# Evaluating innovation theories of harm in merger review: economic frameworks and difficulties

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Several recent high-profile merger review cases in the life sciences space – including *Celgene/Bristol-Myers Squibb*, *Illumina/Pacific Biosciences (PacBio)* and *Roche/Spark* – have focused on innovation theories of harm, concerns that a merger may decrease the level of innovation activities by the merging parties or their competitors and harm consumer welfare. While evaluating such theories of harm is understandably of high interest, antitrust authorities should recognise that innovation is an area that does not lend itself to generalisations of a single economic theory or model. While generalising the production function for widgets as a mathematical function works well enough, innovations are not like widgets and using the same approach can lead to three fundamental problems. First, generalisations are necessarily limited by how well existing models, which fit some situations nicely, describe the broader universe of innovative activity. Second, evidence in these cases is plagued by definitional and measurement problems that are worse than usual for merger assessment since the underlying concepts to be measured or tested are not well specified. Third, remedy policies are difficult to identify for these cases without necessarily assuming some specific way in which innovation is produced. This article summarises each of these categories of challenges, discusses some approaches and considerations employed in past cases, and ultimately explains why a good model of innovation, rooted in the facts of the industry, is the best approach.

**Searching for a theoretical framework**

Developing a framework for analysing innovation, instead of price changes for services or manufactured goods, is challenging because economists have a relatively more limited understanding of precisely how innovations are created. Because the production of widgets usually follows a deterministic process with well-understood inputs and outputs, economists can more confidently predict the potential impact of a merger on production quantities after analysing information such as substitutability of products and cost synergies of production. This in turn allows economists to predict merger-specific price changes. On the other hand, the fact that economists cannot readily predict innovation output from innovation inputs makes an innovating firm's profit maximisation problem complex, opaque, and difficult to model. Thus, even if an antitrust authority can identify overlaps in research targets and potential synergies between R&D teams, economists can only say as a general matter that combining the teams will eliminate one incentive – rivalry – for investing in innovation. Without a general model of how combining research efforts might affect their productivity, economists cannot rule out other possibilities, including, for example, that increased productivity from the combination will dominate and that the incentive to invest in innovation will increase. Thus, it is natural that antitrust economists would search for a theoretical framework that would allow them to more confidently predict such changes for mergers of innovating firms.

Several economists – famously Arrow[1] and Schumpeter[2], among others – have attempted to model innovation and its interaction with competition; however, no consensus has been reached. Carl Shapiro's handbook chapter on the topic summarises themes common to these models in an effort to provide a unified framework for analysing whether innovation will decrease after a merger.[3] Unfortunately, this effort does not address the underlying problem – that the variety of processes by which innovations are created are not well generalised in any one or two mathematic models of production. Identifying the differences between the models we do have can create a false sense of completeness – the types of differences between these models do not capture all of the possible types of differences between innovation processes in different industries.

For example, one theme the article emphasises is appropriability – the extent to which an innovator is able to capture the social benefit of the innovation as profit. One might consider two economic models – one in which there is a race to a single, final discovery, which will be patented and perfectly protected forever, and another in which there is a series of possible discoveries, each of which enables competitors to 'leapfrog' quickly while entitling the innovator to very little protection – as bookending a spectrum on which appropriability is measured. However, even considering just this one particular type of innovation incentive – how a rival's innovation success affects the rewards of subsequent R&D – surely the collection of industries in the economy covers a much broader array of potential structures than just those lying perfectly in between these bookend models.

Unfortunately, focusing on this spectrum (or others mentioned in the chapter) in the absence of an industry-appropriate, realistic model can lead an antitrust authority – looking to economics for general principles – astray. For example, the authority might carefully measure proxies for appropriability, such as patent strength, which – in the absence of an appropriate model – will shed little light on how the particular merger at hand will change innovation outcomes. Do strong patents shape the type of R&D projects firms pursue? Does that influence how much rivalry they experience or avoid pre-merger? Is there a single race, or might one firm be racing for short-term wins while another plays an R&D long game? Consequently, economists seeking to help antitrust authorities should avoid the generalisation and instead carefully review facts to learn how innovation works in the industry in question, attempt to model

that innovation, and then interpret empirical facts within that model to predict the consequences of a merger. It will be insufficient to rely on a preordained collection of parameters for which one might be able to find empirical proxies.

**Evidence and measurement**

Even given a well-formulated model for a particular industry under investigation, empirical analysis of a merger's effect on innovation incentives would still be complicated by measurement issues. One might imagine that almost any empirical analysis would conceptually require some quantification of the innovation produced by the merging parties and other competitors. However, such quantification runs into at least two main difficulties.

First, as already discussed, innovation is not a homogeneous phenomenon, but rather a term used to describe a wide variety of technological advances, all qualitatively different from each other.[4] It is important that the selected model be tailored to the specific type of innovation that is perceived to be at risk. For example, if there are concerns that the firms will produce fewer cost-reducing technologies, then a model focusing on cost reduction may be more appropriate. However, if there are concerns that the firms will abandon plans to develop new products, then a model focusing on product variety would be more relevant. This choice is related to evidence and measurement because it is important that any empirical tabulation of innovation inputs and outputs match those occurring within the model; not just any quantification of levels of or changes in innovation, broadly construed, will suffice. Returning to the examples above, if the model focuses on cost reductions, then empirical work should also focus on innovations that reduce costs. Similarly, if the model focuses on the development of new products, then so should empirical work. Generalised measurements would risk measuring the wrong thing entirely in specific cases.

Second, innovation affects consumer welfare much more circuitously than prices do, and an antitrust authority faces trade-offs when deciding how much to focus on welfare. Measures that most closely approximate welfare consequences, such as sales of new products and lower production costs, are also heavily influenced by factors aside from innovation, such as demand for the new product in the market or shocks to the costs of raw materials used to make the new product. Measures such as investment, expenditure, and the number of R&D employees may be easier to observe but are much more distantly related to welfare. Ultimately, the best approach will depend on the facts of each case.

These issues can be illustrated by considering a technique that past cases have used: tabulating patent citations. In their review of the *Dow/DuPont* merger, the European Commission pursued a variety of such tabulations, citing academic literature: 'One important finding of the economic literature is that citation-based indexes are informative on the technological importance of patents.'[5] While investigating patents, weighted by some measure of their importance, such as citations, may have some probative value, the technique also highlights the two issues above.

First, patents cover a variety of different types of innovation (eg, production processes and new products) which should not enter any model homogeneously.

Second, the relationship between patents and true innovation or its welfare consequences is indirect and, in some cases, non-existent. Patenting is not an inevitable manifestation of innovation but rather a strategic choice. On the one hand, patent thickets demonstrate that generating more patents is not always good or pro-competitive.[6] Bennato and others (2018) argue, 'it has long been recognised that patents are sometimes used to protect an incumbent's market power'.[7] On the other hand, certain firms choose not to patent socially valuable innovations, and instead to maintain their value as a trade secret. Even for patents that protect socially valuable innovations, they track neither the eventual output (valuable goods and services) nor the resources invested (dollars or employees) – two of the types of quantities most likely to appear in a model of innovation and rivalry.

Another empirical technique, less commonly used, is the analysis of deal value to determine whether a transaction in an innovation-related industry might be a killer acquisition. Cunningham and others (2019) define 'killer acquisitions' as acquisitions where 'incumbent firms . . . acquire innovative targets solely to discontinue the target's innovation projects and pre-empt future competition'.[8] The UK's Competition and Markets Authority used the deal-value technique in *PayPal/iZettle* and found no evidence that the transaction was a killer acquisition.[9] However, such an approach is fraught with potential shortcomings.

First, as with patents, the transaction price is strategically chosen, not a direct measure of firm value or expected innovation. Indeed, the Hart-Scott-Rodino Antitrust Improvements Act of 1976 created transaction dollar thresholds under which companies are not required to file for a pre-merger review with US regulators,[10] and Cunningham and others (2019) found more acquisitions occur just below this threshold than would be expected and, furthermore, that these transactions were much more likely to involve a discontinuation of research projects.[11] This suggests that the transaction prices are set with policy in mind. However, concentrating too much on this relationship might also be misleading. Acquisitions – whether killers or not – would be expected to avoid valuations just above the threshold and bunch just below the threshold, to avoid the costly process of merger review. Moreover, the empirical finding of killer acquisitions with low enough values to be manipulated below the filing thresholds is inconsistent with the theory that a killer acquisition might be identified by the large value an entrant with noteworthy potential to disrupt an incumbent could demand as a payment to forego that potential.

Second, when a given target operates in multiple geographic or product markets, the transaction value will represent an aggregation across these markets. If only some of them are candidates for the killer acquisition label, it will be much harder (or impossible) for a competition authority to determine the consideration paid specifically to the target's participation in such markets and then compare that against a reasonable benchmark. Essentially, this is a particular manifestation of the problem that innovation is not a homogenous phenomenon, and an appropriate model should separate different types.

**Remedies**

In the event that anticompetitive harm is found to be likely, then a remedy – often a divestiture of certain assets – must be identified.[12] Identifying acceptable divestiture packages for mergers involving innovation theories of harm involves two issues specific to those mergers: whether to divest products on the market or products in the pipeline, and whether the divestiture of entire products or research pipelines is necessary to make innovation competition possible. The difficulty in finding general policy answers to these questions ultimately derives from the earlier observation that economists have yet to develop a consistently applicable model of how innovations are created. Therefore, economists face difficulty in determining which alterations to the market structure will result in more innovation (ie, which divestitures will work – and may sometimes need to choose a safer, but suboptimal, path).

The first issue mentioned above arises in mergers featuring 'product-to-pipeline' competition – that is, one of the parties has a product on the market, while the other party has a competing product in development. The US Federal Trade Commission has expressed a preference for divesting the product on the market in these cases.[13] Indeed, in the recent, high-profile *Celgene/Bristol-Myers Squibb* merger, the merged entity divested Celgene's Otezla business – the product already on the market.[14] However, in the *Amneal/Impax* merger, which involved several overlapping product markets, most divestitures were of the

pipeline product; several products currently on the market were 'complicated to manufacture', and another held a monopoly position. In both cases, the Federal Trade Commission acknowledged that divesting the market product might lead to its failure, which was an unacceptable risk to consumer welfare. Therefore, they chose the safer path given case-specific facts despite their general reasons to prefer the divestiture of an established product.

'Pipeline-to-pipeline' mergers – those where the parties have products in development that would compete were they both to come to market – raise the question of the appropriate extent of the divestiture or intellectual property licensing. In some cases, again due to lack of a robust model of innovation, competition authorities worry whether divesting a particular research program will interfere with the innovation process, or whether requiring patent licensure will be sufficient to spur innovation at competing firms. For example, with respect to the *Illumina/Pacific Biosciences* merger, the Competition and Markets Authority found patent licensure to be insufficient, acknowledging the importance of 'know-how'.[15] Similarly, with respect to the Dow/DuPont merger, the European Commission required divestiture of 'almost the entirety of DuPont's global R&D organisation' since doing so would 'enable . . . a buyer to sustainably replace DuPont's competitive effect in these markets and continue to innovate'.[16]

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**Conclusion**

Evaluating innovation theories of harm is challenging because economists lack a robust, accurate model of how innovations are created; evidence and measures used in the analyses need to be selected with care because innovations are not homogenous, and the route between innovation and consumer welfare is complex; and identifying acceptable divestiture remedies involves predicting the innovation consequences of altering the market structure, which is difficult because of the lack of a robust, accurate model. Therefore, mergers raising innovation theories of harm will likely require case-specific approaches to address these challenges.

**Endnotes**

1 Kenneth Arrow, 'Economic Welfare and the Allocation of Resources to Invention' in *The Rate and Direction of Inventive Activity: Economic and Social Factors* (Universities-National Bureau Committee for Economic Research and Committee on Economic Growth of the Social Science Research Councils), 609–26.

2 Joseph Schumpeter, *Capitalism, Socialism and Democracy* (Harper & Brothers, New York 1942), 82. Cited by Carl Shapiro, 'Competition and Innovation: Did Arrow Hit the Bull's Eye', in Josh Lerner and Scott Stern (eds), *The Rate and Direction of Inventive Activity Revisited* (University of Chicago Press, Chicago 2012), 361–404.

3 *Shapiro* (n 6).

4 For a couple of examples of ways to categorise innovation, see Rebecca M. Henderson and Kim B. Clark, 'Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms', (1990) 35 *Administrative Science Quarterly* 9–30; Greg Satell, 'The 4 types of Innovation and the Problems They Solve', *Harvard Business Review* (21 June 2017).

5 European Commission, Case M. 7932 – *Dow/Dupont: Commission* Decision of 27.3.2017 [27 March 2017] ¶ 389.

6 See, for example, Stefan Wagner, 'Are "Patent Thickets" Smothering Innovation?' *Yale Insights*, interview.

7 *Bennato and others* (n 15) 6.

8 Colleen Cunningham and others, 'Killer Acquisitions' working paper [2019].

9 UK Competition & Markets Authority, 'Final Report', *Completed Acquisition by PayPal Holdings, Inc. of iZettle AB*, ¶ 11.

10 US Code, 2006 Edition, Supplement 5, Title 15 – Commerce and Trade, chapter 1 – Monopolies And Combinations in Restraint of Trade, § 18a – Premerger notification and waiting period.

11 *Cunningham and others* (n 21).

12 US Federal Trade Commission, 'Statement of the Federal Trade Commission's Bureau of Competition on Negotiating Merger Remedies' accessed 29 January 2021.

13 US Federal Trade Commission, 'Analysis of Agreement Containing Consent Orders to Aid Public Comment', *In the Matter of Amneal Holdings, LLC, Amneal Pharmaceuticals LLC, Impax Laboratories, Inc., and Impax Laboratories, LLC*, 4–5.

14 US Federal Trade Commission, 'Analysis of Agreement Containing Consent Orders to Aid Public Comment', *In the Matter of Bristol-Myers Squibb Company and Celgene Corporation.*

15 UK Competition & Markets Authority, 'Notice of Possible Remedies under Rule 12 of the CMA's Rules of Procedure for Merger, Market and Special Reference Groups', *Anticipated Acquisition by Illumina, Inc. of Pacific Biosciences of California, Inc.*, ¶ 28.

16 European Commission, 'Mergers: Commission Clears Merger between Dow and DuPont, Subject to Conditions', press release [27 March 2017].