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## **Competition, Innovation, and Competition Law: Dissecting the Interplay**

**Wolfgang Kerber\***

**Abstract:** The digital revolution has reinvigorated the discussion about the problem how to consider innovation in the application of competition law. This raises difficult questions about the relationship between competition and innovation as well as what kind of assessment concepts competition authorities should use for investigating innovation effects, e.g., in merger cases. This paper, on one hand, reviews briefly our economic knowledge about competition and innovation, and claims that it is necessary to go beyond the limited insights that can be gained from industrial economics research about innovation (Schumpeter vs. Arrow discussion), and take into account much more insights from innovation research, evolutionary innovation economics, and business and management studies. On the other hand, it is also necessary to develop much more innovation-specific assessment concepts in competition law (beyond the traditional product market concept). Using the example of assessing innovation competition in merger cases, this article suggests to analyze much more systematically the resources (specialized assets) that are necessary for innovation. This concept is directly linked to the new discussion about the Dow/DuPont case in the EU and about data as necessary resource for (data-driven) innovation.

**Key words:** Competition, innovation, competition law, merger control, innovation market

**JEL classification:** K21, L12, L41, O31

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## 1. Introduction

The digital revolution is a technological and economic revolution, whose potential benefits and dangers we are only starting to understand. Digitization, Big Data, data analytics, artificial intelligence, and algorithms will change profoundly the functioning of the economy and even society itself. Economically, the digital revolution is the result of Schumpeterian innovation processes, in which new products and services create new markets, business models and entire industries, while many old markets, business models and industries are getting destroyed or marginalized. These characteristics of "structural change" and "creative destruction" are normal phenomena in Schumpeter's theory of economic development.<sup>1</sup> The disruptive nature of many innovations and the rise of large tech firms (as Google, Facebook, Apple, Amazon etc.) who drive many of these developments have raised the question whether competition law is still capable for dealing with the challenges of the digital revolution or whether competition policy needs new concepts and instruments. There is an increasing concern that traditional concepts in competition law that focus mainly on price effects on existing markets might not be capable of dealing with innovation competition in the digital economy.<sup>2</sup> One particular new phenomenon in this respect is that data has become a new critical resource for innovation (data-driven innovation), leading to the question how data should be taken into account in competition policy.<sup>3</sup>

This paper will not directly address these questions about the application of competition law in the digital economy. Instead the objective of this contribution is to analyze in a much more fundamental way our knowledge and analytical concepts in regard to the relationship between competition and innovation and why we generally have so many problems to deal with innovation in competition law - despite the broad consensus that innovations are one of the important benefits of market competition. An important claim of this paper is that the problems how to analyze and protect innovation competition in competition law are not new but have existed for a long time. It is only the larger current awareness of the huge relevance of innovations that draws our attention to these problems. The main thesis of the paper is that current competition law and economics still suffers from the dominance of a static concept of competition that has also influenced deeply the assessment concepts that are used in the application of competition law. Therefore it is necessary to develop new concepts for dealing with innovation competition both on the theoretical level of competition economics as well as on the level of assessment concepts for analyzing innovation and innovation competition in competition cases. To some extent competition authorities already have started to experiment in this regard albeit without clear and consistent theoretical approaches and assessment frameworks. This paper can only provide a brief overview of the problems and give some selective hints in which direction we should develop new concepts and do further research.

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<sup>1</sup> See Schumpeter (1934, 1942).

<sup>2</sup> See, e.g., Monopolkommission (2015) and Van Gorp/Batura (2015); for the current discussion on disruptive innovation and competition policy, see de Streel/Larouche (2015).

<sup>3</sup> See for data-driven innovation OECD (2015); for the analysis of data in competition cases see Graef (2015), Autorité de la Concurrence/Bundeskartellamt (2016), and Stucke/Grunes (2016).

The article is structured as follows. In section 2, we first will briefly look at conceptual problems in regard to competition, namely that the currently used economic concept of competition and the ensuing assessment concepts in competition law are static concepts that might be well-suited for analyzing price competition but not for analyzing innovation competition. This will be followed by an overview about our limited knowledge from theoretical and empirical competition economics about the relationship between competition and innovation. An important conclusion will be that it is necessary to apply also additional insights from other approaches, as, in particular, innovation research, evolutionary economics, and business and management studies. Section 3 discusses some ideas about more innovation-specific assessment concepts in competition law (beyond the traditional analysis based upon the product market concept) that would consider innovation competition in a more direct way. Based also on experiences of competition authorities who experimented to some extent with more innovation-specific concepts, e.g., in merger cases, it is suggested to focus in a much more systematic way on the analysis of necessary specialized resources for innovation as an additional layer of investigations, both for identifying relevant innovation competitors and for analyzing anticompetitive effects of mergers, agreements, and business behaviour. From that perspective also data as the new critical resource in the digital economy would find a systematic place in a more general concept of analyzing innovation competition. Brief conclusions can be found in section 4.

## **2. Competition and Innovation: A Difficult and Complex Relationship**

### **2.1 The Problem of Static Concepts in Competition Law and Economics**

For a better understanding of the difficulties to take innovation into account in the application of competition law it is helpful to look briefly how current microeconomic theory deals conceptually with competition and innovation. The basic problem is that in mainstream neoclassical economics competition and innovation are analyzed as two separate problems. Theoretical industrial economics still starts with the ideal of the model of perfect competition, which would lead to an efficient allocation (static economic efficiency), and analyzes to what extent the price/quantity equilibria on "imperfect" markets (as oligopolistic settings) deviate from this optimal solution. The main competition problem is seen in deadweight losses (as static inefficiencies) that arise from prices larger than marginal costs, which also is crucial for the definition of market power in this theoretical approach. Product and process innovations are not integrated in this theoretical concept of competition.<sup>4</sup> Instead, from this mainstream economics perspective, innovation is primarily analyzed as a problem of potentially insufficient incentives for innovation due to too fast imitation through knowledge spill-

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<sup>4</sup> See, e.g., the textbook of Belleflamme/Peitz (2015, 41-104). If innovation is addressed, then only as an additional problem in a separate chapter (e.g., Tirole, 1988, ch.10, Belleflamme/Peitz 2015, 497-530)

overs (appropriability problem). Arrow (1962) showed that under the ideal (knowledge) assumptions in the model of perfect competition there are no private incentives for innovation leading to a public good problem for innovations. Therefore from a microeconomics perspective these knowledge spillovers lead to a different market failure, which calls either for government subsidies and/or for temporary exclusive (intellectual property) rights as appropriate policy solutions. Therefore from this theoretical perspective there is a danger of a strict separation of both issues: (1) Competition policy deals with the market failure "competition problems" on existing markets, which then focusses mainly on price competition for already existing products, and (2) innovation policy deals mainly with the market failure problems of insufficient innovation incentives due to appropriability problems.<sup>5</sup> This dualism is also present in the law, with the separation (but also the manifold tensions) between competition law and IP law. As a consequence, it is not surprising that innovation has been seen in competition economics always more as an "additional" issue that does not really fit into this basic theoretical concept of (static) competition. However, it is important to understand that the main problem is a theoretical problem and not a normative one. Competition economists have always acknowledged the importance of innovation for increasing consumer welfare, and have therefore no problem in accepting that behavior that leads to less or slower innovation can harm consumers and therefore can be anticompetitive according to a consumer welfare standard.

One of the huge challenges for a greater consideration of innovation in the application of competition law is that this static concept of competition has deeply influenced also the basic categories and assessment concepts in competition law. A wellknown example is market definition. The hypothetical monopoly test (SSNIP-test) looks only at the currently existing products, and analyzes in this step-by-step process of including products in the market whether profitable price increases of 5 - 10% are possible, which basically requires an analysis of the substitutabilities between all current products. Future products with so far unknown characteristics cannot be taken into account. Therefore the SSNIP test can only lead to an entirely static product market, which cannot consider that in many markets the incumbent firms (and new entrants) regularly develop new products and services, which change demand and cost functions as well as the substitutabilities between the products.<sup>6</sup> Another consequence of this static concept is that most competition assessments only focus on the question whether a merger, an agreement or a potentially abusive behaviour lead to less consumer welfare through higher prices. A very good example are merger simulation models, whose basic approach is to compare the price/quantity equilibrium after the merger with the price-quantity equilibrium before the merger, and try to predict in this way whether the merger leads to short-term price increases.<sup>7</sup> Despite a broad consensus that competition law should not only pro-

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<sup>5</sup> Knowledge spillovers are positive technological externalities that can lead to market failure due to non-internalized externalities.

<sup>6</sup> For the application of the hypothetical monopoly test see Kerber/Schwalbe (2008, 262-277) and Bishop/Walker (2010, 107-148), and for a critique of its static character see also Podszun (2016).

<sup>7</sup> For merger simulation models and their problems see Budzinski/Christiansen (2007).

tect price competition but also competition in regard to quality, variety, and innovation, these other non-price parameters usually play no role in competitive assessments.<sup>8</sup>

Although there is broad critique in regard to this static concept of competition,<sup>9</sup> currently no convincing integrated and well-established concept of competition exists that also includes innovation. In our "common sense" notion of competition, competition has always been seen as a rivalrous process between firms that try to offer lower prices, better quality, and new products for the benefit of consumers. From that perspective innovation has always been an important part of competition, and competition has always been seen as a dynamic process. This is reflected to some extent by the widespread use of the concept of "dynamic competition".<sup>10</sup> However, the term "dynamic competition" today is mostly only used as a synonym for innovation competition or Schumpeterian competition, i.e. competition with new products or production technologies, but is not based upon a clear theory about the dynamics of competition. Therefore it is not surprising that dynamic competition is not integrated into current mainstream competition economics. This term rather refers to much older concepts of dynamic competition that had included innovation competition. Most important in that respect are theories of dynamic competition that have their roots in Schumpeter's concept of competition as a process of innovation and imitation. Particularly in Germany, such a Schumpeterian concept of dynamic competition had played a large role from the 1960s up to the 1990s.<sup>11</sup> The problem, however, is that these concepts have not been developed much further, and, in the meantime, are not any more part of our accepted stock of knowledge about competition, at least in economics. The situation is similar with Hayek's concept of "competition as a discovery procedure", which views competition as a trial and error-process, through which firms find out and learn what the best products and production technologies might be. Also this concept can be found widely quoted in a very general way, but it was never developed in such a clear way that it would have been possible to apply it directly in the assessment of competition cases.<sup>12</sup> However, all of these concepts viewed innovation competition as an essential part of competition, and were very

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<sup>8</sup> The attempts to apply the SSNIP test also to non-price parameters as quality or innovation have run into a lot of difficult problems. In the context of the digital economy a new discussion has emerged about the possibility to protect privacy as a part of quality as a non-price parameter (see Stucke/Grunes 2016, 113-122).

<sup>9</sup> See in the current antitrust discussion, e.g., Evans/Hylton (2008), Sidak/Teece (2009), Kerber (2011), Curzon Price / Walker (2016), and the current literature about disruptive innovation as, e.g., de Streef / Larouche (2015).

<sup>10</sup> Also the term "dynamic efficiency" is used, often in the context of the important tradeoff between static efficiency and innovation (dynamic efficiency) (see, e.g., Curzon-Price/Walker 2016). However, it should be understood that the term "dynamic efficiency" is mostly used only as a synonym for the innovation dimension of competition and is not defined in economics in the same clear way as static efficiency in static general equilibrium theory.

<sup>11</sup> See, e.g., Arndt (1952), Heuss (1965), Hoppmann (1977); for the US discussion see Clark (1961) and Ellig/Lin (2001). For example, important insights from this concept of dynamic competition were (1) that innovation also influences the market structure, and (2) that market power through innovation is not a problem if it is temporary but becomes a problem, if through a lack of imitation or innovation of competitors, it gets permanent.

<sup>12</sup> See Hayek (1978); see also Kirzner (1997) for the Austrian market process theory.

critical in regard to the static concept of competition focussing on price competition.<sup>13</sup> I admit that these brief characterizations might not be enough nuanced and lack a careful and deep explanation that cannot be provided here. But the point I want to make here is that one of the main problems for properly considering innovation in the application of competition law is that we do not have developed a convincing theoretical concept of (dynamic) competition that encompasses innovation and innovation competition in a satisfactory way.<sup>14</sup>

## 2.2 Competition and Innovation: What do we know?

Current surveys on competition and innovation in competition policy usually start with the Schumpeter vs. Arrow framework as two seemingly opposing views about the relationship between competition and innovation.<sup>15</sup> In Schumpeter's late work on "Capitalism, Socialism, and Democracy" (1942) he suggested that monopolistic firms might be more innovative due to better financing of R&D through past monopoly profits and higher incentives for appropriating the benefits of innovation. This led to the two more specific Schumpeter hypotheses that (1) a larger firm concentration and (2) a larger firm size might have positive effects on innovation.<sup>16</sup> Whereas these hypotheses suggest a potential conflict between competition and innovation, Arrow (1962) showed that a firm with market power might have less innovation incentives (due to the "replacement" or "cannibalization" effect), and therefore a more competitive market structure might also have positive effects on innovation. However, more recent analyses showed that both views need not contradict each other but can also be viewed as complementary.<sup>17</sup> A much discussed hypothesis is the "inverted U-shape", i.e. that neither a monopoly nor a market structure with many firms might be conducive for innovation but a market structure between both.<sup>18</sup> However, a clear comprehensive theoretical framework for all relevant effects in regard to competition and innovation is still missing. What we have, however, are the manifold results from many specific theoretical and empirical studies about competition and innovation.<sup>19</sup>

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<sup>13</sup> To some extent, the old structure - conduct - performance (SCP-) framework was a concept that included innovation in a systematic way, because innovation was seen as one of the criteria of market performance, allowing the analysis of the (still very important) relationship between market structure and innovation. Therefore the entire discussion about the Schumpeter hypotheses in regard to the correlation between (1) firm concentration and innovation, and (2) firm size and innovation (see section 3.2), did fit well into this old SCP-paradigm (which again is based upon even older concepts of workable competition).

<sup>14</sup> Therefore economics so far also has not succeeded to develop a clear concept of competition as a process, although the notion that competition law should protect competition as a process is widely accepted, and not only among competition lawyers (Drexl 2012) but also among competition economists (see, e.g., Shapiro 2012, 383).

<sup>15</sup> See, e.g., the recent Competition policy brief of the EU Commission (2016) about EU merger control and innovation.

<sup>16</sup> See for an overview Scherer/Ross (1990, 630-660).

<sup>17</sup> See Shapiro (2012, 361-370) and Baker (2007).

<sup>18</sup> See Aghion et al (2005) and the recent overview in Peneder/Wörter (2014, 657-660).

<sup>19</sup> General overviews can be found in Gilbert (2006), Katz/Shelanski (2007), Cohen (2010), Shapiro (2012), and Peneder/Wörter (2014).

In theoretical industrial economics a number of game-theoretic models have been developed that analyze primarily innovation incentives in markets.<sup>20</sup> Depending on the specific assumptions different groups of models have to be distinguished. For example, patent race models, in which firms compete with each other for first getting a patent (with a winner-takes-all result), are models that do not take into account a link to pre-innovation markets (as in the Arrow model). Here the intensity of competition might be very high, but in dynamic patent races it also depends on whether the firms have symmetric or asymmetric knowledge (with leading and laggard firms), and whether leapfrogging is possible or not.<sup>21</sup> An important question is whether patent protection is assumed as perfect or imperfect, leading in the latter case to knowledge spillover effects, which might reduce innovation incentives through less appropriability.<sup>22</sup> Another group of models (also with imperfect patent protection) could show that a larger number of firms might lead to incentives to accelerate R&D but only to a certain degree, because in the case of too many firms the revenues of each firm might not cover the R&D costs anymore.<sup>23</sup> Particularly important is the group of models that also include the pre-innovation product markets. For example, Aghion et al (2001, 2005) show that whether strong competition (in sectors with "neck and neck competitors") or market power (with leading and laggard competitors) lead to higher innovation incentives depends on the question whether in these sectors the incentives through "Schumpeterian rents" are larger or smaller than the incentives through the "escape-competition effect". These results are in line with the models of Boone (2000, 2001) who analyzed the effects of weak or intense competitive pressure on innovation incentives. More recent models about the direct effects of mergers on innovation incentives question the "inverted U-shape" by claiming that reductions of the number of firms lead to less innovation.<sup>24</sup> However, a more detailed analysis of these and other models show that the effects on innovation incentives depend also on a number of additional assumptions, e.g., homogeneous or differentiated products, price or quantity competition, the specific appropriability conditions, entry barriers, and whether product or process innovations are analyzed. Overall, this literature shows that there is no simple relationship between firm concentration (or competition) and innovation, and that the size of innovation incentives can depend on a number of specific conditions.<sup>25</sup> Although this literature can offer a lot of specific results that can be tried to use in the analysis of cases, the general insights from this theoretical literature for understanding innovation competition remain limited.<sup>26</sup>

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<sup>20</sup> See as overviews, e.g., Tirole (1988, ch.10), Belleflamme/Peitz, 2015, ch.18), and Bundeskartellamt (2017).

<sup>21</sup> See Loury (1979) and the overview in Reinganum (1989).

<sup>22</sup> See D'Aspremont/Jacquemin (1989).

<sup>23</sup> See Scherer/Ross (1990, 630-637).

<sup>24</sup> See Federico/Langus/Valletti (2017) and Motta/Tarantino (2017).

<sup>25</sup> See De Bondt / Vandekerckhove (2012) and Kern/Mantilla Contreras (2014); see also the critical discussion in Shapiro (2012, 370-376) who questions whether some of these models are really dealing with innovation.

<sup>26</sup> See Curzon-Price/Walker (2016, 476).



At least as important as these theoretical models are the many empirical studies that have been made since the 1960s in empirical industrial economics about market structure and innovation.<sup>27</sup> After many studies in different countries, with different sets of industries, for different time periods, and with different methods and data, meta-studies about the results have come to a broadly accepted consensus that both Schumpeter hypotheses about a positive correlation between firm size and innovation and between firm concentration and innovation could not be confirmed empirically. It rather seems to be clear that there is no innovation-optimal firm size, and it rather depends much on the industry and on the technology, whether small (start-up) firms, medium-sized or large firms are more innovative. The same is also true for firm concentration. Although there have been studies that claim that a moderate firm concentration might have positive effects on innovation, which would confirm the "inverted U-shape" hypothesis, there also seems to be a broad opinion that, overall, the empirical evidence for this claim is still weak.<sup>28</sup> Rather there is a consensus that there is no general stable relationship between firm concentration and innovation that can be deemed as valid across sectors, although it is widely accepted that very low and very high concentration might not be conducive for innovation. Important findings are that firm concentration might only be one determinant among a number of others, as, e.g., entry barriers, appropriability conditions, and technological opportunities, and that the results can be very different in different industries. But there is empirical evidence that competitive pressure induces firms to invest more in R&D in order to increase their efficiency.<sup>29</sup> One particularly interesting group of studies has analyzed directly the impact of mergers on the innovation activities of the merging firms. Most of these studies came to the conclusion that mergers lead to a reduction of innovation activities post-merger, which support the thesis that the negative effects of mergers on innovation might be larger than positive effects through efficiencies and synergies in R&D.<sup>30</sup> A specific more differentiated result offers Cassiman et al. (2005) who have shown in their empirical study that the innovation effects depend on the technological relatedness of the merging firms, because R&D is larger if the merging firms have complementary technologies than substitute technologies.

Both theoretical and empirical industrial economics can offer rich and differentiated insights into the determinants of innovation on markets that could only be summarized here very briefly. Particularly the fact that it is not generally possible to draw clear conclusions whether a higher firm concentration is positive or negative for innovation, has often been interpreted in that way that we do not know enough about innovation for considering innovation effects in competition law. This is a huge misinterpretation. It only shows that firm concentration in the traditional sense (and therefore also market shares) might play a much smaller role, and that other determinants and characteristics of markets can be much more important, and that their relative importance might differ much more in

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<sup>27</sup> See the overviews in Gilbert (2006), Katz/Shelanski (2007, 19-27), Cohen (2010), Shapiro (2012) and Peneder/Wörter (2014).

<sup>28</sup> See Shapiro (2012, 380) and the overview in Peneder/Wörter (2014)

<sup>29</sup> See Shapiro (2012, 382).

<sup>30</sup> See De Man/Duysters (2005), Ornaghi (2009), and recently Haucap/Stiebale (2016); as overview see Kerber/Kern (2014, 13-15).

different industries than, e.g., in price competition.<sup>31</sup> On one hand, current theoretical and empirical industrial economics can offer a lot of specific insights in regard to competition and innovation, on the other hand, our lack of knowledge about innovation in industrial economics suggests that it is necessary to turn also to other approaches that deal with innovation and economic evolution.

In that respect, it is first necessary to understand that innovation processes as the search for / development / creation of new (i.e., so far unknown) knowledge are very complex phenomena with very specific characteristics. They are characterized by large and "true" uncertainty (Knight 1921), creativity, and high unpredictability. Therefore innovation cannot be understood as "production processes" (with a clear relation between R&D as input and innovations as output). Rather innovation processes are complex trial-and error-processes, in which new problem solutions are tried out, and experiences made that lead to new problem solutions etc. Therefore innovation processes are more like processes of experimentation (with many feedback loops), in which the ultimate solution is the result of a step-by-step process whose results cannot be predicted in advance.<sup>32</sup> Due to this uncertainty and unpredictability no "optimal" research path can be determined, leading to the wellknown phenomenon that usually different firms have often very different ideas about what kind of research paths might be successful, which leads to a diversity in their approaches of solving a problem in an innovative way. These characteristics of innovation processes are also the reason why traditional microeconomics with its optimization approach runs into fundamental problems in explaining innovation and analyzing innovation competition.

Therefore it is not surprising that in the field of innovation research a broad pluralism of theoretical and empirical approaches exists. The broad and manifold (primarily empirical) studies in innovation research, which often are also focussing on specific industries, can provide many specific insights that can be used for the analysis of innovation effects in competition law. Particularly interesting are the studies in the field of "industrial dynamics" which analyze the dynamics of markets and industries, as, e.g., industry cycles, path-dependent processes, and other dynamic patterns of the evolution of industries.<sup>33</sup> Another promising group are evolutionary theories of innovation and economic change that use basic ideas of Schumpeter, Hayek, Nelson/Winter, and many others.<sup>34</sup> Evolutionary approaches are more suitable to deal with situations of true uncertainty and high unpredictability, because evolutionary models can use an explicit variation-selection mechanism as one possibility how the experimental character of innovation processes as trial and error-processes can be analyzed.<sup>35</sup> From that perspective innovation competition can be understood as an evolutionary process of parallel experimentation with new problem solutions, in which new knowledge is created and spread through imitation. This can be linked directly to Schumpeterian competition as a pro-

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<sup>31</sup> For such a discussion see also Shapiro (2012, 382) and Katz/Shelanski (2007, 27).

<sup>32</sup> For an early critique of a linear model of innovation, see Kline/Rosenberg (1986).

<sup>33</sup> See for an overview Cantner (2011).

<sup>34</sup> See generally for an evolutionary approach Nelson/Winter (1982), Nelson (1995); especially in regard to an evolutionary concept of competition see Kerber (1997) and Metcalfe (1998).

<sup>35</sup> See Nelson (1995).

cess of innovation and imitation and to Hayek's concept of competition as a discovery procedure. It is also an approach that can analyze competition as a process, and can therefore also be seen as an interesting theoretical approach for developing a new concept of "dynamic competition". Therefore evolutionary innovation economics can contribute a new and different perspective on innovation competition that so far has not been used in competition policy. One of the important insights are the benefits of heterogeneity and diversity.<sup>36</sup> If heterogeneous firms with different knowledge and capabilities try to develop new innovative problem solutions independently from each other, and can learn mutually from their successes and failures, then the existence of a larger number of independent firms can lead to the finding and selection of better innovations, because more different research paths are tried out. Therefore the diversity of an existing population of firms (in the sense of the number of firms and their heterogeneity) can have a large value (in some analogy to the value of biodiversity) for the long-term innovation process in an industry. For the application of competition law, e.g. in merger reviews, this evolutionary argument leads to the conclusion that a reduction in the number of innovating firms that are doing parallel research, can have a negative impact on technological progress, although the tradeoff with R&D efficiencies might limit the optimal number of independently innovating firms.<sup>37</sup>

Important insights into innovation processes in markets can also be gained from approaches in business and management studies. Especially strategic management theories, the so-called resource-based view and, more recently, the "dynamic capabilities" perspective are interesting approaches for a better understanding of innovation in a dynamic competitive context.<sup>38</sup> Based upon an early approach of Penrose (1959) the resource-based view sees the firm as a bundle of resources which are decisive for its competitiveness and therefore profitability. Firms are heterogeneous, because they differ in their control over valuable, rare, inimitable and non-substitutable resources (VRIN resources). Resources of the firm can consist of a broad set of tangible and intangible resources, but particularly important is the focus on knowledge, skills, and capabilities. These resources can be, e.g., machinery, laboratories, intellectual property (patents, trademarks), abilities and knowledge of managers and employees, and organizational knowledge. The "dynamic capabilities" approach is a further step, because it focusses much more explicitly on the need of firms to change and innovate in a rapidly changing world. Its basic idea is to ask for the "dynamic capabili-

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<sup>36</sup> The existence and persistence of heterogeneity of firms in regard to productivity is one of the important well-confirmed insights from the empirical literature; see the survey of Syverson (2011).

<sup>37</sup> See in much more detail Kerber (2011) and Kerber/Saam (2001), where this effect is shown in a simulation model. It is important that this effect of a merger is not based upon innovation incentives, but on an evolutionary variation-selection-effect. A similar argument about the advantages of "econodiversity" can be found in Farrell (2006), where he also asks the question whether competition policy should protect such diversity. These kinds of advantages of diversity have also been emphasized in Comanor/Scherer (2013) and mentioned in Shapiro (2012, 382) and Rubinfeld/Hoven (2001, 72); from an innovation economics perspective see Cohen/Klepper (1992).

<sup>38</sup> See for the following Penrose (1959), Barney (1991), Teece/Pisano/Shuen (1997), Teece (2007) and Wojcik (2015) who offers an overview about this broad literature. These theories are also closely related to the evolutionary approach of Nelson/Winter (1982) who view the knowledge of the firm as consisting of routines, skills and capabilities. See also Montgomery (1995) and Noteboom (2001).

ties" that are necessary for changing the knowledge, skills, and capabilities of firms, or, in the early definition of Teece/Pisano/Shuen (1997, 516), the "firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environment". This focus on the role of (knowledge) resources, learning, and capabilities for being innovative can help a lot to understand innovation and innovation competition.<sup>39</sup> Overall, there are a number of promising approaches beyond traditional theoretical and empirical industrial economics, which however so far have not been analyzed enough whether and how their insights could be used in the application of competition law in regard to innovation competition.

### **2.3 Consequences for the application of competition law**

Although we have a lot of specific theoretical and empirical insights about the relationship between competition and innovation, this relationship looks both very complex and difficult. Part of the difficulties is due to the fact that our knowledge is still often vague and full of gaps and contradictions, but part of the difficulties have their roots also in the lack of a more comprehensive concept of competition that also includes innovation competition. Much of the complexity of the relationship is also due to the specific characteristics of innovation that require the insights of different theoretical approaches. How has the application of competition law dealt with these difficulties so far? On one hand, competition authorities were cautious and therefore reluctant to analyze innovation effects and innovation competition. Especially under the influence of the "more economic approach" and the attempts to quantify anticompetitive effects, competition authorities have developed a tendency to focus their competitive assessments on consumer harm through price increases, and have ignored in many cases possible effects on innovation and innovation competition. In that respect, we can observe an application bias against the analysis of innovation effects.<sup>40</sup> However, on the other hand, it can also be observed that in certain groups of cases competition authorities also have tried to take into account innovation effects but often in a rather experimental way that is not always based upon a clear theoretical framework for the assessment of innovation effects. Therefore competition authorities have had to face regularly complaints that their analysis is based more on speculation than clear economic analysis. But this only reflects our lack of clear theoretical concepts for the analysis of innovation competition. However, these experimental attempts to consider innovation also show that competition authorities are aware of the importance of innovation effects and try to find ways how to take them into account in competition cases.

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<sup>39</sup> See also Sidak/Teece (2009) who emphasize the relevance of the capabilities approach for "dynamic competition".

<sup>40</sup> See the critique in Evans/Hylton (2008) and Curzon-Price/Walker (2016).

### **3. Towards More Innovation-Specific Assessment Approaches in Competition Law**

#### **3.1 Introduction**

In competition policy discussions there is an increasing awareness that the well-established static framework for assessing competition problems might not be sufficiently appropriate for dealing with innovation effects.<sup>41</sup> Therefore a discussion about the necessity of new assessment concepts in regard to innovation in competition policy is overdue. However, it has to go deeper and further than the current discussions suggest. One part of this discussion has to refer to competition economics itself and the question of our appropriate concept of competition. It is necessary to have a much deeper discussion what "dynamic competition" or "innovation competition" can really mean and how more comprehensive concepts of competition that also encompass innovation competition can look like. This is directly related to the above-mentioned necessity that due to the specific characteristics of innovation it is necessary to apply a pluri-theoretical approach, i.e. that not only the mainstream theoretical and empirical industrial economics approach should be applied but also the insights and methods of innovation research, evolutionary approaches, and management theories, as strategic management, the resource-based view and the dynamic capabilities-approach.<sup>42</sup> Another part of the discussion refers to the level of assessment concepts in competition law. In that respect, the next sections will discuss briefly some experiences with innovation-specific assessment concepts in merger reviews, and try to give some hints about the direction of future research.

#### **3.2 Market Definition and the Problem of the Identification of the Relevant Innovation Competitors**

One of the huge problems of assessing innovation effects in competition policy is that competition authorities are still clinging too much to the traditional static concept of product markets (with the hypothetical monopoly/SSNIP test as basic assessment concept). In the meantime, it has been increasingly acknowledged that market definition is not an end in itself but only an instrument for competitive assessments. The main task of market definition is to identify the relevant competitors that have to be included into a competitive assessment of a certain behavior or a merger. The problem with the product market concept is that the incumbent firms on this market might not be the same that compete for innovation. Not all incumbent firms might invest in R&D, and there might be firms outside of these product markets that are competing for innovations with incumbent firms. Therefore the relevant set of competitors in regard to innovation competition can differ significantly from the set of competitors that are relevant for price competition. Both in EU competition law and in US antitrust law this crucial insight has not found a systematic consideration in the assessment

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<sup>41</sup> See, e.g., Pleatsikas/Teece (2001), Sidak/Teece (2009), Evans/Hylton (2008) with their critique of "static-ization of antitrust", Kerber (2011), and de Streel / Larouche (2015) in regard to "disruptive innovations".

<sup>42</sup> Similar recommendations have been made by Sidak/Teece (2009).

concepts about innovation effects. In both jurisdictions the competition authorities still rely on the product market concept and try to solve the problems with innovation, which they are well aware of, by grasping the effects either through the concept of potential competition or, in the case of the expected emergence of new markets, with the concept of future markets. Both approaches can solve some problems but are ultimately not convincing and do not go far enough, because they do not directly address innovation competition.<sup>43</sup> It would be much more appropriate to directly identify the set of relevant innovation competitors, and then carry out a direct analysis of the effects on innovation competition. This is closely related to the basic idea of the much (and also very controversially) discussed "innovation market approach" of Gilbert/Sunstein (1995), which could win only some official recognition in the context of IP licensing agreements but has not been considered, e.g., in the Horizontal Merger Guidelines, which both in the US and the EU are clearly based upon the product market concept.<sup>44</sup>

However, despite this official reliance on the product market concept, the competition authorities have somehow experimented with more innovation-specific assessment concepts in their case practice, esp. in the US. In an econometric study of all 399 challenged US mergers between 1995 and 2008, Kern/Dewenter/Kerber (2016) analyzed to what extent the US competition authorities DoJ and FTC used a "more innovation-specific" assessment concept in their merger reviews.<sup>45</sup> The main criterion for distinguishing the use of the traditional product market approach from such a "more innovation-specific" approach for market definition was whether the competition authorities used in their complaints a market definition that entails only the "manufacture and sale" or - more broadly - the "research, development, manufacture and sale" of a range of products, indicating that the competitive assessment in the latter case would also encompass competition in innovation.<sup>46</sup> The results show that the competition authorities used in those 135 merger cases,<sup>47</sup> in which innovation aspects have been mentioned, a market definition that explicitly comprised also "research and development" in 70% of all (323) markets with innovation aspects. Therefore in the majority of cases such a more innovation-specific concept was used by the authorities. Although the FTC used this innovation-specific concept significantly more than the DoJ, both agencies used both concepts in regard to assessing innovation effects of mergers. Another interesting result is that a statistically significant increase of the use of the innovation-specific concept can be found from the period 1995

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<sup>43</sup> See for an analysis of these different concepts Kern (2014).

<sup>44</sup> See EU Commission (2004) and DoJ/FTC (2010) for the EU and US Horizontal Merger Guidelines. However, "innovation markets" were explicitly considered in DoJ/FTC (1995). For a critical analysis of "innovation markets" see from different perspectives Davis (2003), Katz/Shelanski (2007, 41-44), Carrier (2008) and Drexl (2012).

<sup>45</sup> For a broader explanation of this study and its theoretical background with also additional descriptive results see also Kerber/Kern (2014).

<sup>46</sup> In the first case with a pure product market innovation effects were only mentioned in the competitive assessment of the merger. In the second case that included innovation in the market definition, innovation effects were either mentioned explicitly also in the competitive assessment or it was only claimed that the merger has anticompetitive effects on the market.

<sup>47</sup> This means that in a third of all challenged US mergers the competition authorities have considered innovation aspects in at least one market. However this does not allow any clear conclusion about the importance of these innovation concerns in these cases.

- 2003 to the later period 2004 - 2008. In the empirical study also other more innovation-specific assessment criteria could be found, as, e.g., using the plain number of competitors instead of more sophisticated concentration measures as the HHI or market shares in the competitive assessment part of the case.<sup>48</sup> However, the study also showed that the agencies did not develop a clear consistent approach how to assess innovation effects of mergers but remained often vague about the reasonings why the merger might lead to negative effects on innovation.

Although this practice of the US agencies of using also innovation in the market definition part of merger reviews should not be over-interpreted as a direct application of the innovation market concept, and also has not been acknowledged in the reform of the US Horizontal Merger Guidelines in 2010, the EU merger policy was much more reluctant in using innovation-specific concepts that bear at least some resemblance to innovation markets. The EU Commission has relied much more explicitly on the potential competition and the future market concept. It would be very worthwhile to analyze more specifically the EU merger cases in respect to the application of innovation-specific assessment concepts, and analyze also specifically to what extent and how the EU Commission experimented in that respect in regard to identifying the relevant competitors, assessing innovation competition, and using remedies.<sup>49</sup> In regard to the specific case group of pharma mergers, both the US and the EU have developed a rather consistent approach for assessing innovation effects. Through the much clearer definition of innovation projects through the regulatory framework in the pharmaceutical industry (with different preclinical and clinical phases of research) the innovation competitors can be more easily identified (pipeline projects), which facilitates the analysis of the effects of a merger on innovation competition. Although still different case groups emerge, depending on the question whether one of the merging firms already sell a drug on the market whose revenues might be threatened by the pipeline product of the other merging firm (which is more a classical potential competition case) or both firms have competing products in the pipeline, in which case the merger threatens to eliminate the direct innovation competition,<sup>50</sup> the solution of requiring the divestiture of one of the R&D projects (with all necessary assets) to a third-party for protecting competition between parallel research projects by ensuring the possibility of finishing successfully the R&D project is well-established in both jurisdictions.<sup>51</sup> The problem is that outside of the heavily-regulated pharmaceutical industry such an approach of directly identifying clearly overlapping innovation activities is much more difficult.

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<sup>48</sup> It is a well-established insight that market shares on product markets need not reflect well the market positions in regard to innovation competition (see DoJ/FTC 1995).

<sup>49</sup> It would be very interesting to analyze to what extent the EU Commission in its merger cases has experimented with the assessment of innovation effects beyond the brief guidance that can be found in the only paragraph (para.38) that deals with innovation in the 2004 Horizontal Merger Guidelines.

<sup>50</sup> See also the distinction of different case groups in Shapiro (2012, 390).

<sup>51</sup> For an interesting analysis of US pharmaceutical merger cases from an explicit innovation-specific perspective see Carrier (2008).

### 3.3 Looking at Resources as Preconditions for Innovation: A Suggestion

One of the huge problems of dealing with innovation in competition policy has its roots in the large uncertainty and unpredictability of innovation. On one hand, this can help competition, because we know that even entrenched monopolistic positions and the market power of well-established incumbent firms might be successfully challenged through the unpredictable emergence of radical innovations, e.g., also from new start-ups. Economic history is full of examples for the disruptive effects of such innovations (and the impact of Schumpeter's "creative destruction"). This is also the reason why a considerable number of competition scholars are convinced that, in the long run, we can rely on Schumpeterian competition for challenging dominant positions of firms (as, e.g., even Google and Facebook) through the creation of new innovations. Therefore Schumpeterian competition is often seen as part of the "self-healing powers" of a market economy, which in combination with our limited knowledge about innovation in market competition and how we can protect innovation competition through competition law can lend also a lot of support for the general policy recommendation of being very cautious about intervening into markets for protecting innovation competition through the application of competition law. On the other hand, however, we should be very cautious in accepting this belief that innovation and Schumpeterian competition is always possible and can be relied upon, irrespective of the structure of the economy and the market power and anticompetitive behaviour of incumbent firms. Therefore it might be advisable to promote innovation by protecting innovation competition against the anticompetitive effects through mergers, horizontal agreements, and problematic business strategies (with, e.g., foreclosure effects).<sup>52</sup> However, the knowledge problem through the uncertainty and limited predictability of innovation has to be taken into account in regard to the assessment of innovation effects in competition law.<sup>53</sup>

Although innovations "out of the blue" are possible,<sup>54</sup> we know that most innovations are the result of (sometimes long and expensive) R&D activities, require the access to specific resources, and their success can depend on many specific circumstances on the market as well as on the legal and regulatory framework. Therefore innovations depend on specialized resources and other preconditions, whose absence can make them impossible or at least reduce the probability of their success significantly. One part of these preconditions consists of the legal and regulatory framework. In the recent discussion about "disruptive innovations" the potentially negative effects of old regulatory regimes for new innovative business models (as Uber or AirBnB) have gotten much new attention. But another important part are resources that are necessary for innovation. Critical are particularly specialized resources and assets as laboratories, intellectual property rights (as patents and trademarks), knowledge resources (including capabilities and knowhow based upon experi-

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<sup>52</sup> See for this discussion, e.g., Baker (2009).

<sup>53</sup> See for a discussion of the error costs of over- and underenforcement in regard to innovation in antitrust law Shelanski (2013).

<sup>54</sup> This is supported from an evolutionary economics perspective, because it sees the existence of creativity of entrepreneurial individuals (as, e.g., Steve Jobs) with unpredictable innovations as an endogenous part of market competition and economic evolution.



ence/learning-by-doing), and highly qualified R&D staff that can neither be easily duplicated or substituted through other resources.<sup>55</sup> In the current digital revolution data and perhaps also capabilities for data analytics (and therefore highly talented data scientists) are seen as the new critical resources for the manifold types of innovation in the digital economy. As far as we can identify specialized resources that are necessary for certain kinds of innovation processes and can operationalize them in a sufficiently objective way, we can also make some predictions about the (im)possibility or (im)probability of innovations, and can use this in the analysis of innovation effects in competition law cases. Therefore focussing much more systematically on necessary specialized resources for innovation might be an important new level of analysis, if we want to take innovation in competition law seriously.

In many regards this is not a new approach. The crucial relevance of specialized assets and resources has already been emphasized by the "innovation market" approach. In their proposed five-step procedure for identifying the relevant innovation competitors and the possible anticompetitive and efficiency effects Gilbert/Sunstein (1995) not only looked at the identification of overlapping R&D activities but also combined this with the identification of specialized assets that are necessary for this kind of R&D, and insisted that they would not recommend the definition of separate innovation markets, if no such specialized assets can be identified. This means that they are using the specialized assets for identifying who else might be a relevant innovation competitor. It is clear that such an analysis is close to the question about barriers to entry in regard to a specific kind of innovation, i.e. that the analysis of necessary resources can also be interpreted as an analysis of entry barriers. However, it is necessary to distinguish very clearly between a traditional analysis of barriers to entry in regard to price competition, and an analysis of barriers to entry in regard to innovation. Therefore also the often used criterion of "contestability" means something different. So far, however, we have no clear concept of "contestability" in regard to innovation competition, but looking systematically at necessary specialized resources for innovation might help to clarify the concept.<sup>56</sup>

The crucial relevance of specialized resources can also be found in the case practice of the US and EU in regard to innovation. In the pharmaceutical merger cases the necessary resources for innovation play a crucial role in the remedies. In many settlement agreements about divestitures of R&D projects, the FTC has defined meticulously all necessary resources that they deem as important for ensuring that there is no diminishing of the probability of the success of the divested R&D project. But specialized resources for innovation can even play a more important role, if innovation activities cannot be defined any more as well as in the pharmaceutical industry, or if the

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<sup>55</sup> Theoretically this can be linked to the resource-based view of the firm which views valuable, rare, inimitable, and nonsubstitutable resources as critical.

<sup>56</sup> "Contestability" in the old theory of "contestable markets" (Baumol/Willig) was defined in a purely price-theoretic way with no link to innovation, with the consequence that "perfect contestability" would force incumbent firms to set prices as in perfect competition. See for this distinction also Curzon Price/Walker (2016, 478, Fn.10); Shapiro (2012) uses the term "contestability" in an entirely different way.

innovation effects should be analyzed in a more long-term way (beyond short-term product cycles). One old example in the US is the Lockheed/Northrop merger case in the military aircraft industry that had been challenged by the DoJ on grounds of innovation concerns.<sup>57</sup> In addition to the immediate problem of competition among parallel research projects, the DoJ emphasized also a much more fundamental long-term concern, namely that both were the leading firms in regard to certain kinds of aircraft technology and therefore it was seen a need "to maintain a number of firms with the capability of innovating to meet future national security challenges".<sup>58</sup> Although there was also a concern about higher procurement prices due to the merger, the main argument was that the elimination of one firm with the capabilities to innovate would lead to a reduction of the overall capability of the US military aircraft industry to solve so far unknown future security challenges through innovative solutions. The implicit assumption behind this reasoning about the relevance of maintaining a minimum number of independent firms for innovation was the evolutionary argument that different firms will come up with different innovative ideas and therefore will try out different research paths for solving a problem.

It is interesting that in recent merger cases also the EU Commission has used reasonings, which seem to be not far from this basic idea that it is important to maintain several independent firms that are capable of doing research in certain fields beyond the protection of direct competition between parallel R&D projects (as in the many pharmaceutical merger cases). On March 27, 2017, the EU Commission approved the merger between Dow and DuPont with the condition that DuPont has to divest major parts of its global pesticide business, including its global R&D organisation.<sup>59</sup> In addition to concerns about reduced choice and higher prices in a number of markets for existing pesticides, the Commission was most concerned about a significant reduction of innovation competition for pesticides. Particularly remarkable is that the Commission did not only address the problem of the parties' incentives to pursue parallel innovation efforts, but was also concerned about the general incentives of the merging firms to develop new pesticides: "After the merger, only three global integrated players would remain to compete with the merged company, in an industry with very high barriers to entry. The number of players active in specific innovation areas would be even lower than at the overall industry level."<sup>60</sup> The Commission concluded: "The sale of the underpinning R&D organisation and pipeline ensures the viability and competitiveness of the divested business on a lasting basis and will enable the buyer to become a global integrated R&D competitor" (ibid.). Important is here that not only competition between already existing R&D projects is protected but also future so far unknown innovation activities. In that respect, the Commission also has a more long-term perspective about the innovation effects (beyond the currently existing inno-

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<sup>57</sup> See *United States v. Lockheed Martin Corporation and Northrop Grumman Corporation*, Complaint (March 23, 1998) and Rubinfeld/Hoven (2001, 85-90).

<sup>58</sup> Robinson (1999, 13), who was DoJ Director of Operations and Merger Enforcement. She added that "protecting variety in innovation is critically important" (ibid., 15).

<sup>59</sup> Decision in case M.7932 Dow/DuPont; see also EU Commission (2017b).

<sup>60</sup> See Press release "Dow/DuPont", Brussels, 27 March 2017, and: "Other competitors have no or more limited R&D capabilities" (ibid.).

vation projects). Such a reasoning makes clear that the relevant competitors in innovation are here defined by the necessary resources and capabilities for doing R&D in a certain innovation area, and suggest that effective innovation competition might need the existence of a minimum number of independent firms who have the necessary capabilities.<sup>61</sup>

It is not possible here to develop such a more resource-oriented approach for analyzing competition concerns in regard to innovation competition in greater detail. This needs much more comprehensive future research, also in regard to the question to what extent and how resources are already taken into account in competition assessments. It is also clear that the analysis of necessary specialized resources is certainly not sufficient for protecting innovation competition, because the latter can also be influenced by anticompetitive business strategies or specific characteristics of the market (as, e.g., direct and indirect network effects on platform markets). But it would be very helpful to develop a more general assessment framework for analyzing the role of necessary specialized resources for innovation competition. It would certainly encompass the question whether firms, e.g., through mergers (but perhaps also through exclusive agreements) would try to monopolize specialized resources that are necessary for innovation in a particular area. In a similar way also a high concentration of specialized resources could be a problem, because this might endanger the existence of independent innovation competitors as sources of innovation. The control of necessary resources could be used for either foreclosing (or blocking) innovation or for controlling further innovation, e.g. through licensing agreements. This raises the question whether under certain conditions these resources can be seen as essential facilities to which a dominant firm might have to grant access (e.g., according to Art. 102 TFEU). It would also be necessary to develop new methods for identifying and operationalizing specialized resources.<sup>62</sup> The basic idea in regard to an analysis of necessary specialized resources for innovation can also be aligned to the old notion of protecting "open" markets, i.e. that the firms can easily enter the market with new innovations, and that the decentralized experimental character of markets is not endangered by established firms through controlling specialized resources that are necessary for innovation.

The competition policy discussions in regard to the digital economy have increasingly focussed on the question of the role of data for competition and innovation. Innovation in the digital revolution is driven through the analysis of huge sets of data that have become available through Big Data (and which will further increase exponentially through the future Internet of Things) leading to the characterization of this kind of innovation as "data-driven innovation". The crucial role of data has also been emphasized in the new EU Communication "Building a European data economy", in which the access to and trade of data is seen as a precondition for a thriving data economy and for the

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<sup>61</sup> A similar reasoning can also be found in the General Electric/Alstom case (Case No COMP/M.7278, General Electric/Alstom, Commission decision of 8 September 2015); see also EU Commission (2016, 5).

<sup>62</sup> In that respect it might be worthwhile to look at the experiences of the resource-based view and the "dynamic capability" approach.

ensuing innovations.<sup>63</sup> If data are a necessary resource for innovation in the digital economy, then the role of data in competition policy can be analyzed in the same way as any other necessary resource for innovation.<sup>64</sup> In regard to mergers it can be asked whether the merging firms can monopolize certain kinds of data or whether a merger would lead to a too high concentration of certain kinds of data that might impede competition in regard to innovations that need this kind of data. Refusal to give access to necessary data might raise questions about abusive behaviour in the case of dominant firms (Art. 102 TFEU) which would hamper innovation, either using an "essential facility" or a "foreclosure" reasoning, especially also in vertical settings. Data as a necessary resource for innovation can also play a role in constellations that can be interpreted as data cartels or data pools, and which might require cartel exemptions according to Art. 101 (3) TFEU that might lead to FRAND solutions (similar to patent pools).<sup>65</sup> However, in all of these applications of competition law to data as resources, it is necessary to analyze very carefully the specific kinds of data, and to what extent firms can get access to them also via other channels (e.g. from data markets) or whether they can substitute them through other types of data or services. Only if this specific kind of data is necessary and essential for certain innovations, the control of these data can be used strategically for impeding innovation competition. In that respect, it is also necessary to develop reliable methods for distinguishing clearly between different types of data and for identifying and defining specific sets of data as specialized assets.<sup>66</sup>

#### 4. Conclusions

The digital revolution leads to many challenges in regard to the question how legal rules and regulations have to be adapted to the new characteristics of the digital economy with its manifold disruptive innovations and the new critical role of data and data analytics. It is not clear so far to what extent our traditional competition law is flexible and open enough for dealing with these challenges. However, there is a consensus that innovation and therefore also innovation competition is crucial for the success of the digital revolution, i.e. that consumers and society benefit from these technological and economic developments. Therefore competition policy has to play a crucial role within the entire legal and regulatory framework for the digital economy. This article, however, claims that competition law and economics has deep-rooted conceptual problems in dealing properly with innovation in competition law. This is partly due to the dominance of static concepts of competition

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<sup>63</sup> See OECD (2015) and EU Commission (2017)

<sup>64</sup> However, there is also a discussion whether only "data" or also other resources are critical for innovation in the digital economy, as, e.g., the capabilities for data analytics or data scientists (as specialized human resources).

<sup>65</sup> However, in the context of the discussion about a European data economy granting access to certain kinds of data, especially also for data-driven innovation, might also be implemented with new sector-specific regulations outside of traditional competition law, and under less restrictive conditions. This might be especially interesting in regard to "access to data" problems in the context of the "Internet of Things", as, e.g., "smart cars" or "smart energy". See, e.g., MPI (2017) and Kerber (2017).

<sup>66</sup> See for the need to a subsegmentation of data in that regard Graef (2015).

and assessment approaches, into which the analysis of innovation effects does not fit very well. Partly it is due to the lack of more innovation-specific assessment concepts that focus directly on innovation competition. It is therefore necessary to develop, on one hand, a broader, pluri-theoretical approach to innovation competition, which also applies the insights of innovation research, evolutionary approaches, and management theories, as, e.g. strategic management, and the resource-based view / dynamic capabilities approach. On the other hand, it is necessary to develop a much clearer, consistent framework for the analysis of competition problems in regard to innovation, both in regard to identifying the relevant innovation competitors and analyzing effects on innovation competition. This article suggests that the analysis of specialized resources that are necessary for innovation might be one important element in this regard. A better general framework for analyzing innovation competition would also help to deal with the manifold problems of innovation competition in the digital economy.

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