innovation and, additionally, the impact on future prices that are typically higher after a merger.*

C. The Role of Efficiencies

Without claiming generality, one can still use this framework to get at least a sense of the magnitude of the efficiencies that would be needed in order for a merger to have a positive impact on consumers. Take the example where innovations are pure substitutes for each other. Additionally, imagine competition in a duopoly is described by tough Bertrand competition, so that $d = 0$. Finally, assume that there are merger-specific cost synergies that increase ex post profits (so that they would stimulate innovation) but do not feed into cheaper prices for consumers. Hence it is also $CS^m = CS^{m^2}$. In particular, let us assume that (fixed) cost savings are about 10% of ex post profits, so that $m = 1.1$ (these are arguably quite large efficiency gains). Then, under all these assumptions, it is:

$$p^D = 0.5 < p^M \approx 0.53$$

In other words, the ex post efficiency gains for the merged monopolist are sufficient to spur additional innovation effort compared to a duopoly. Is this enough for consumers to be better off? Simple calculations show that it is then

$$CS^M - CS^D \approx 0.276CS^m - 0.25CS^d$$

Can this expression be positive? It depends on the shape of the demand function, but it is not very likely. For instance, it is well-known that, with a linear demand and constant marginal cost of production, consumer surplus with competition is four times larger than consumer surplus with monopoly, in which case it would be:

$$CS^M - CS^D \approx 0.276CS^m - 0.25CS^d = -0.724CS^m < 0$$

so that consumers are still worse off after a merger, because the increase in the probability of innovation is not compensated by the fact that they gain little from it. Put it differently, if one still sticks to this example with linear demand but let the efficiency parameter m vary, one can write:

$$CS^M - CS^D = -\frac{(17 - 14m + 3m^2)}{2(3 - m)^2}CS^m < 0$$

which is always negative for all valid values of m .

One can of course envisage other cases. For instance, if the gains for consumers from perfect competition compared to monopoly were much lower, say only 50% rather than 4 times larger, it is possible to show that consumers would be better off after a merger if and only if merger-specific efficiencies would be $m = 1.45$, that is, at least 45% of the ex post profits (in this case, under monopoly, the probability of success increases to $p^M \approx 0.65$)

The bottom line of this analysis is quite straightforward. When thinking about the impact of a merger on consumers, one has to take into account both the impact on innovation and the impact on future prices. The condition for a merger to have a positive effect on consumers is more stringent than the condition to have a positive effect on innovation. This is because – whatever the innovation levels – the merger suppresses future price competition, to the detriment of consumers. We conclude that *the conditions to find a positive impact of a merger on consumers (rather than innovation alone) become more stringent.*