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MERGERS AND THE INCENTIVES TO UNDERTAKE PRODUCT INNOVATION ORIENTED R&D: FIRST STEPS TOWARDS AN ASSESSMENT APPROACH

Benjamin René Kern, Juan Manuel Mantilla Contreras*[+]

ABSTRACT

The firms that compete with one another in terms of innovation do not necessarily coincide with the relevant competitors on pre-innovation product markets. As a consequence, the findings about the ambiguous interrelation between (product) market concentration and innovation cannot be transferred one-to-one to the interrelationship between innovation competition and innovation. By identifying and classifying the most relevant effects, which are decisive for the impact of mergers on the incentives to invest in product innovation oriented R&D, we will demonstrate that the interrelation between innovation competition and innovation is not always as unclear as it seems. Hence, by analyzing the model-theoretic industrial organization literature, this article aims to contribute to the discussion about the development of a decision theoretic assessment framework for analyzing the impact of mergers on innovation and is therefore also in line with the idea of a rule-based competition policy which is, from a law and economics perspective, ought to reduce error costs, give legal guidance and reduce legal uncertainty.

JEL: K21; L12; L41; O31

I. INTRODUCTION

The outstanding relevance of innovation for economic growth and consumer welfare is relatively undisputed among lawyers and economists.[1] Therefore, it is only coherent that the 2010 U.S. 'Horizontal Merger Guidelines', in comparison to its predecessor, explicitly contain the objective of the protection of 'innovation competition' as well as the consideration for innovation related efficiency gains.[2] However, until today there is no adequate and widely accepted theoretical framework for the assessment of these aspects in merger review.[3] Hence,

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1 *See* Solow (1957); Denison (1985); Graham (1979).

2 *See* U.S. Dep't of Justice & Fed. Trade Comm'n, Horizontal Merger Guidelines (1992, rev. 1997); U.S. Dep't of Justice & Fed. Trade Comm'n, Horizontal Merger Guidelines (2010), § 6.4.

3 *See* Kern (2014).

it is still not clear how antitrust agencies should actually comply with these objectives in a transparent and comprehensible manner.

The only framework that was designed particularly for the consideration of innovation effects so far was the 'Innovation Market Analysis' (IMA) of Richard Gilbert and Steven Sunshine.[4] However, after the 'IMA' was introduced in 1995, it was heavily criticized by many scholars.[5] In this connection it was argued that the 'Innovation Market Analysis' would rely on a general presumption of harm, in the sense that a higher concentrated 'Innovation Market' is generally unfavourable for innovation, although a stable interrelationship between 'market structure' and innovation was not identified.[6] The latter argument was also central in the FTC's recent decision to close the investigation of the *Genzyme/Novazyme* merger.[7] In the course of this, Chaiman Muris defended the decision against the dissenting statements of Commissioner Mozelle W. Thompson and Commissioner Pamela J. Harbour. Thereby, he relied on the findings of the 'Global Marketplace Report'[8], which revealed that there is no stable interrelation between 'market concentration' and innovation. Apart from ambiguous empirical observations[9], the report relied particularly on the model-theoretic industrial organization literature which delivered very contradictory results, showing that very competitive as well as highly concentrated (product) markets can basically spur innovation (depending on the specific assumptions made in the corresponding models). However, it is remarkable that the discussion about competition, concentration and innovation did not fully account for the crucial implications, following from the separate consideration of innovation competition on the one hand and product market competition on the other. Since the competitors on product markets and the ones which compete with one another in the sphere of innovation do not necessarily coincide, the crucial novelty of the 'IMA' was that it aimed at identifying the relevant innovation competitors independently from their role on actual product markets.[10] But, this distinction in innovation and product market competitors has, apart from its relevance for the identification of these competitors, also strong implications for the assessment of potential anticompetitive innovation effects of mergers. Consider for instance a merger which takes place between two firms that compete with one another only in

4 *See* Gilbert & Sunshine (1995a).
5 *See* Morse (2001), pp. 27; Hoerner (1995), pp. 49; Hay (1995), pp. 14; Rapp (1995), pp. 19; Gilbert & Sunshine (1995b), pp. 75; Landman (1999), pp. 728; Carlton & Gertner (2003), pp. 38; Davis (2003), pp. 680.
6 *See* Rapp (1995); Carlton & Gertner (2003); Davis (2003).
7 *See* Muris (2004), pp. 18; Thompson (2004); Harbour (2004).
8 *See* Federal Trade Commission, Office of Policy Planning (1996) [hereinafter GLOBAL MARKETPLACE REPORT], chapter 7, pp. 11.
9 For an excellent overview *see* Gilbert (2006), pp. 187.
10 *See*, Gilbert & Sunshine (1995a).

terms of innovation (leaving product market competition unaffected). This would imply that only a fraction of the insights, provided by the vast array of theoretical models, matters in this concrete merger review. Such a situation can, for example, occur when two research companies, which do only compete with one another in terms of innovation, merge. Another possible scenario, leading to such a situation, is that the firms are indeed producers of actual products, but they do not compete with one another on the same relevant product markets (pre-innovation product market competition is therefore not affected by the merger). Hence, these types of mergers require focusing on different models in order to gain insights for the assessment of possible anticompetitive innovation effects, than a merger taking place between two firms that do also compete with one another on pre-innovation product markets. As a consequence, since some mergers leave product market concentration unaffected, it is very questionable whether the findings about the ambiguous interrelationship between product market competition and innovation can be transferred one-to-one to the interrelation between innovation competition and innovation.

Therefore, this paper analyzes the model-theoretic industrial organization literature and its findings about competition and the incentives to invest in product innovation oriented R&D against the background of this distinction into innovation competition on the one hand and product market competition on the other. The decision to focus on product innovations was taken on the basis of the concerns about innovation effects, put forward in the applied merger reviews (in the U.S. as well as in the E.U.). Since, in both jurisdictions, explicit anticompetitive innovation effects were raised predominantly in connection with product innovations, we likewise focus on the effects of mergers on the incentives and abilities to undertake product innovation oriented R&D. For this purpose, we firstly reviewed the broad range of theoretical models, provided by the industrial organization literature. This step is carried out in analogy to the eminent works of Gilbert (2006)[11], and Schulz (2007)[12]. However, in comparison to these previous works we did not systematize the literature primarily according to the underlying assumptions of the models (*e.g.*, whether the models rely on perfect IPRs or not). Instead, we tried to reveal the concrete underlying mechanisms, which determine the innovation incentives in each of the examined models. By clustering these mechanisms, we received several effects, which we consider as the major impact factors for the firms' innovation incentives. By doing this, our approach is close to the seminal work

[11] *See* Gilbert (2006).
[12] *See* Schulz (2007).

of Baker[13], who also identified four important "principles" relating competition and innovation, which are particularly relevant for the assessment of innovation effects in antitrust. However, in comparison to Baker, we particularly examined the underlying mechanisms of the models with respect to the question whether they rely on pre-innovation product market competition, or not. As a consequence, we received two distinct groups of effects. The first group consists of effects which hinge on a change of current product market concentration. The second group encompasses those kinds of effect which come into play even though pre-innovation product market competition is unaffected. Consequently, the effects of the first group are only relevant, if pre-innovation product market structure is affected by a certain merger, while the effects of the second group have to be considered even in those situations in which mergers do only affect innovation competition.

However, since the changes in the firm's innovation incentives, stemming from the effects of both groups, hinge again on several determinants (*e.g.* the type of pre- and post-innovation competition, or the regime of IPRs), we again analyzed the underlying mechanisms of the models behind each effect in detail. As a consequence, we received a set of determinants which are critical for how the identified effects act on the incentives to innovate within each of the two groups. Finally, we matched the identified effects with six case groups in which mergers, affecting innovation competition, can basically take place.[14] Since not every effect is always relevant, and because of the fact that the determinants, which are decisive for the impact of a certain effect, can moreover differ from case to case, we analyzed the potential effects of a certain merger separately for each of these case groups.

Hence, we will demonstrate that the link between competition and the incentives to undertake product innovation oriented R&D, which can be derived from the industrial organization literature, is not always that unclear as it seems on the first sight. Especially with respect to mergers between firms that compete with one another in terms of innovation, absent/detached from actual product markets, the relationship appears to be far less cloudy. Besides this, we will also try to identify the most relevant effects, as well as the corresponding determinants, which have an impact on the incentives to invest in product innovation oriented R&D in a particular situation.

As a consequence, this article aims to contribute to the discussion about the development of an assessment framework for analyzing the innovation effects of mergers. It is therefore in the spirit of the idea of a rule-based competition policy which is, from a law and economics

[13] *See* Baker (2007).
[14] *See* Kern (2014), pp. 9.

perspective, ought to reduce error costs, give legal guidance and reduce legal uncertainty.[15] The identification and categorization of effects thereby provides (1) a checklist of assessment criteria which antitrust authorities should account for when analyzing the impact of mergers on the firms' incentive to undertake product innovation oriented R&D and (2) these identified effects can furthermore serve as a starting point for the development of such a decision theoretic assessment framework.

The paper is structured as follows: In Section 2 we will give an overview on the most relevant innovation effects of mergers and assign them to the two different groups (effects which hinge on pre-innovation competition and those which do not). Thereby, we will also explain the economic theory behind the respective effects and introduce the relevant determinants which are decisive for how these effects influence the innovation incentives of the merging firms. Subsequently, in Chapter 3, we will evaluate the impact of a certain merger on the incentives to invest in product innovation oriented R&D. This assessment is carried out by explicitly considering for the influence of the relevant determinants on the introduced effects under different situations. In Section 4 we will then link the insights, gained in Chapter 2 and 3, to the six case groups developed by Kern (2014)[16]. Thereby we will analyze how the characteristics of a particular case group, in the sense of relevant effects and corresponding determinants, influence the assessment of the incentives to invest in product innovation oriented R&D. Conclusions follow in Section 5.

II. Effects of Mergers which Influence the Incentives to Invest in Product Innovation Oriented R&D

Since the relevant competitors in terms of innovation do not necessarily coincide with the relevant competitors on product markets, it is possible that a particular merger has an impact on innovation competition, although product market competition is unaffected. Therefore, it is crucial to review the theoretical findings about competition and the incentives to innovate, provided by the industrial organization literature, and to analyze the corresponding theoretical models with respect to the question whether they rely on pre-innovation product market competition (group 1) or not (group 2). What is important for this approach is therefore the underlying mechanisms of the models which constitute the identified effects. Some of these effects are already well known because they are an integral part of the industrial organization

[15] *See* Easterbrook (2006); Christiansen & Kerber (2006).
[16] *See* Kern (2014), pp. 9.

literature. Famous examples are, for instance, the "replacement effect"[17] or the "escape competition effect"[18]. Others, however, are less prominent. Hence, in the following we will give an overview on the most relevant effects, which belong either to group 1, or group 2, and discuss how they basically influence the firms' incentives and abilities to innovate. By doing this, we will not only give reason for the allocation of the effects towards the two groups. Furthermore we will also identify the relevant determinants which are decisive for the impact of each effect on the firms' innovation incentives. These determinants are derived from the assumptions made in the different models (*e.g.* assumption about the type and characteristics of pre- and post-innovation competition, or about the regime of IPRs). As a consequence, we will subsequently analyze how these determinants influence the functioning, and thus also the impact of each effect on the incentives to innovate, under different situations.

A. Effects which come into play when Pre-Innovation Product Market Competition is affected

Even though the identification of innovation competitors independently of the firms' role on current product markets allows considering for innovation competition independently of pre-innovation product market competition (since the pre-innovation product market competitors cannot be equated to innovation competitors), pre-innovation product markets can still have an effect on the firms' incentives to invest in product innovation oriented R&D. Thus, we want to find out: (1) what are the relevant effects which have to be assessed in the review of a merger of two innovation competitors that do also compete with one another on the respective pre-innovation product market? (2) When and how are they triggered by mergers and acquisitions?

1. Financial Base Effect

A very popular argument why product market concentration affects the incentives and abilities to innovate is that firms, which possess market power, can finance their R&D projects more easily due to higher profit margins. This argument, which goes back to Schumpeter[19], implies that firms, which operate under intense competition, generate merely little or even zero profits (in the extreme case of perfect competition), leaving no room for R&D investments. Hence, an increase in product market concentration might be beneficial to innovation in the sense that firms are enabled to undertake R&D in the first place. However,

[17] *See* Arrow (1962).
[18] *See* Aghion, et al. (2001); Aghion, et al. (2005); Bonanno & Haworth (1998); Boone (2001).
[19] *See* Schumpeter (1942); Evans & Hylton (2008).

critics also claimed that this argument has only limited relevance, because the firms, independent of their own financial base, have the alternative to finance their R&D investments by the capital market.[20]

Nevertheless, if we consider capital markets as being imperfect, a merger, which increases a firms' market power, can still be beneficial to innovation, because it improves the firms' financial base. However, this requires that the type of competition is not close to a Bertrand like price-competition. In this case, the merger would have only a very limited effect on the firms' profit margins. Similar considerations come into play if we consider the merging firms as competitors which indeed compete with one another on an actual product market, but with differentiated products. Hence, in analogy to the conventional assessment of static price effects, the diversion ratio, and thereby the question whether the products are close ore rather far substitutes, appears to be decisive.[21]

2. The Escape Competition Effect

Closely linked to the last effect is the so called "escape competition effect".[22] Even though arguing from the opposite direction, the idea behind this effect is that very intense pre-innovation product market competition can also generate high innovation incentives, because the firms might wish to escape this competitive environment by inventing new products which create a new (less competitive) relevant product market.[23]

How a certain merger will reduce this "escape competition effect" depends mainly on how competition intensity has to be characterized in a particular situation.[24] If the number of competitors is the decisive factor, a merger will, by eliminating a competitor, most likely reduce the incentives to invest in product innovation oriented R&D. If, however, competition is intense because of a Bertrand like price-competition, then mergers will probably not affect the "escape competition effect" (unless the merger leads to a monopoly).[25] The same holds true for situations in which the merging parties compete with one another with differentiated products, which can furthermore be characterized by a low diversion ratio.[26] Thus, in the case of differentiated products, the negative effect on innovation incentives via the "escape

[20] *See* Modigliani & Miller (1958).
[21] *See* Belleflamme & Vergari (2011).
[22] *See* Aghion, et al. (2001); Aghion, et al. (2005); Bonanno & Haworth (1998); Boone (2001); Belleflamme & Vergari (2011).
[23] *See* Aghion (2005).
[24] *See* Bonanno & Haworth (1998).
[25] *See* Delbono & Denicolo (1990).
[26] *See* Belleflamme & Vergari (2011).

competition effect" appears to be particularly relevant, whenever the merging parties are producers of close substitutes.

3. Pre-Innovation Market Size and Appropriability Effect

Another important effect which is also an inherent part of a vast amount of theoretical models, results from the size of a firm's share of a certain pre-innovation product market. However, the role of the pre-innovation product market size for the incentives to innovate is twofold:

It has been shown that firms, which have a high market share, have stronger incentives to invest in process innovations.[27] This is due to the fact that process innovations, offering cost-cutting potentials, are particularly profitable whenever these cost-cuttings come into place in combination with a large output. Consequently, the incentives to undertake R&D towards process innovations are higher for firms which possess a relatively high market share, while the incentives to strive for product innovations are often assumed to be particularly prevalent for fringe firms, which have solely a small market share.[28] As a consequence, it can be assumed that an increase of the pre-innovation market share has a negative impact on the proportion of the overall R&D budget which is spend for product innovation oriented R&D.

Nevertheless, the firms' share of a pre-innovation product market might still have a positive impact on the appropriability of profits, even if these profits stem from product innovations. As a consequence, in such situations, the incentives to invest in product innovation oriented R&D can improve, even though the distribution of the overall R&D budget actually changes at the expense of these kinds of R&D expenditures. However, those situations require that the pre-innovation product market share has a strong connection to the post-innovation product market share and this condition is, in contrast to process innovation oriented R&D, less stable. In regard to product innovations, a high market share on a pre-innovation product market has solely then a positive effect on the appropriability of innovation profits, as long as the pre-innovation product market share can be sufficiently transmitted to the post-innovation product market. In other words, a high market share on a pre-innovation product market has a positive effect on a firm's incentives to invest in product innovations, as long as these innovations do not constitute an entirely new relevant product market. Otherwise it is rather the characteristics and the competition intensity of the post-innovation product market (which has only a limited or no connection to the current pre-innovation product market), which determines the incentives to innovate ("Schumpeterian

[27] *See* Bonanno & Haworth (1998); Boone (2000); Dutta, et al. (2005); Schmutzler (2010); Baker (1994); Yin & Zuscovitch (1998); Vives (2008).

[28] *See* Yin & Zuscovitch (1998).

Rents")[29]. This implies that the incentives to invest in product innovations (via the "pre-innovation market size and appropriability effect") are only then positively influenced by the pre-innovation market share, when it comes to incremental product innovations.[30] For radical product innovations, the pre-innovation market share has no positive effect (leaving the "financial base effect" aside). Moreover, as soon as we expect that firms can protect their innovations sufficiently by IPRs, granting them a temporal monopoly position, the role of pre-innovation market shares additionally loses relevance. Hence, the findings that a higher market share generates higher innovation incentives because of a better appropriability cannot be transferred one-to-one to product innovations.

Thus, how does a merger, which changes the firms' market share on a pre-innovation product market, influence the firm's incentives to invest in product innovations via the "pre-innovation market size and appropriability effect"? If competition authorities can expect that firms can protect their innovations sufficiently by IPRs (by gaining a monopoly position after introducing an innovation), there are no arguments why this effect should have a positive impact on the firms' incentives to invest in product innovation oriented R&D. If IPRs are, however, considered as insufficient (*e.g.* because inventing around is expected to be quite likely), there might appear a positive impact regarding the incentives to invest in R&D towards the generation of incremental product innovations as a result of the augmented market share. Nevertheless, with respect to radical product innovations, the effect should again be negligible. There is, however, a general negative impact on the incentives to invest in product innovations, since the merged entity has an incentive to spend a higher fraction of the overall R&D budget on process innovations.

However, in analogy to the effects discussed before, also this effect loses its relevance, whenever the merger takes place between firms which compete with one another on pre-innovation markets by offering differentiated products which can be characterized by a low diversion ratio.

4. Increase in the Extent of a Replacement Effect

The idea of a "replacement effect" goes back to Kenneth Arrow.[31] In this connection he assumed that firms, which possess market power on pre-innovation markets, have lower incentives to invest in R&D, because the benefits from an innovation will be devoured to a large extent by the loss of previous profits. In terms of product innovations this would apply

[29] *See* Rumelt (1987); Chen & Schwartz (2010); Aghion, et al. (2005).
[30] *See* Greenstein & Ramey (1998); Shaked & Sutton (1982); Shaked & Sutton (1983).
[31] *See* Arrow (1962); *See also* Reinganum (1989).

when a newly invented product replaces the old one by, in an extreme case, making it entirely obsolete. If, however, the degree of replacement is merely little (*e.g.* because the firm can still sell both the new and old product simultaneously to different types of consumers) then this effect becomes less important.

As a consequence, if the introduction of a new product is expected to have a significant replacement effect on existing products, a merger, which increases pre-innovation market power, will also increase the extent of the replacement effect. This is the case as long as the firms do not compete with one another in terms of a Bertrand like price-competition (pre-innovation profits and thus the extent of the replacement effect would be virtually unaffected) and, in the case of differentiated products, as long as the firms' products are close substitutes (otherwise the replacement effect will be less relevant).

However, it is not clear how the increase of the replacement effect will affect the firm's innovation incentives at the end of the day. It is possible that the merger will diminish the incentives to innovate because, due the increase in pre-innovation product market power (and thus pre-innovation profits), the firm has "less to win" after introducing a new product (the difference between pre-innovation and post-innovation profits declines). But, an increase in pre-innovation market power can also increase the firms' incentives to innovate because the firm has simultaneously "more to lose". This is the case, if another firm introduces a product innovation which has a replacement effect on the firm's current product. Hence, the increase in pre-innovation market power can also increase the firms' incentive to undertake R&D in order to defend its current market position.

Therefore, in order to determine whether the increase in pre-innovation market power in- or decreases the firm's innovation incentives via the replacement effect, it is decisive to find out whether the merged entity must fear that another firm could introduce a product which has a replacement effect on its current products (and profits), or not. It can be suggested that in analogy to the differentiation in the literature on potential competition there are two different types of the replacement threat.[32] Firstly, one can think of a replacement threat because the entity "observes" that another firm is already undertaking R&D towards the generation of a product which would replace its own products and profits. Apart from this "actual replacement threat" one can secondly think of a "perceived replacement threat". The idea behind this notion of the replacement effect is that even though the entity does not "observe" that another firm is already working on such a product innovation, there is still a reasonable risk that a replacement takes place. This risk hinges on the existence and relevance of entry

[32] *See, e.g.,* Areeda & Turner (1980).

barriers, necessary to undertake R&D towards product innovations which will have a replacement effect on the incumbent firm's products. As soon as these entry barriers are considered to be low, the firm's innovation incentives would increase as a consequence of the increase in pre-innovation market power.[33] However, whenever these entry barriers are considered to be high, the overall change of the innovation incentives via the "perceived replacement effect" will most likely be negative.

Therefore, what is crucial for assessing the overall direction of an increase in the extent of a replacement effect on the firms' incentives to innovate is (1) the investigation of the R&D projects which are already underway ("actual replacement threat") and (2) the existence and relevance of entry barriers for entering the process of innovation competition ("perceived replacement threat").

B. Effects which come into play even though Pre-Innovation Product Market Competition is unaffected

Besides the effects discussed within the previous section, there are also several effects which come into play because they are triggered by a change in innovation competition, even though pre-innovation product market structure is unaffected.

1. Entry Barriers & the Monopolization of Critical Assets Effect

The role of entry barriers is generally a decisive criterion for the assessment of innovation effects of mergers. This stems from the fact that already the identification of the relevant innovation competitors requires that the participation in the process of innovation competition prerequisites that the firms possess specific specialized assets.[34] Otherwise, if these entry barriers cannot be defined, innovation competition has to be understood as a process which is quite open. However, whenever R&D in a certain field indeed requires specialized resources, mergers can lead to a further agglomeration of these assets (*e.g.* patents or specially trained staff). This can additionally hamper, and/or create disincentives for, potential innovation competitors to enter the process of innovation competition.[35] This is particular critical in connection with the "perceived replacement threat effect", because it could allow the firm to shield itself from potential innovation competition. However, it has to be acknowledged that this is only problematic in the case of substitutive assets/resources. In the case of complementary assets, a merger can be beneficial for innovation because it might enable

[33] *See* Greenstein & Ramey (1998).
[34] *See* Gilbert Sunshine (1995a); Kern (2014).
[35] *See* De Bondt (1977); Vives (2008).

firms to innovate more efficient/rapidly.[36] These considerations should therefore be subject within the investigation of merger specific efficiency gains.

2. *Elimination of an Actual Replacement Threat Effect*

In the last section we have discussed how an increase in pre-innovation market power can influence the firms' incentives to innovate by augmenting the extent of the replacement effect. Even though the replacement effects generally requires that a link between pre-innovation product markets and product innovations exists, the replacement effect can still play an important role even though pre-innovation product market structure and thus the extent of the replacement effect is unaffected by the merger. This is the case when the target firm is actually the main source for a menacing replacement of the acquiring firm's products (*e.g.* because the target firm is the only firm currently undertaking R&D in this field or because other firms are way behind in the innovation process or lack crucial assets). Thus, even though pre-innovation product market structure is not affected by the merger, the replacement effect still plays an important role because the acquiring firm would practically eliminate the most relevant threat for its pre-innovation profits. As a consequence, even though also this feature of the replacement effect is closely linked to existing product markets, the "elimination of an actual replacement threat" affects the firms' incentives to innovate by avoiding that the replacement takes place, irrespective of the fact whether the target firm is an actual pre-innovation product market competitor, or not.

Therefore, what seems to be crucial for evaluating the "elimination of an actual replacement threat-effect" is to find out whether there are still enough other firms which are likewise planning to introduce a product innovation which is expected to have a replacement effect on the merging firms' products.[37] If this is not the case, it is again the relevance and existence of entry barriers which determines whether the elimination of an actual replacement threat has a negative impact. If entry barriers are high, the elimination will most likely have a negative effect on the firms' innovation incentives. Hence, the assessment of these determinants (actual replacement threat and perceived replacement threat) again seems to be decisive for assessing the effect of the loss of a potential innovator (threatening current product market profits) for the firms' incentives to innovate.

[36] *See* Cassiman, et al. (2005).
[37] *See* Gilbert (2006).

3. Post-Innovation Product Market Competition and Appropriability Effect

The relevance of the characteristics of post-innovation product markets and the degree of competition on these markets is usually discussed in connection with the expected innovation profits after the innovation is introduced (Schumpeterian Rents).[38] The "pre-innovation market size and appropriability effect", introduced in the previous chapter, purposely captured only the effects, stemming from pre-innovation product market shares for the appropriability of innovation profits. Hence, the "post-innovation product market competition and appropriability effect" completes our considerations by accounting for the relevant innovation competition and its impact on post-innovation profits. Although the capability of the firms to appropriate their innovation profits was also decisive in connection with the "pre-innovation market size and appropriability effect", this condition was exclusively affected by the firm's pre-innovation market share. In comparison to these considerations, this effect directly accounts for the expected characteristics of post-innovation product market competition. Hence, in contrast to our considerations about pre-innovation product market competition, the decisive factor which determines the expected degree of competition on a post-innovation product market is not the distribution of current market shares and thus not the degree of current product market competition, but current innovation competition. What is crucial in this respect is therefore the innovator's ability to exclude rivals from imitation, the number of firms which are likewise undertaking R&D and the size and characteristics of the post-innovation product market (including the expected type of competition on post-innovation markets, *e.g.*, Bertrand or Cournot, etc.). This becomes evident, if we consider that a large innovation reward will most likely attract many firms which likewise invest in R&D. As a consequence of this increase in innovation competition, the firms' innovation efforts will most likely increase because each firm has an incentive to be the first to invent, either in order to file a patent or due to possible first mover advantages (stimulus effect).[39] But, whenever the firms can protect their innovations only insufficiently by IPRs, too much competition might also lead to a decrease of the incentives to invest in R&D, because the profits of an innovation have to be shared with too many competitors (market room factor).[40] In an extreme case, the whole R&D process might even break down, because the profits, which each single firm can capture, are so little that the R&D cost cannot be recouped.[41] However, what should have become clear is that post-innovation product market competition hinges on today's intensity

[38] *See* Loury (1979); Dasgupta & Stiglitz (1980); Aghion, et al. (2005); Lee & Wilde (1980).
[39] *See* Scherer & Ross (1990); Kamien & Schwartz (1976); Fudenberg, et al. (1983).
[40] *Ibid.*
[41] *See* Scherer & Ross (1990).

of innovation competition and not necessarily on today's pre-innovation product market competition.

If the firms are, however, able to protect their innovations sufficiently by IPRs, this aspect becomes less relevant.[42] Even though the patent race literature indeed suggests that the R&D expenditures per firm will decline as the number of competitors increases (because the probability that another firm wins the race is augmented), the aggregated R&D expenditures are still higher under intense competition and the probability that an innovation is achieved earlier is augmented.[43] Hence, a crucial factor for the analysis of the "post-innovation product market competition and appropriability effect" is whether the firms can protect their innovations sufficiently by IPRs, or not. If IPRs are insufficient, competition authorities have to balance the "stimulus factor" against the "market room factor" in order to estimate the overall impact of this effect on the innovation incentives.

Nevertheless, there is another theoretical argument why mergers between two innovation competitors might not have a negative (or maybe even a positive) effect on the firms' incentives to innovate. This argument hinges on asymmetries between the competitors progresses regarding their attempt to achieve a certain innovation. In particular, the asymmetries among the research projects might have strong implications for the incentives to innovate if, for instance, the distance in progress between the firms' R&D programs is so large, that the laggard firm is close to give up and stop its R&D efforts.[44] Under such a setting (a leading firm and a laggard firm merge), a merger will most likely not diminish the firms' incentives to undertake product innovation oriented R&D. In the case that two laggard firms merge, this event might even increase the firms' incentives, if the merger allows them to catch up with the leader. If, however, the distance among the research projects is short and competition is intense, a merger will affect the firms' innovation incentives as described before in connection with the "post-innovation product market competition and appropriability effect".

Besides the fact that differences the firms' R&D programs matter, it is also important to consider for the circumstance whether the laggard firm can be expected to catch up with the leader via leapfrogging.[45] If an innovation is expected to require knowledge accumulation or a certain "stock of knowledge",[46] leapfrogging is less likely to occur and the distance between

[42] *See* Reinganum (1989).
[43] *See* Loury (1979); Dasgupta & Stiglitz (1980).
[44] *See* Fudenberg, et al. (1983); Harris & Vickers (1987); Lippman & McCardle (1987); Grossman & Shapiro (1987); Doraszelski (2003).
[45] *See* Vickers (1986); Harris & Vickers (1987); Harris & Vickers (1985).
[46] *See* Fudenberg, et al. (1983); Doraszelski (2003).

the firms' R&D programs matters as described in the last paragraph. But, whenever leapfrogging is deemed as possible (either because an innovation is not expected to require knowledge accumulation/a certain stock of knowledge, or because it can be expected that knowledge can easily be acquired and adopted), even the acquisition of a laggard firm could be anticompetitive.

4. Internalization of Spillovers Effect

The argument about an increase of innovation incentives due to an internalization of R&D spillovers was most prominently captured by d'Aspremont and Jacquemin.[47] Hereby the authors showed that the existence of these spillovers can lead to an underinvestment in R&D because an extensive part of the knowledge, generated by the entity which undertakes the R&D efforts, drains off and has to be shared with the firm's competitors. As a consequence, a positive side effect of the merger might be the internalization of such spillovers, leading to an increase of innovation incentives.

III. Evaluation of the Effects of Mergers on the Incentives to Invest in Product Innovation Oriented R&D

The previous chapter represents a synopsis of the most relevant effects of mergers on the incentives to undertake product innovation oriented R&D, provided by the industrial organization literature. But, how do the identified effects work under different situations? In the assessment above we have seen that the changes of the firms' innovation incentives, stemming from the effects of both groups, hinge again on several determinants (*e.g.* the type of pre- and post-innovation competition, or the regime of IPRs). As a consequence, by looking through the introduced effects, we receive a set of determinants which are decisive for analyzing the impact of each of the identified effects on the incentives to innovate.

For the effects of the first group (effects which stem from a change in pre-innovation product market competition) these decisive determinants were:

- The type of pre-innovation product market competition (Bertrand, Cournot, etc.)
- The relevance of IPRs as well as the differentiation of product innovations into radical (in the sense that a new product market is created) and incremental product innovations
- The existence of an "actual replacement threat" as well as the existence and relevance of entry barriers for a "perceived replacement threat"

[47] *See* D'Aspremont & Jacquemin (1988).

For the effects of the second group (effects which do not stem from a change in pre-innovation product market competition) the decisive determinants were:

- The distinction between a complete and incomplete elimination of an "actual replacement treat" and the existence and relevance of entry barriers for a "perceived replacement threat"
- The relevance of IPRs, and, in the case of insufficient IPRs, the type of post-innovation product market competition (Bertrand, Cournot, etc)
- The distinction between situations in which leapfrogging is expected to be likely or unlikely and, in the latter case, the differentiation into "neck and neck", "leader and laggard" and "laggard and laggard" innovation competitors

An overview on the effects of each of the two groups, as well as the corresponding relevant determinants, can be found in table 1 (for group 1) and table 2 (for group 2). The effects of table 2 have to be considered in any case in which the merging parties are considered as innovation competitors, while the effects of table 1 do only play a role when the merging parties do also compete with one another on the respective pre-innovation product markets. In both tables the relevant effects are listed on the y-axis. The determinants, which characterize either the type of current pre-innovation product market competition (table 1), or the type of post-innovation product market competition (table 2), are listed on the x-axis.

Besides this, the two tables also provide a first evaluation of how a certain merger will, ceteris paribus, affect the innovation incentives of the merging parties via the identified effects under different situations (characterized by the respective determinants introduced above). In this connection we differentiated between three basic directions of how a certain effect can affect the innovation incentives of the merging parties; (1) Either the impact of the effect is approaching zero ($\rightarrow 0$), (2) the effect is expected to be positive (+), or (3) the effect is expected to be negative (-). However, since the evaluation of the effects is carried out in a ceteris paribus analysis, which implies that each effect is evaluated isolated (holding all the other effects constant), the following tables provide solely a rough guidance.

Table 1: How does a merger between two innovation competitors change the merging firms' incentives to undertake product innovation oriented R&D (caused by mergers which also affect Pre-Innovation Product Market Competition)?

Type of Pre-Innovation Product Market Competition / **Effects**	homogeneous products		differentiated products	
	competition in price	competition in quantity	close substitutes	far substitutes
Financial Base Effect	→0	+	+	→0
Escape Competition Effect	→0	-	-	→0
Pre-Innovation Market Size and Appropriability Effect				
- Perfect IPRs	→0/-	→0/-	→0/-	→0/-
- Imperfect IPRs (radical)	→0/-	→0/-	→0/-	→0/-
- Imperfect IPRs (incremental)	+/-	+/-	+/-	+/-
Increase in the Extent of a Replacement Effect				
- No Actual Replacement Threat and High Entry Barriers	→0	-	-	→0
- Actual Replacement threat and/or Low Entry Barriers	→0	+	+	→0

"→0" stands for: *is approaching zero*; "-" stands for: *negative impact*; "+" stands for: *positive impact*

Source: Authors

The "financial base effect" has either a positive impact on the firms' innovation incentives or its impact is approaching zero. This stems from the fact that a merger of two innovation competitors which do also compete with one another on pre-innovation product markets will increase the firms' pre-innovation market power and thus also their profits, as long as the firms' products are relatively close substitutes and the competition on this market is not characterized by a Bertrand like price competition. Hence, the firms' financial base improves and the ability to invest in R&D will increase.

The same (although with inverted sign) holds true for the "escape competition effect". Once the merger increases the firms' profits on a pre-innovation product market, the necessity

to escape the current product market competition is reduced and the impact on the firms' incentives to undertake product innovation oriented R&D is therefore negative.

The "pre-innovation market size and appropriability effect" has generally either a negative impact on the firms' incentives to invest in product innovation oriented R&D, or its impact is approaching zero. This stems from the fact that the pre-innovation product market share of the acquiring firm will increase due to the transaction. As a consequence of this increase in market share, the incentives to invest in process innovation oriented R&D are augmented. This can result in a shift of financial resources away from product innovation oriented R&D towards process innovation oriented R&D. The only possible impact of the "pre-innovation market size and appropriability effect" might occur with respect to the incentives to undertake R&D towards the development of incremental product innovations. In this connection an increase of the firm's market share can increase the incentives to invest in product innovation oriented R&D, despite an eventual reallocation of the firm's R&D budget.

The last effect which has to be considered within this first group is the "increase in the extent of a replacement effect". In analogy to the "financial base effect" and the "escape competition effect" the innovation incentives are only affected by the merger if it leads to increasing profits on the pre-innovation product market (as long as the firms' products are relatively close substitutes and competition on this market is not characterized by a Bertrand like price competition). In dependence of the existence of an "actual" or a "perceived replacement threat", the effect has either a positive or a negative impact on the firms' innovation incentives. If an "actual replacement threat" exists and/or the entry barriers are considered to be low, the increase in profits on the pre-innovation product market leads to increased innovation incentives. This happens because the firm has "more to lose" after the merger. However, in a scenario of a missing "actual replacement threat" and high entry barriers, the firm would be well protected against a potential replacement but would simultaneously have "less to win" after the merger. This is the case because the profits, which can additionally be earned as a consequence of the introduction of a new product, are lower than before the merger.

Table 2: How does a merger between two innovation competitors change the merging firms' incentives to undertake product innovation oriented R&D (caused by mergers which do not necessarily affect Pre-Innovation Product Market Competition)?

Type of Post-Innovation Product Market Competition / **Effects**	perfect IPRs	imperfect IPRs			
		homogeneous products		differentiated products	
		competition in price	competition in quantity	close substitutes	far substitutes
Entry Barriers & the Monopolization of Critical Assets Effect	-	-	-	-	-
Elimination of an Actual Replacement Threat Effect					
- Complete Elimination of the Actual Replacement Threat and High Entry Barriers	-	-	-	-	-
- Incomplete Elimination of the Actual Replacement threat and/or Low Entry Barriers	→0	→0	→0	→0	→0
Post-Innovation Competition and Appropriability Effect					
- Leapfrogging is Expected to be Likely	-	→0	+/-	+/-	→0
- Leapfrogging is Expected to be Unlikely (neck and neck)	-	→0	+/-	+/-	→0
- Leapfrogging is Expected to be Unlikely (leader & laggard)	→0	→0	→0	→0	→0
- Leapfrogging is Expected to be Unlikely (laggard & laggard)	→0/+	→0/+	→0/+	→0/+	→0/+
Internalization of Spillovers Effect	+	+	+	+	+

"→0" stands for *is approaching zero*; "-" stands for *negative impact*; "+" stands for *positive impact*

Source: Authors

Once competition in innovation is considered as a process which requires critical specialized assets, the acquisition and monopolization of such (substitutive) assets will most likely have a negative impact on the firm's incentives to innovate. This stems from the fact that this monopolization shields the firm from potential innovation competition which, absent the merger, could *e.g.* lead to a replacement of current products.

The evaluation of the "elimination of an actual replacement threat effect" hinges on the fact whether the merger sufficiently eliminates the menacing replacement threat or not. If the

acquirer assimilates the only firm which represents a serious source for a replacement threat and entry barriers are furthermore high, than the effect will have a negative impact on the firm's innovation incentives. If the merger, however, leads either only to an incomplete elimination of the actual replacement threat or the elimination is complete but entry barriers are very low, than the impact will most likely be approaching zero.

The evaluation of the impact of the "post-innovation product market competition and appropriability effect" is probably the most complex one. This stems from the fact that its impact on the firms' incentives hinges on several determinants. Since intense innovation competition can create high innovation incentives (because each firm has an incentive to innovate first), but too much innovation competition can also cause appropriability problems, a merger can lead to both, an in- or a decrease of innovation incentives. A crucial factor which determines whether the effect goes in the one or the other direction is the distinction into situations in which IPRs allow only for an insufficient protection of an introduced innovation, and those situations in which an innovation is well protected by intellectual property rights. But, under insufficient IPRs, the impact of the effect is furthermore determined by the expected type of post-innovation product market competition. The appropriabilty, and thus the innovation incentives, will *e.g.* not change significantly, if the future products of the merging parties were expected to be solely far substitutes or to compete with one another in a Bertrand like price competition. If the these products are, however, expected to be relatively close substitutes, the incentives can increase, if the positive influence of a change in the "market room factor" overcompensates the negative influence of a change in the "stimulus factor". Nevertheless, besides the characteristics of IPRs and the type of post-innovation product market competition, it is also decisive whether leapfrogging is expected to be possible and, if this is not the case, whether the merging firms are neck-and-neck innovation competitors. The previous considerations about the impact of this effect hold only true, if at least one of these two properties is fulfilled. Otherwise, the merger will most likely not affect the firms' innovation incentives (*e.g.* in the case of a leader and a laggard competitor which was close to giving up) and, in the case of a merger between two laggard competitors, the merger can even increase the firms' innovation incentives because it prevents them from dropping out of the competition process.

The last effect which has to be assessed is the possibility that knowledge spillovers get internalized. Hence, whenever significant spillover effects between the merging firms existed before the merger, the internalization of these spillovers will most likely increase the firms' innovation incentives.

IV. Assessing the Incentives to Invest in Product Innovation Oriented R&D within Six Distinct Case Groups

A. Six Case Groups of Innovation Competition Mergers

Since not every effect is always relevant and because of the fact that the determinants, which are decisive for the impact of a certain effect, can differ from merger case to merger case, the first step towards the development of an assessment framework is to identify groups of merger cases which share the same properties. Consequently, each of these case groups encompasses those kinds of merger cases which require the assessment of similar effects and determinants. Thus, the review process varies from case group to case group, but remains consistent and uniform within each case group. As a consequence, such an approach allows to combine the objective of accounting for the specific characteristics of each merger case with the requirement that this assessment is carried out in a consistent and transparent manner.

As it was shown in Kern (2014)[48], there can basically emerge six distinct scenarios in which a merger, which affects innovation competition, can take place from an antitrust authority's perspective. In this connection it was proposed to differentiate between mergers in which the relevant innovation competitors correspond to the relevant competitors on the respective pre-innovation product markets and (2) those kind of mergers in which innovation competition takes place detached/absent from pre-innovation product market competition. Therefore, the firms which are involved in a merger (which raises anticompetitive concerns with respect to innovation) can, but do not necessarily have to, be pre-innovation product market competitors. Beside this, it was suggested to account for the fact whether antitrust authorities can "observe" the R&D projects of the merging parties and their competitors (*e.g.* because of FDA approval procedures in pharmaceutical mergers)[49], or whether the authorities have difficulties in doing so. In the latter case, antitrust authorities have to rely on "specialized assets" which are deemed as indispensable for undertaking R&D in a certain field of research.[50] As a consequence, besides the distinction in mergers which affect pre-innovation product market competition and those which exclusively affect innovation competition, is it further necessary to differentiate between mergers (1) in which R&D is "observable" and those (2) in which the agencies have to rely on the "specialized assets". Nevertheless, in the case of "observable" R&D projects it is moreover important to distinguish between R&D projects which are expected to create an entirely new product market (close to the idea of radical/drastic innovations) and those, which will most likely

[48] *See* Kern (2014), pp. 9.
[49] *See* Carrier (2008), pp. 401.
[50] *See* Gilbert & Sunshine (1995a).

result in a product which still belongs to an already existing product market (close to the idea of incremental innovations). Thus, the subcategory of "observable" R&D has to be further refined into "observable" R&D which constitutes a new product market and "observable" R&D which does not constitute a new market. This distinction leads to the following six Case Groups:

Table 3. Overview on Six Case Groups of Innovation Competition Mergers

	The Merging Firms are Pre-Innovation Product Market Competitors	The Merging Firms are not Pre-Innovation Product Market Competitors
Identification by required Specialized Assets	(1)	(2)
"Observable" R&D Projects which create a New Relevant Product Market	(3)	(4)
"Observable" R&D Projects which do not create a New Relevant Product Market	(5)	(6)

Source: Kern (2014).

It is evident that in some merger cases competition authorities have to account for the whole range of identified effects, because the merger will alter both, pre-innovation product market structure and the competitive structure regarding innovation competition (*i.e.* in case group 1, 3, and 5). This stems from the fact that in these mergers the innovation competitors do also compete with one another on the respective pre-innovation product market. As a consequence, such a merger will alter both, pre-innovation product market structure as well as the competitive structure with respect to innovation competition. Therefore, also the incentives to innovate will be affected by both changes.

In other merger cases, however, only a limited number of the introduced effects appear to be relevant. This is particular true for those kinds of mergers in which current pre-innovation product market structure is unaffected by a merger (*i.e.* case group 2, 4, and 6). Hence, in contrast to case group 1, 3, and 5, mergers between firms which compete with one another only in regard to innovation do not change the actual pre-innovation product market structure. Thus, the incentives and abilities to innovate, stemming from the nature and characteristics of pre-innovation product market competition, are not affected by such kind of mergers. As a consequence, many insights regarding the firms' incentives and abilities to invest in R&D,

provided by models which rely on mechanisms, rooted in pre-innovation product market competition, do not hold anymore in such a situation.

B. Assessing the Innovation Incentive Effects of Mergers within the Six Case Groups

1. The Merger Affects Innovation Competition as well as Pre-Innovation Product Market Competition and the Firms are identifiable by the required Specialized Assets

This first case group is probably the fuzziest and most ambiguous one, making it very difficult to assess. This stems from the fact that the R&D projects, in these merger cases, cannot be "observed" and pre-innovation product market competition as well as innovation competition is affected. Hence, a merger which takes place in such an environment will influence the firms' innovation incentives via both channels. As a consequence, competition authorities have to analyze each of the introduced effects carefully in order to come to a satisfactory assessment.

In regard to the effects, stemming from a decrease in pre-innovation product market competition, it has to be assessed whether:

- The financial base of the merging parties improves and whether this will have a significant effect on the firms' capability to invest in R&D, or whether this increase will only play a minor role for financing R&D, because of an already high financial base (due to a large firm size or substantial market power on other markets).
- The incentives to escape the respective pre-innovation product market are reduced by the merger and whether this reduction is substantial, or whether there are still enough competitors left who ensure that the competitive pressure on the actual pre-innovation product market is upheld.
- The incentives to invest in product innovation oriented R&D are reduced due to an increase of the pre-innovation market share and a consequential reallocation of the R&D budget away from product oriented - towards process oriented R&D, or whether these incentives are expected to increase in the case of imperfect IPRs in combination with incremental product innovations. As a consequence of the fact that R&D projects can hardly be "observed" in this case group, this differentiation between radical and incremental product innovations will probably be difficult to assess. Hence, in these merger cases it will be very challenging to reveal the overall impact of this effect.
- A replacement effect is likely to occur and if so, whether the merger augments its extent. In order to find out whether the merger will rather in- or decrease the firms' innovation incentives via this effect, competition authorities have to assess whether an "actual"

and/or "perceived replacement threat" exists. This requires analyzing the current and "observable" research projects of the merged entity's innovation competitors as well as the existence and relevance of entry barriers. Since this case group is characterized by R&D projects which can hardly be "observed", the investigation of the replacement effect has to be carried out predominantly by analyzing the entry barriers in the sense of specialized assets which are necessary to undertake R&D towards product innovations which will have a replacement effect on the firms' products. If these entry barriers are low, the increase in market power will most likely lead to an increase of innovation incentives, because after the merger the firm has "more to lose". However, the incentives will rather decline, if the entry barriers are high. This stems from the fact that the merged entity has firstly "less to win" and secondly because the perceived threat, that a replacement takes place, is low.

In regard to the effects, which do not hinge on pre-innovation product markets, it has to be assessed whether:

- The merger leads to a monopolization of critical specialized assets (*e.g.* patents) which are decisive for taking part in the process of innovation competition.
- The merger will lead to an elimination of an actual replacement threat and if so, whether there are still enough competitors left, which ensure that the competitive pressure is upheld. This assessment is again quite difficult due to the fact that the R&D projects can hardly be "observed". Instead, it is again helpful to assess the existence and relevance of entry barriers in the sense of specialized assets which are necessary to undertake R&D towards product innovations which will have a replacement effect on the incumbent firms' products.
- The incentives to innovate are changed via the "post-innovation product market competition and appropriability effect". In this connection it is first of all crucial to find out whether innovation profits can be appropriated due to the existence of strong IPRs, or whether IPRs have to be considered as imperfect and insufficient. In the latter case, it is furthermore important to get an impression of the post-innovation product market characteristics and the expected type of competition. On this basis, competition authorities have to assesses whether the reduced "stimulus effect" or rather the improved "market room factor" has a stronger impact on the firm's innovation incentives. Apart from that, it is also important to investigate whether one of the competitors is way ahead in the innovation process, or not. However, since the possibility to "observe" whether one

firm is ahead, or not, is not provided in these kinds of merger cases, the influence of distance on the innovation incentives will most likely play a minor role in the corresponding assessment.

- The merger between two innovation competitors is expected to lead to a noticeable internalization of R&D spillovers. If this is the case, the merger might have a positive impact on the firms' innovation incentives due to the internalization of these spillovers.

Prominent merger cases which fall into this case group are, for instance, the proposed mergers of GM and ZF[51] or Lockheed Martin and Northrop Grumman[52], as well as the merger of Halliburton and Dresser.[53]

2. The Merger affects only Innovation Competition and the Firms are identifiable by the required Specialized Assets

In comparison to case group 1, the analysis of effects stemming from pre-innovation product markets is no longer a part of the anticompetitive assessment. The assessment of the effects, which do not hinge on pre-innovation product markets, should be carried out in analogy to case group 1.

3. The Merger affects Innovation Competition as well as Pre-Innovation Product Market Competition and R&D Projects are furthermore "Observable" (expected to create a New Relevant Product Market)

How does the assessment change for mergers falling into case group 3, in comparison to those of case group 1? Since the merger will still alter both pre-innovation product market structure and innovation competition, antitrust authorities still have to account for the whole set of effects as they were described in line with the assessment of case group 1. However, there are some remarkable differences. These differences stem from the fact that, in this case group, antitrust authorities can "observe" the R&D projects of the firms. The ability to "observe" the respective R&D projects results, in most cases, from lengthy regulatory approval procedures (like in the case of pharmaceuticals)[54], which function as entry barriers for future goods markets. As a consequence, antitrust authorities can get quite a good impression of which products might make it to the market within the next couple of years. However, not only the antitrust authorities can "observe" these projects, but also all the other firms. Besides this,

[51] *See*, United States v. General Motors Corp., Civ. No. 93-530 (complaint filed D.Del. Nov. 16, 1993).
[52] *See* United States v. Lockheed Martin Corp., Civ. No. 98-00731 (D.D.C. complaint filed March 23, 1998).
[53] *See* United States v. Halliburton Co., Civ. No. 98-2340 (D.D.C. complaint filed Sept. 29. 1998).
[54] *See* Carrier (2008).

there seems to be a high correlation between the industries which can be characterized by these regulatory approval procedures, and the industries in which the relevance of IPRs for appropriating innovation profits is particularly high.[55] Furthermore, the competitive assessment of mergers, which fall into case group 3, deals with research projects which are expected to constitute a new relevant product market. Hence, we will only consider for the effects regarding radical product innovations, leaving incremental product innovations aside.

In regard to the effects, stemming from a decrease in pre-innovation product market competition, these properties of case group 3 have the following effects for the competitive assessment (in comparison to case group 1):

- The "pre-innovation market size and appropriability effect" will now have a neutral or negative impact. This stems from the fact that the relevance of IPRs, regarding a merger which falls into case group 3, is expected to be high. Furthermore, this case group encompasses mergers in which the emergence of a new product market is at stake. As a consequence, neither current market shares nor current market power will improve the firms' ability to appropriate their innovation profits. However, the increased market share of the merged entity can lead to a reallocation of the R&D budget towards process innovation oriented R&D, leaving less financial resources to strife for product innovations.
- There is also a high likelihood that the "increase in the extent of a replacement effect" will have a negative impact. This stems from the circumstance that the high relevance of IPRs and experience in these industries often constitute high entry barriers for entering the process of innovation competition. Besides this, the regulatory approval procedures, which are expected to play an important role in this case group, do not allow for an unexpected and fast introduction of a new product. As a consequence, the merged firm will get a pretty good impression of whether and when a competitor might introduce a new product, which would threaten its current profits. Hence, the idea of a balance between having "less to win" and simultaneously also "more to lose" seems to shift towards the "less to win" side. This stems from the fact that the likelihood that these greater losses become reality gets easier to estimate and calculate. Such a behavior is also in line with a so called "fast second strategy"[56] which implies that dominant firms are rather reluctant with respect to investing in R&D unless they are challenged. Only after realizing this threat, they start to vigorously fight back.

[55] *See* Cohen, et al. (2000); Peneder (2010).
[56] *See* Scherer & Ross (1990).

However, under the existence of an "actual replacement threat" one can also think of increasing innovation incentives. This is the case when there is at least one firm which already works seriously on an innovation which could have a replacement effect on the firm's products. In comparison to the exclusive analysis of entry barriers in line with case group 1, the ability to "observe" R&D projects now allows to directly identify the firms which currently undertake R&D towards product innovations which could, if carried out successfully, replace current products. If there is indeed at least one firm which is already seriously undertaking R&D, the innovation incentives of the merged entity would increase because the firm has "more to lose", even though the assessment reveals that entry barriers are high.

- Apart from these changes, the assessment of effects stemming from pre-innovation product markets should be carried out in analogy to the corresponding assessment of case group 1.

In regard to the effects, which do not hinge on pre-innovation product markets, the properties of case group 3 have the following effects for the competitive assessment (in comparison to case group 1):

- As already discussed in line with the "increase in the extent of a replacement effect", the ability to "observe" R&D projects allows for a direct assessment of the products which are currently in the R&D pipelines. This has also strong implications for the assessment of the "elimination of an actual replacement threat effect". First, it is crucial to assess whether a certain merger would lead to the elimination of a concrete replacement threat and if so, whether there are still enough competitors left which ensure that the replacement threat is upheld. In comparison to case group 1, this analysis becomes feasible thanks to the ability to "observe" the firms' R&D projects. What is also new in case group 3 is the significance of IPRs (*e.g.* patent protection) for current and future product markets. Whenever existing products are protected by IPRs, the elimination of an actual replacement threat can be particularly critical. This stems from the fact that a patent provides a temporal and legally granted monopoly position, leading to the greatest replacement effect possible. Therefore, in the case that no serious threat exists, the merged firm would have a strong incentive to delay the introduction of a new product until the patent of the existing product (and thus the temporal monopoly) expires.
- Since IPRs can be expected to play an important role in the industries whose mergers often fall into this case group, also the "post-innovation product market competition and

appropriability effect" will most likely have a negative impact because of the diminished "stimulus factor". However, whenever IPRs are nevertheless insufficient, it has to be assessed whether the expected type of post-innovation product market competition can be characterized rather by competition in price or quantity, whether the R&D projects of the merging parties are expected to result in relatively homogeneous or rather differentiated products, and in the case of differentiated products, whether the products are expected to be rather close or far substitutes. In dependence of the outcome of this analysis it is possible that a positive impact because of the "market room factor" exists. However, even in those cases were one could think of such a positive influence, there still remains the negative impact because of the "stimulus factor". Hence, these two opposing "factors" have to be balanced against each other.

However, since the assessment of innovation effects of mergers should be triggered exclusively once the process of innovation competition is already highly concentrated and can furthermore be characterized by high entry barriers, it is very questionable whether the positive effect of the "market room factor" will have a strong impact on the outcome of the subsequent analysis. These doubts are further intensified since this case group deals with existing R&D projects which are already underway. This implies that the firms expected them to be profitable. Hence, even if the merger does not take place there is apparently enough "room" in the post-innovation market, given the number of competing R&D programs.

- However, what could relax the anticompetitive doubts is the analysis of the distance between the merging firms' R&D projects. Whenever R&D is expected to be cumulative, innovation competitors can be characterized as either "neck and neck", or "leader and laggard" competitors (or even "laggard and laggard" competitors). This differentiation is again possible due to the ability to "observe" the firms' R&D projects. Hence, whenever leapfrogging can be excluded, serious doubts will mainly arise in situations in which the competitive situation between the merging firms can be characterized as being close to "neck and neck". Whenever a leader and a laggard competitor merge, this situation might be less problematic (in the case of a merger of two laggards, the impact might even be positive).
- Apart from these changes, the assessment of the effects, which do not hinge on pre-innovation product markets, should be carried out in analogy to the corresponding assessment of case group 1.

4. The Merger affects only Innovation Competition and R&D Projects are furthermore "Observable" (expected to create a New Relevant Product Market)

In comparison to case group 3, the analysis of effects, stemming from pre-innovation product markets, is no longer a part of the anticompetitive assessment. The assessment of the effects, which do not hinge on pre-innovation product markets, should be carried out in analogy to case group 3. Hence, apart from merger specific efficiency gains (synergies, complementary assets, etc.) almost all effects indicate that a reduction of the number of competitors results in a reduction of aggregated R&D efforts and most likely in a delay of the introduction date of the innovation. The only general argument(s) in favor of less competition is the possibility that duplicative R&D efforts could be avoided and spillovers might get internalized. Apart from that, competition authorities have to assess whether one of the companies is way ahead of the other(s) in the innovation process and whether leapfrogging is expected to be possible, or not. Prominent merger cases which fall into this case group were, for instance, the mergers of Glaxo and Wellcome[57] or Ciba-Geigy and Sandoz[58].[59]

5. The Merger affects Innovation Competition as well as Pre-Innovation Product Market Competition and R&D Projects are furthermore "Observable" (<u>not</u> expected to create a New Relevant Product Market)

The assessment of mergers falling into case group 5 is very similar to those falling into case group 3. The main difference is that the "observed" R&D projects are expected to lead to product innovation which will be incremental in the sense that they do not constitute a new relevant product market.

In regard to the effects, stemming from a decrease in pre-innovation product market competition, the properties of case group 5 have the following effects for the competitive assessment (in comparison to case group 3):

- Due to the fact that this case group deals with incremental product innovations, the "pre-innovation market size and appropriability effect" might also have a positive impact on the innovation incentives, if the firms are unable to protect their innovations sufficiently by IPRs. However, since the industries in which R&D efforts are quite "observable" can mostly be characterized by a high relevance of IPRs, this positive impact is (as in case group 3 & 4) rather theoretical.

[57] *See* Glaxo plc, 119 F.T.C. 815 (1995).
[58] *See* Ciba-Geigy Ltd., 123 F.T.C. 842 (1997).
[59] *See*, *also* American Home Products Corp., 119 F.T.C. 217 (1995); Pfizer Inc. and Warner-Lambert Co., FTC Dkt. No. C-3957 (June 19, 2000); Baxter Int'l, Inc., 123 F.T.C. 904 (1997); The Upjohn, Co., 121 F.T.C. 44 (1996); Glaxo Wellcome plc, 131 F.T.C. 56 (2001).

- Apart from these changes, the assessment of effects stemming from pre-innovation product markets should be carried out in analogy to the corresponding assessment of case group 3.

In regard to the effects, which do not hinge on pre-innovation product markets, the properties of case group 5 have the following influence on the competitive assessment (in comparison to case group 3):

- The existence of a replacement effect is less likely to be a problem in this case group. Since the R&D programs aim at the development of products, which are expected to be offered on an existing relevant product market, they have to be considered as sufficiently substitutable. Hence, it is difficult to think of a replacement effect if the "new" and the "old" products are that interchangeable. Instead, these types of product innovations will rather lead to an increase in product variety. Nevertheless, an additional product entering an existing market will most likely result in an increase in competition on this market and thus to a decline of current profits. As a consequence, even though a real replacement is quite unlikely in this case group, there is still a risk that the target firm's product innovation will never enter the market after the merger.
- Apart from these changes, the assessment of the effects, which do not hinge on pre-innovation product markets, should be carried out in analogy to the corresponding assessment of case group 3.

6. The Merger affects only Innovation Competition and R&D Projects are furthermore "Observable" (not expected to create a New Relevant Product Market)

In comparison to case group 5, the analysis of effects, stemming from pre-innovation product markets, is no longer a part of the anticompetitive assessment. The assessment of the effects, which do not hinge on pre-innovation product markets, should be carried out in analogy to case group 5.

Prominent merger cases which fall into this case group were, for instance, the merger of Hoechst and Marion Merrell Dow[60] or the one between Astra and Zeneca.[61]

[60] *See* Hoechst AG, 120 F.T.C. 1010 (1995).
[61] *See* Zeneca Group plc, 127 F.T.C. 874 (1999).

IV. Conclusion

This article identified and classified the most relevant effects, which determine the impact of innovation competition mergers on the incentives to invest in product innovation oriented R&D. In this connection we differentiated between merger cases in which the merger affects only the intensity of innovation competition, and those cases in which the merger has an impact on both innovation competition and pre-innovation product market competition. Besides this, the article furthermore identified the relevant determinants, which are decisive for how a certain effect acts on the incentives to innovate. However, since not every effect is always relevant and because of the fact that the determinants can also differ from case to case, the development of an assessment framework requires the classification and allocation of merger cases, which share the same properties, into case groups. As a result, each of these case groups encompasses those kinds of merger cases which require the assessment of similar effects and determinants. Hence, the review process varies from case group to case group, but remains consistent and uniform within each case group. Since such an approach allows combining the objective of a case-specific assessment with the requirement that this assessment is carried out in a consistent and transparent manner, it is in the spirit of a rule based competition policy.

As a consequence, this article contributes to the discussion about developing an assessment framework for analyzing the innovation effects of mergers. Thereby it was also shown that the interrelation between competition and the incentives to innovate is not always as unclear as it seems without making the differentiation between effects that hinge on pre-innovation product markets and those that do not. As a result, while the assessment of the effects of mergers on the firm's incentives to undertake product innovation oriented R&D can indeed be challenging in some case groups (in particular within case group 1), it turned out that the investigation is much less complex in others (in particular within case group 4).

However, it has to be recalled that this article focused exclusively on the incentives to invest in product innovation oriented R&D. Hence, it has to be acknowledged that the findings of this paper cannot be transferred to questions related to the effects of mergers on the incentives to invest in process innovations. This becomes particularly evident if one considers for the "Pre-Innovation Market Size and Appropriability Effect". Hereby it was shown that a merger can indeed result in decreased incentives to invest in product innovation oriented R&D, because the merger leads to a reallocation of the firm's R&D budget. This, however, implies that the incentives to undertake process innovations increase at the same time.

Besides this, a final assessment framework has to be supplemented by empirical studies in order to reveal the relevance and suitability of each of the theoretically developed assessment criteria.[62] Furthermore, even though this article focused exclusively on the assessment of the merged firm's incentives to innovate, the final assessment framework should not neglect to account for the benefits of "diversity" and "parallel research" for innovation. The consideration of incentive aspects alone will not be appropriate to capture innovation competition in its full extent.[63] Moreover, it also needs to be emphasized that the findings of this paper do not imply that mergers have per se an anticompetitive effect on innovation, once the assessment of the introduced effects leads to a negative outcome. There is still great potential for merger specific efficiencies. Such efficiencies can encompass *e.g.* synergies among the merging entities, economies of scale and scope in R&D, a reduction of duplicative R&D efforts or the bringing together of complementary assets. As a consequence, these positive efficiency gains have to be balanced against the negative effects that might be revealed by the prior analysis. Besides the necessity to balance the potentially negative innovation incentive effects of mergers against innovation related efficiencies gains, the assessment of innovation effects generally represents only one part of the overall competitive assessment of mergers. Even though this article also accounted for pre-innovation product markets, the analysis of static price and non-price effects was not part of the assessment. As a result, the competitive assessment of mergers is not completed until it is analyzed how a certain merger affects competition with respect to all competition parameters: static price and non-price competition as well as innovation competition.

BIBLIOGRAPHY

Aghion, Philippe, et al (2001), 'Competition, Imitation and Growth with Step-by-Step Innovation', *The Review of Economic Studies*, Vol. 68, pp. 467-492.

Aghion, Phillipe, et al. (2005), 'Competition and Innovation: an Inverted-U Relationship', *Quarterly Journal of Economics*, Vol. 120, pp. 701–728.

Areeda, Philip E. & Turner, Donald F. (1980), *Antitrust Law*, Boston, Little, Brown and Company.

Arrow, Kenneth J. (1962), 'Economic Welfare and the Allocation of Resources to Invention', in Richard R. Nelson (ed.), *The Rate and Direction of Economic Activity*, Princeton University Press, pp. 609-626.

[62] *See*, *e.g.*, Kretschmer (2012).
[63] *See* Kern & Ackermann (2014).

Baker, Jonathan B. (1994), 'Fringe Firms and Incentives to Innovate', *Antitrust Law Journal*, Vol. 63, pp. 621-642.

Baker, Jonathan B. (2007), 'Beyond Schumpeter vs. Arrow: How Antitrust Fosters Innovation', *Antitrust Law Journal*, Vol. 74, pp. 575 - 602.

Belleflamme, Paul & Vergari, Cecilia (2011), 'Incentives to Innovate in Oligopolies', *The Manchester School*, Vol. 79, pp. 6-28.

Bonanno, Giacomo & Haworth, Barry (1998), 'Intensity of Competition and the Choice between Product and Process Innovation', *International Journal of Industrial Organization*, vol. 16, pp. 495-510.

Boone, Jan (2000), 'Competitive Pressure: The Effects on Investments in Product and Process Innovation', *RAND Journal of Economics*, Vol. 31, pp.549-569.

Boone, Jan (2001), 'Intensity of Competition and the Incentive to Innovate', *International Journal of Industrial Organization*, vol. 19, pp. 705-726.

Carlton, Dennis W. & Gertner, Robert H. (2003), 'Intellectual Property, Antitrust and Strategic Behavior', in Adam B. Jaffe et al. (eds.), *Innovation Policy and the Economy*, Vol. 3, MIT Press, pp. 29-59.

Carrier, Michael A. (2008), 'Two Puzzles Resolved: Of the Schumpeter-Arrow Stalemate and Pharmaceutical Markets', *Iowa Law Review*, Vol. 93, pp. 393-450.

Cassiman, Bruno et al. (2005), 'The Impact of M&A on the R&D Process: An Empirical Analysis of the Role of Technological and Market Relatedness', *Research Policy*, Vol. 34, pp. 195-220.

Chen, Yongmin & Schwartz, Marius (2010), 'Product Innovation Incentives: Monopoly vs. Competition', *Georgetown University, Department of Economics Working Papers, available at* HTTP://SPOT.COLORADO.EDU/~CHENY/RESEARCH/CHEN_MARIUS_APRIL5_2012.PDF (Jan. 30, 2014).

Christiansen, Arndt & Kerber, Wolfgang (2006), 'Competition Policy with Optimally Differentiated Rules Instead of "Per Se Rules vs. Rule of Reason"', *Journal of Competition Law and Economics*, Vol. 2, pp. 215–244.

Cohen, Wesley M., et al. (2000), 'Protecting Their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent (Or Not)', *NBER Working Paper No. 7552, available at* HTTP://WWW.NBER.ORG/PAPERS/W7552.PDF (Jan. 22, 2014).

Dasgupta, Partha & Stiglitz, Joseph E. (1980), 'Uncertainty, Industrial Structure, and the Speed of R&D', *The Bell Journal of Economics*, Vol. 11, pp. 1-28.

D'ASPREMONT, Claude & JACQUEMIN, ALEXIS (1988), 'Cooperative and Noncooperative R&D in Duopoly with Spillovers', *The American Economic Review*, Vol. 78, pp. 1133-1137.

Davis, Robert W. (2003), 'Innovation Markets and Merger Enforcement: Current Practice in Perspective', *Antitrust Law Journal*, Vol. 71, pp. 677-703.

De Bondt, Raymond R. (1977), 'Innovative Activity and Barriers to Entry', *European Economic Review*, Vol. 10, pp. 95-109.

Delbono, Flavio & Denicolò, Vincenzo (1990), 'R&D Investment in a Symmetric and Homogeneous Oligopoly: Bertrand vs Cournot', *International Journal of Industrial Organization*, Vol. 8, pp. 297-313.

Denison, Edward F. (1985), *Trends in American Economic Growth, 1929-1982*, Washington, DC, Brookings Institution.

Doraszelski, Ulrich (2003), 'An R&D Race with Knowledge Accumulation', *RAND Journal of Economics*, Vol. 34, pp. 20-42.

Dutta, Prajit K. & Lach, Saul & Rustichini, Aldo (1995), 'Better Late Than Early: Vertical Differentiation in the Adoption of a New Technology', *Journal of Economics & Management Strategy*, Vol. 4, pp. 563-589.

Easterbrook, Frank (1984), 'The Limits of Antitrust', *Texas Law Review*, Vol. 63, pp. 1-40.

Evans, David & Hylton, Keith (2008), 'The Lawful Acquisition and Exercise of Monopoly Power and its Implications for the Objectives of Antitrust', *Competition Policy International*, Vol. 4, pp. 203-241.

Federal Trade Commission, Office of Policy Planning (1996), Anticipating the 21st Century: Competition Policy in the New High-Tech, Global Market Place Report, Chapter 7, *available at* http://www.ftc.gov/opp/global/report/gc_v1.pdf (Nov. 7, 2012).

Fudenberg, Drew, et al. (1983), 'Preemption, Leapfrogging and Competition in Patent Races', *European Economic Review*, Vol. 22, pp. 3-31.

Gilbert, Richard J. & Sunshine, Steven C. (1995a), 'Incorporating Dynamic Efficiency Concerns in Merger Analysis: The Use of Innovation Markets', *Antitrust Law Journal*, Vol. 63, pp. 569-601.

Gilbert, Richard J. & Sunshine, Steven C. (1995b), 'The Use of Innovation Markets: A Reply to Hay, Rapp, and Hoerner', *Antitrust Law Journal*, Vol. 64, pp. 75-82.

Gilbert, Richard J. (2006), 'Looking for Mr. Schumpeter: Where Are We in the Competition-Innovation Debate?', in Adam B. Jaffe et al. (eds.), *Innovation Policy and the Economy*, Vol. 6, MIT Press, pp. 159-215.

Graham, Edward M. (1979), 'Technological Innovation and the Dynamics of the U.S. Comparative Advantage in International Trade', in Christopher T. Hill & James M. Utterback (eds.), *Technological Innovation for a Dynamic Economy*, New York, NY, Pergamon Press, pp. 118-160.

Greenstein, Shane & Ramey, Garey (1998), 'Market Structure, Innovation and Vertical Product Differentiation', *International Journal of Industrial Organization*, Vol. 16, pp. 285-311.

Grossman, Gene M. & Shapiro, Carl (1987), 'Dynamic R&D Competition', *The Economic Journal*, Vol. 97, pp. 372-387.

Harbour, Pamela J. (2004), *Dissenting Statement of Pamela J. Harbour Genzyme Corporation's Acquisition of Novazyme Pharmaceuticals Inc.*, File No. 021-0026, *available at* http://www.ftc.gov/os/2004/01/harbourgenzymestmt.pdf (Aug. 20, 2013).

Harris, Christopher & Vickers, John (1985), 'Perfect Equilibrium in a Model of a Race', *The Review of Economic Studies*, Vol. 52, pp. 193-209.

Harris, Christopher & Vickers, John (1987), 'Racing with Uncertainty', *Review of Economic Studies*, Vol. 54, pp.1-21.

Hay, George A. (1995), 'Innovations in Antitrust Enforcement', *Antitrust Law Journal*, Vol. 64, pp. 7-17.

Hoerner, Robert J. (1995), 'Innovation Markets: New Wine in old Bottles?', *Antitrust Law Journal*, Vol. 64, pp. 49-73.

Kamien, Morton I. & Schwartz, Nancy L. (1976), 'On the degree of rivalry for maximum innovative activity', *The Quarterly Journal of Economics*, Vol. 90, pp. 245-260.

Kern, Benjamin R. & Ackermann, Malte (2014), 'Shedding Some Light on the Dark Matter of Competition: Insights from the Strategic Management & Organizational Science Literature for the Consideration of Diversity Aspects in Merger Review', *MAGKS - Joint Discussion Paper Series In Economics, NO.05-2014, available at* http://www.uni-marburg.de/fb02/makro/forschung/magkspapers/05-2014_ackermann.pdf (Feb. 09, 2014).

Kern, Benjamin R. (2014), 'Innovation Markets, Future Markets, or Potential Competition: How should Competition Authorities account for Innovation Competition in Merger Reviews?', *World Competition: Law and Economics Review (forthcoming).* Previous version as: *MAGKS - Joint Discussion Paper Series In Economics, NO.08-2014, available at* http://www.uni-marburg.de/fb02/makro/forschung/magkspapers/08-2014_kern.pdf (Feb. 25, 2014).

Kretschmer, Jürgen-Peter (2012), 'How to deal with resale price maintenance: What can we learn from empirical results?', *European Journal of Law and Economics*, March 22, pp. 1-26.

Landman, Lawrence B. (1999), 'Innovation and the Structure of Competition: Future Markets in European and American Law', Part I-III, *Journal of the Patent and Trademark Office Society*, Vol. 81, pp. 728-881.

Lee, Tom & Wilde, Louis L. (1980), 'Market Structure and Innovation: A Reformulation', *The Quarterly Journal of Economics*, Vol. 94, pp. 429-436.

Lippman, Steven A. & McCardle, Kevin F. (1987), 'Dropout Behavior in R&D Races with Learning', *The RAND Journal of Economics*, Vol. 18, pp. 287-295.

Loury, Glenn C. (1979), 'Market Structure and Innovation', *Quarterly Journal of Economics*, Vol. 93, pp. 395-410.

Modigliani, Franco & Miller, Merton H. (1958), 'The Cost of Capital, Corporation Finance & the Theory of Investment', *The American Economic Review*, Vol. 48, No. 3, pp. 261-297.

Morse, Howard M. (2001), 'The Limits of Innovation Markets', *Antitrust & Intellectual Property*, Vol. 2, pp.22-35.

Muris, Timothy J. (2004), *Statement of Chairman Timothy J. Muris in the matter of Genzyme/Novazyme Pharmaceuticals, Inc.*, File No. 021-0026, *available at* http://www.ftc.gov/os/2004/01/murisgenzymestmt.pdf (Nov. 7, 2012).

Peneder, Michael (2010), 'Technological regimes and the variety of innovation behaviour: Creating integrated taxonomies of firms and sectors', *Research Policy*, Vol. 39, pp. 323-334.

Rapp, Richard T. (1995), 'The Misapplication of the Innovation Market Approach to Merger Analysis', *Antitrust Law Journal*, Vol. 64, pp. 19-47.

Reinganum, Jennifer F. (1989), 'The Timing of Innovation: Research, Development, and Diffusion', *Handbook of Industrial Organization*, Vol. 1, pp. 849-908.

Rumelt, Richard P. (1987), "Theory, Strategy, and Entrepreneurship", in D. Teece (ed.), *The Competitive Challenge*, Cambridge, MA, Ballinger, pp. 137-158.

Scherer, Frederic M. & Ross, David (1990), *Industrial Market Structure and Economic Performance*, 3RD EDN., Boston, HOUGHTON-MIFFLIN.

Schmutzler, A. (2010), 'Is Competition Good for Innovation? A Simple Approach to an Unresolved Question', *Foundations and Trends in Microeconomics*, Vol. 5, pp. 355-428.

Schulz, Norbert (2007),'Review of the Literature on the Impact of Mergers on Innovation', *ZEW Discussion Paper No. 07-061*, *available at* ftp://ftp.zew.de/pub/zew-docs/dp/dp07061.pdf (Jan. 21, 2014).

Schumpeter, Joseph A. (1942), *Capitalism, Socialism and Democracy*, New York, NY, Harper.

Shaked, Avner & Sutton, John (1982), 'Relaxing price competition through product differentiation', *The Review of Economic Studies* ,Vol. 49, pp. 3-13.

Shaked, Avner & Sutton, John (1983), 'Natural Oligopolies', *Econometrica*, Vol. 51, pp. 1469–1484.

Solow, Robert M. (1957), 'Technical Change and the Aggregate Production Function', *The Review of Economics and Statistics*, vol. 39, pp. 312-320.

Thompson, Mozelle W. (2004), *Dissenting Statement of Commissioner Mozelle W. Thompson Genzyme Corporation's Acquisition of Novazyme Pharmaceuticals Inc*., File No. 021-0026, *available at* http://www.ftc.gov/os/2004/01/thompsongenzymestmt.pdf (Aug. 20, 2013).

U.S. Department of Justice & Federal Trade Commission (1992, rev. 1997), 'Horizontal Merger Guidelines', *available at* HTTP://WWW.JUSTICE.GOV/ATR/PUBLIC/GUIDELINES/HMG.PDF (Dec. 13, 2012).

U.S. Department of Justice & Federal Trade Commission (2010), 'Horizontal Merger Guidelines', *available at* HTTP://WWW.FTC.GOV/OS/2010/08/100819HMG.PDF (Dec. 13, 2012).

Vickers, John S. (1986), 'The Evolution of Market Structure When There Is a Sequence of Innovations, *Journal of Industrial Economics*, Vol. 35, pp. 1-12.

Vives, Xavier (2008), 'Innovation and Competitive Pressure', *Journal of Industrial Economics*, Vol. 56, pp. 419-469.

Yin, Xiangkang & Zuscovitch, Ehud (1998), 'Is Firm Size Conducive to R&D Choice? A Strategic Analysis of Product and Process Innovations', *Journal of Economic Behavior & Organization*, Vol. 35, pp. 243-262.