A Capability Approach to Merger Review

Iain	Matthew	David
Boa	Elliott	Foster
Frontier Economic Ltd	University of Cambridge	Frontier Economic Ltd

Abstract

Merger analysis typically focuses on possible strategic price effects in markets where there is existing competition between the merging firms. We refer to this as the product based approach. This paper proposes a complementary approach based on an assessment of the merging firms' capabilities that can provide insights on potential merger effects, including in circumstances where the product based approach offers little practical guidance to antitrust authorities. Our approach is rooted in the resource-based view of business strategy that starts from the premise that it is a firm's capabilities (sometimes called core competencies), which drive its competitive advantage across markets. We argue that mergers in which firms' capabilities are less overlapping are more pro-competitive on several dimensions: immediate competition in overlapping markets, immediate competition in other markets, long-run competition and innovation.

Reference Details

A CAPABILITY APPROACH TO MERGER REVIEW

IAIN BOA, MATTHEW ELLIOTT, AND DAVID FOSTER

ABSTRACT. Merger analysis typically focuses on possible strategic price effects in markets where there is existing competition between the merging firms. We refer to this as the product based approach. This paper proposes a complementary approach based on an assessment of the merging firms' capabilities that can provide insights on potential merger effects, including in circumstances where the product based approach offers little practical guidance to antitrust authorities. Our approach is rooted in the resource-based view of business strategy that starts from the premise that it is a firm's capabilities (sometimes called core competencies), which drive its competitive advantage across markets. We argue that mergers in which firms' capabilities are less overlapping are more pro-competitive on several dimensions: immediate competition in overlapping markets, immediate competition in other markets, long-run competition and innovation.

1. Introduction

A common lens through which many businesses think about their competitive advantage is the capabilities that they and their rivals possess. This approach is sometimes called the resource-based view of business strategy and has long history as core part of most MBA programs.[1] The basic idea is that a firm derives its competitive advantage in a given market from the capabilities it has, sometimes called core competencies. In the literature these are broadly interpreted to include many things, including, technological know-how, patents, key human capital, relationships with suppliers, corporate culture, the customer base of a firm, the data a firms has collected about its customers, and so on.

The standard approach to merger analysis by antitrust authorities starts from a different place. Rather than focusing on firms' capabilities, the emphasis is typically on identifying the strategic pricing effects that might be associated with the merger in the markets where both firms operate pre-merger. We refer to this as the product-based approach.

While the product-based approach works well in a wide range of circumstances, it struggles when there is significant uncertainty as to the nature of the products that might be offered post-merger. One prominent example of this is assessing the impact of a merger on potential competition in markets characterised by significant levels innovation – a core concern in most "killer acquisition" cases. Another is trading off the potential for the merger to boost innovation in the medium term versus its shorter term impacts on price competition.

Recent trends in corporate deal-making have brought the types of mergers where these sorts of issues arise to the fore – see, for example, Cunningham et al. (2021). In this paper we propose an extension of the product-based approach, based on an analysis of firms' capabilities that we believe provides a systematic framework for assessing such mergers.

Our approach is motivated by the large management literature on the resource-based approach to business strategy, and we build directly on the formalism used in Chen et al. (2022) to study conglomeratization. Our core results are that the more overlapping firms' capabilities are, and hence the closer the firms are in capability space: 1) the greater the potential harmful anticompetitive effects of the merger; and 2) the weaker the potential pro-competitive benefits – either in terms of improving existing products or creating entirely new products – of the merger. In both cases the *scarcity* of an overlapping capability – i.e. a capability held by the merging firms, but few others – amplifies the potential negative impact of a merger on competition and consumer welfare. In particular, mergers in which capabilities are mainly overlapping, and for which some of these overlapping capabilities are scarce, are likely to raise the greatest levels of concerns. We also show that these concerns go beyond immediate competitive effects. When a merger has more overlapping capabilities the scope for strong future competitors to emerge is reduced and innovation opportunities are curtailed, while these effects are again exacerbated when the overlapping capabilities are scarce.

2. Motivating Example

In this section we present a simple example of a standard horizontal merger problem. The aim is to show that a fuller understanding of firms' capabilities can aid an assessment of whether the merger is pro-competitive or anti-competitive. Arguably this perspective is more important still when considering conglomerate mergers, but the more familiar horizontal case

---

[1] As of May 2022, Wernerfelt (1984), Prahalad and Hamel (1990), and Barney (1991), all key references in this literature, collectively have more than 160,000 Google Scholar citations.

provides a useful pedagogical device. All calculations underlying the claims in this example are deferred to Appendix A.

Three firms, A, B and C compete on price and each produce a single differentiated product at marginal cost 0. Initially each product i faces a demand curve

$$q_i = \alpha_i - p_i + \frac{\sum_{j \neq i} p_j}{3}.$$

The parameter α_i is a demand shifter that reflects the relative desirability of the different products.

Now suppose that two of the firms propose to merge. In order to understand the impact of the merger, it is important to understand what underlies the firms' demand curves. A common perspective used to improve understanding of this is to view the demand of each product as being derived from a set of underlying attributes which are valued differently by different consumers.

Suppose that in this case there are three attributes a product may or may not have that determine its desirability - post-sales customer care (Post-sales), and two attributes related to product quality (Quality 1) and (Quality 2). The ability of firms to endow their products with these attributes is determined by the immutable and scarce capabilities (sometimes referred to as core competencies) that they have.

Suppose that in this case there are three possible capabilities firms might have. Outstanding customer services (Customer care), a strong engineering team (Engineering) and good supply relationships (Relationships). The Customer care capability endows the product with the post-sales customer care attribute, while both the Engineering and Relationships capabilities contribute towards product quality; A product has Quality 1 if the corresponding firm has with either (or both) of these two capabilities, and Quality 2 if the firm has both of them. Table 1 shows the initial attributes of the three products.

	Post-sales	Quality 1	Quality 2
Product A	Yes	No	No
Product B	No	Yes	No
Product C	No	Yes	No

TABLE 1. Product Attributes

To capture the increased willingness to pay associated with the different attributes we let the demand shifter α_i depend on them. Specifically, suppose

$$\alpha_i(a_i, a_{-i}) := 2/3 + |a_i| - \sum_{k \neq i} |a_k|/3,$$

where a_i is the set of attributes product i has, and hence $|a_i|$ is the number of attributes that firm i has. Note that, all else equal, increasing the number of attributes i has by 1 increases i's demand by 1 and reduces 2 and 3's demand by 1/3rd each. So of the increased demand that 1 faces when its product has more attributes, 1/3rd would be diversion from 2's customers, 1/3rd would be diversion from 3's customers and the rest would be from customers that did not buy any of the products previously.

With this formulation, pre-merger $\alpha_i = 2/3 + 1 - 2(1/3) = 1$ for all products i. So absent a merger the equilibrium prices will be 0.75 for all products, generating overall consumer surplus of 0.84.

If firm A merges with B to create firm AB, then the newly created firm will be able to produce an improved product by drawing on the combined strengths of the merging firms. The high quality post-sale customer care from A can be combined with the high-quality of product B.

We model the merger by replacing product A with (an improved) product AB, and replacing product B with the same (improved) product AB. Hence we let the merged firm face a demand function equal to the sum of the demand functions firms A and B would have faced separately with these improved attributes, and adjust the demand firm C faces similarly. For example, suppose a price of 0.75 is set for product AB and firm C continues to charge a price of 0.75, then the previous consumers of product A and product B are able to purchase an improved product for the same price as before, while the only alternative product C remains exactly as attractive as prior to the merger; Thus we expect all these customers to buy product AB.[2] Specifically, letting $\hat{a}_j$ and $\hat{p}_j$ be the post merger attributes and prices,

$$
\begin{aligned}
D_{ABj}(\hat{a}_j, \hat{p}_j) &= D_{Aj}(\tilde{a}_j, \tilde{p}_j) + D_{Bj}(\tilde{a}_j, \tilde{p}_j), \\
D_{Cj}(\hat{a}_j, \hat{p}_j) &= D_{Cj}(\tilde{a}_j, \tilde{p}_j),
\end{aligned}
$$

for prices $\tilde{p}_A = \tilde{p}_B = \hat{p}_{AB}$ and $\tilde{p}_C = \hat{p}_C$, and for attributes $\tilde{a}_A = \tilde{a}_B = \hat{a}_{AB}$ and $\tilde{a}_C = \hat{a}_C = a_C$. We therefore have

$$
\begin{aligned}
D_{ABj}(\hat{a}_j, \hat{p}_j) &= \frac{10}{3} - \frac{4}{3}\hat{p}_{AB} + \frac{2\hat{p}_C}{3}, \\
D_{Cj}(\hat{a}_j, \hat{p}_j) &= \frac{1}{3} - \hat{p}_C + \frac{2\hat{p}_{AB}}{3}.
\end{aligned}
$$

Given these new demand conditions, the equilibrium prices are then 1.41 for product AB, and 0.64 for product C. Although some prices increase post merger, those products are also now more desirable, and this is reflected in increased aggregate consumer surplus of 1.08, an increase of more than 25%. This merger is pro-competitive.

The case of firm A merging with firm C is equivalent. However, it is harder to anticipate the impact of a merger between B and C. It is not clear whether we should expect firms B and C to be able to both produce better quality products by drawing on each others' expertise, or whether their capabilities are too similar for any such synergies to be realized. To better understand what will occur it is helpful to understand what underlying capabilities are driving the product attributes, in this case, product quality.

If both firms are relying on the same capability, say excellent supply relationships, then it is likely that there will be limited opportunities for synergies to be realized and the merger may not enable either product to be improved (see Table 2). In this case the merger will be anticompetitive and consumer surplus will decline to 0.74 (a loss of more than 12%). There are no synergies to offset the loss in competition and overall consumer surplus decreases as a result of the merger. On the other hand, if one firm has excellent supply relationships and the other has a very strong engineering team then it is likely that they will be able to benefit

---

[2] An alternative approach is that after the merger of firms A and B a new product replaces product A and a separate new product replaces product B, and the prices of both these products are set to maximize the profits of the firm AB. The example presented here can be easily adapted to that setting without changing the main conclusions.

from each other, resulting in better products for consumers and higher consumer surplus post-merger (see Table 3).[3]

	Capabilities			Attributes		
	Customer care	Relationships	Engineering	Post-sales	Quality 1	Quality 2
A	Yes	No	No	Yes	No	No
B	No	Yes	No	No	Yes	No
C	No	Yes	No	No	Yes	No

TABLE 2. Capabilities (Case 1) and product attributes after a merger between B and C

	Capabilities			Attributes		
	Customer care	Relationships	Engineering	Post-sales	Quality 1	Quality 2
A	Yes	No	No	Yes	No	No
B	No	Yes	No	No	Yes	Yes
C	No	No	Yes	No	Yes	Yes

TABLE 3. Capabilities (Case 2) and product attributes after a merger between B and C

	Prices			Consumer Surplus		
	No merger	B-C merge (Case 1)	B-C merge (Case 2)	No merger	B-C merge (Case 1)	B-C merge (Case 2)
A	0.75	0.82	0.64	0.28	0.33	0.20
B	0.75	0.95	1.41	0.28	0.20	0.44
C	0.75	0.95	1.41	0.28	0.20	0.44
Total				0.84	0.74	1.08

TABLE 4. A comparison of prices and consumer surplus after a merger between B and C for Case 1 (overlapping capabilities) and Case 2 (non-overlapping capabilities).

There are some interesting features of this example worth emphasizing. Consider a merger analysis based only on pre-merger market data - prices, quantities, market shares, etc. By all these measures all the mergers we considered look identical, despite the very different outcomes they can generate. A more sophisticated analysis might consider the product attributes. There are by now standard methods for identifying key product attributes in a given market and analyzing products as bundles of these attributes (Hoberg and Phillips, 2010, 2016). The basic idea is that firms with more similar product offerings are likely to be closer competitors and hence a merger between them is more likely to be anticompetitive.[4]

---

[3] Indeed, beyond the impact in the market being considered here, the ability to source higher quality parts combined with a strong engineering team might facilitate innovation that permits the merged firm to enter new markets leading to further consumer surplus gains in these other markets.

[4] This might also manifest as a higher cross elasticity of demand between the two products, which our ex-ante symmetric formulation abstracts from. Removing this symmetry would help the standard analysis do better.

On this basis, a merger between A and B might be correctly identified as being relatively pro-competitive while a merger between B and C would be deemed relatively anti-competitive. However, as we have seen this is not necessary the case. The merger between B and C can be as pro-competitive as the merger between A and B.[5] Moreover, understanding the capabilities of the merging firms and how much these overlap is informative for anticipating whether the merger will be pro-competitive or anti-competitive. All else equal, when capabilities overlap less, the merger will generate more synergies and be more pro-competitive.

A full understanding of these potential synergies requires understanding capabilities. These are correlated with product attributes and possibly the cross-elasticities of demand. So the standard analysis based on cross elasticities will tend to incorporate some indirect and partial information about offsetting synergies; Product attribute analysis goes further and provides better information, but further gains are possible by directly taking into account firms' capabilities.

3. MODEL

We seek to analyze whether a proposed merger between two firms is pro-competitive or anti-competitive. Firm i competes in markets J_i (producing one product for each such market). Consider a market $j \in J_i$. Consumers of market j products value certain product attributes. We let the set of product attributes valued by market j consumers be M_j. A given firm i operating in market j will produce a product that has some of these attributes. We let $a_{ij} \subseteq M_j$ be the set of attributes that firm i's product has in market j. Firm i's demand in market j depends on a_{ij}, the valuable product attributes it has, and a_{kj} for all $k \neq i$ - the product attributes its competitors have. We stack these relevant product attributes for market j in a_j.

We model the impact of product attributes on demand by including demand shifters $\alpha_{ij}(a_j)$ in i's linear demand function[6] for market j:

$$D_{ij}(a_j, p_j) := \alpha_{ij}(a_j) + \sum_k \beta_{ikj} p_{kj},$$

where p_{kj} is the price of product k in market j and the prices different firms charge in market j are collected in the vector p_j. We assume that demand is decreasing in own price, increasing in others' prices and a reduction in price by firm i increases its demand considerably more than it reduces any other firm's demand. Specifically, for all i and all j, $-\beta_{iij} > \left(\frac{n-1}{2}\right) \max_{k \neq i} \beta_{ikj} > 0$, and $\beta_{ikj} > 0$ for all i, all j and all $k \neq i$. This guarantees that there exists a unique Nash equilibrium of the game in which firms simultaneously choose their prices (Vives (1999), Chapter 6).

We also assume that the increases in demand from improvements in product attributes induce the same substitution patterns as changes in prices. In other words, for every change in i's product attributes, there is a price i could charge that would hold its demand, and

---

[5] In the more pro-competitive case, when B has the Relationships capability and C has the Engineering capability, the change in consumer surplus from B and C is the same as when A and B merge. However, in the longer run, combining B and C's capabilities, could open up more or better innovation opportunities than combining A and B's capabilities as Engineering and Relationships both feed into production and product quality.

[6] There are well known problem generating linear demand curves from a mass of consumers with unit demand and distributed preferences over different products (Jaffe and Weyl, 2010), but they are commonly used in merger simulations and can represent a first-order local approximation of the demand system. They can also be generated by a representative consumer with quadratic preferences (Amir et al., 2017).

the demand of its competitors', constant. This is a strong assumption, but provides an illustrative baseline case. Specifically, we let

$$\alpha_{ij}(a_j) = \bar{\alpha} - \sum_k \beta_{ikj} f(a_{kj}),$$

where $f(\cdot) > 0$ increases as the firm in question adds additional attributes to its product (i.e., satisfies $f(\hat{a}) > f(a)$ if $\hat{a} \supset a$).

Firm i's product attributes in a given market j are increasing in, and derived from, its capabilities F_i. Consider a firm i with capabilities F_i. It will then have attributes relevant for market j given by $a_{ij}(F_i)$. If i acquires some additional new capabilities giving it capabilities $\hat{F}_i \supset F_i$, then its product attributes for a given market j will weakly improve to $\hat{a}_{ij}(\hat{F}_i) \supseteq a_{ij}(F_i)$. Where it should not cause confusion, we abuse notation and drop the arguments from the attribute functions. Thus, holding the capabilities of the other firms fixed as we increase i's attributes in market j, $\alpha_{ij}(\hat{a}_j) \geq \alpha_{ij}(a_j)$, where $\hat{a}_j$ differs from a_j only in the attributes of i's product.

As an example, a product might have attribute $a1$ if and only if its producer has capability $c1$, while product might have attribute $a2$ if and only if its producer has both capability $c1$ and $c2$ and a product might have attribute $a3$ if and only if its producer has capability $c1$ or $c2$. Ultimately, the demand for a given product in a given market is determined just by the attributes that the available products have, and the prices of the products.

We assume that firms have zero marginal cost for all products for simplicity. Hence, absent any mergers, firm i solves

$$\max_{p_{i1} \geq 0, \ldots, p_{im} \geq 0} \sum_j p_{ij} D_{ij}(a_j, p_j).$$

Overlapping markets for two firms A and B are markets in which they both compete (make positive sales). If firms A and B merge to create firm AB, we model the merger by letting the products offered by A and B be replaced by improved products that make use of the combined capabilities of firm AB. Letting $\hat{a}_j$ and $\hat{p}_j$ be the post merger attributes and prices, firm AB faces a demand function

$$D_{ABj}(\hat{a}_j, \hat{p}_j) = D_{Aj}(\tilde{a}_j, \tilde{p}_j) + D_{Bj}(\tilde{a}_j, \tilde{p}_j),$$

where $\tilde{p}_{Aj} = \tilde{p}_{Bj} = \hat{p}_{ABj}$ and $\tilde{p}_{ij} = \hat{p}_{ij}$ for all $i \neq A, B, AB$; and $\tilde{a}_{Aj} = \tilde{a}_{Bj} = \hat{a}_{ABj}$ and $\tilde{a}_{ij} = \hat{a}_{ij}$ for all $i \neq A, B, AB$.

4. ANALYSIS

In this section we consider the impact of a merger between two firms A and B into the firm AB. We will evaluate the immediate impact of the merger on the competitiveness of different markets, as well as considering the possible longer run effects.

4.1. **Immediate Impact.** We begin with a fairly straightforward result about the immediate impact of a merger on consumer surplus in different markets. We will say that capabilities are contained if either $F_A \subseteq F_B$ and/or $F_B \subseteq F_A$.

Proposition 1. Following a merger between firms A and B to create firm AB:
  (i) Consumer surplus weakly increases in all non-overlapping markets and strictly increases in all non-overlapping markets for which,
      (a) firm AB is stronger in market j than firm A was ($a_{ABj} \supset a_{Aj}$), and
      (b) firm AB is stronger in market j than firm B was ($a_{ABj} \supset a_{Bj}$), and

   (c) firm AB competes in market j post merger.
  (ii) If capabilities are contained then consumer surplus remains constant in all non-overlapping markets.
  (iii) Consumer surplus can increase or decreases in overlapping markets.

We relegate the proof of Proposition 1 to Appendix B. Proposition 1 shows that when capabilities are not contained, consumer surplus will increase in affected non-overlapping markets, while the impact in overlapping markets is ambiguous. In non-overlapping markets when the newly created firms cannot enhance the product offering consumer surplus is unaffected, and when the product offering can be improved consumer surplus strictly increases. This may include markets in which neither of the merging firms were present prior to the merger. In overlapping markets the merger can again allow a better product to be created and brought to market (when capabilities are not contained), but the resulting consumer benefits need to be traded off against a loss of competition.

To better understand the impact of a merger in overlapping markets we will compare a merger between firms A and B when their capabilities are more and less overlapping. We consider a merger when firms A and B have capabilities F_A and F_B respectively prior to the merger, versus the case in which they have capabilities $\hat{F}_A$ and $\hat{F}_B$ respectively prior to the merger. We let $|F_A| = |\hat{F}_A|$ and $|F_B| = |\hat{F}_B|$ so that in both cases each firm has the same number of capabilities. Further, to keep the counterfactual of preventing the merger constant, we assume that the same initial equilibrium prices and demands obtain in all markets prior to firms A and B merging, regardless of whether they have capabilities F_A and F_B versus capabilities $\hat{F}_A$ and $\hat{F}_B$. We say capabilities $\hat{F}_A$ and $\hat{F}_B$ are *less overlapping* than capabilities F_A and F_B if the merged firm in the former case has all the capabilities the merged firm has in the later case, and some additional ones—i.e., if $\{\hat{F}_A \cup \hat{F}_B\} \supset \{F_A \cup F_B\}$.

Firms A and B will be able to improve their products more in all markets when their underlying capabilities are less overlapping. Consider for example the impact of the merger in a specific market j. Suppose firm A has capabilities F_A that gives it product attributes a_{Aj} for market j, while firm B has capabilities F_B giving it product attributes a_{Bj}. Post merger the merged firm will have access to all attributes a_{Aj}, all attributes a_{Bj}, and possibly some additional attributes which require capabilities from both F_A and F_B to be present. We interpret these new product attributes that are made possible by the merger as (immediate) innovations. We discuss the impact on future innovation in Section 4.3. The more overlapping firm F_A's and F_B's capabilities are, the more similar a_{Aj} and a_{Bj} will be, and hence the fewer different product attributes the merged firm will have in market j. In the extreme case where $F_A = F_B$ the merged firm's product will only have the same attributes that firm A (and firm B) had prior to the merger, and there is no immediate innovation. These effects make mergers between firms with less overlapping capabilities more pro-competitive.

Proposition 2. When firm A and B's underlying capabilities are less overlapping, the merger of A and B to create firm AB will result in all firms in all markets generating weakly higher consumer surplus. Moreover, for all markets j such that AB has strictly more attributes when capabilities are less overlapping and AB competes in market j when capabilities are less overlapping, consumer surplus will strictly increase and all firms $i \neq AB$ will set lower prices.

Proposition 2 compares the impact of a merger between firms A and B when their capabilities are more overlapping, to a merger between the same firms when their capabilities are less overlapping. In the later case, firm A and B will have products post merger in all
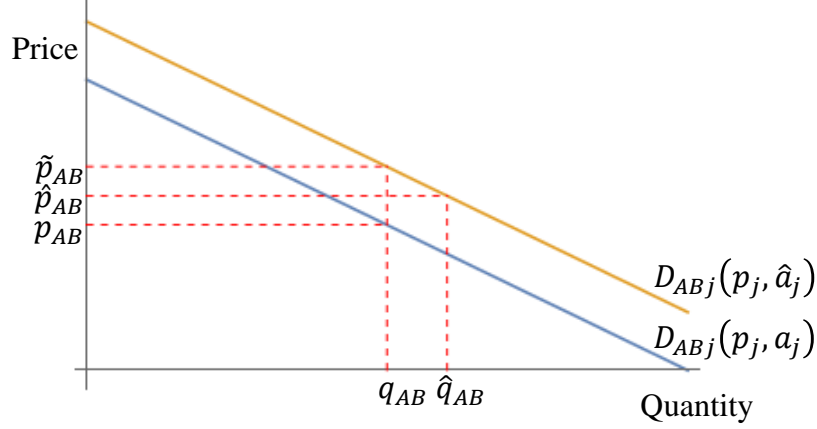
FIGURE 1. How the equilibrium price set by firm AB changes when the merger that creates it involves capabilities that are less overlapping. The less overlapping scenario is captured by capabilities $\hat{a}_{AB} \supset a_{AB}$, which shifts AB's demand curve out (holding fixed other firms' capabilities and prices), leading firm AB to produce more in equilibrium.

markets that are weakly better. When the product is the same, the market is unaffected. When firm AB has a better product and enters the market, Proposition 2 shows that this strictly increase consumer surplus in that market and strictly reduces the prices set by all other firms.

To gain intuition for Proposition 2 consider a market j in which firm AB is able to deliver a strictly better product post merger. Let a_{ABj} denote AB's attributes when the merger is more overlapping, and let $\hat{a}_{ABj} \supset a_{ABj}$ denote AB's attributes when the merger is less overlapping. Figure 1 illustrates the increased demand that firm AB might obtain in market j post merger holding the prices of all other firms fixed.

Let the equilibrium prices and output of firm AB in market j when capabilities are more overlapping be p_j and q_{AB} respectively. Then, from this starting point, when capabilities are less overlapping, suppose firm AB increases its price just enough to hold its output constant. This is achieved by firm AB increasing its price from p_{ABj} to $\tilde{p}_{ABj}$ as shown in Figure 1. Holding the remaining firms' prices fixed, this leaves all individual demands unaffected in comparison to the equilibrium outcome when AB's capabilities are more overlapping. Moreover, at these new prices consumer surplus is exactly the same as in equilibrium when capabilities are more overlapping: by construction $CS_i(p_j, a_j) = CS_i(\tilde{p}_j, \hat{a}_j)$ for all firms i.

It can be shown that, at prices $\tilde{p}_j$, firm AB's profits are strictly decreasing in its prices. Intuitively it faces the same marginal changes to demand as when it was previously optimizing, but now the value of each additional sale is higher. Thus the marginal value of setting a lower price is higher, while the inframarginal losses remain constant and firm AB can do better by setting a lower price. In contrast, the other firms are still maximizing their profits at prices $\tilde{p}_j$ as they face identical demand conditions to before and are setting the same prices. However, if firm AB now reduces its price (as doing so will increase its profits), these other firms best respond by also reducing their prices, which incentivizes firms AB to reduce its price further, and so on. Thus in equilibrium, each firm sets a price strictly lower than that given by the vector of prices $\tilde{p}_j$. This implies that at the new equilibrium, prices $\hat{p} < \tilde{p}$

entry by entry and consumer surplus is strictly higher than at prices $\tilde{p}$. Thus we have that, $CS(p_j, a_j) = CS(\tilde{p}_j, \hat{a}_j) < CS(\hat{p}_j, \hat{a}_j)$.

To go beyond the guidance on consumer harm implied by Proposition 2 we can consider which capabilities are overlapping. When many firms in a given market wield a capability the fact it is overlapping is of less concern, all else equal - after the merger this capability can still be deployed against the merging firms. On the other hand, when an overlapping capability is scarce, such that no other firms hold a copy of it, the merger can have a more detrimental effect on competition. For example suppose that most (if not all) valuable product attributes for a market j require capability c. Then if only the merging firms have capability c, competition in the market will be substantially weakened by the merger. In such a scenario, the merging firms will also look like close competitors in market j when their product attributes are compared and would likely have larger market shares than their competitors pre-merger.

It is interesting to compare an analysis at the capability level to one at the product level. Given that capabilities are used to generate product attributes, the more overlapping capabilities are, the more similar products will be all else equal.[7] This means that when product attributes are close, the capabilities of A and B are more likely to be close too. In this way an analysis of product attributes, which is relatively standard practice, already proxies for an analysis of capabilities and the implications are similar. While more similar products make antitrust authorities more suspicious of a merger, more similar capabilities is also a reason for antitrust authorities to be more suspicious. The fact that closeness in product attribute space can proxy for closeness in capability space does not mean that capability do not need to be considered. As shown in the example in Section 2, an analysis of capabilities provides additional valuable information.

4.2. **Future impact: competition and hoarding.** Viewing mergers through the lens of capabilities also helps to reveal the likely impact of a merger on future competition. Of course, when two firms merge and combine their capabilities, those capabilities are not available to their competitors to use. However, as long as those capabilities are deployed, it is hard to say definitively whether future competition will be adversely affected. The firm itself benefits from the capabilities it uses to create competitive pressure for other others. Nevertheless, mergers can result in capabilities being hoarded. That is, held by the merged firm but not deployed.

Hoarding can be a problem when merging firms have overlapping capabilities. Duplicate copies of the capability may then be held onto by the merging firm to reduce the threat of future competition without being deployed. In such cases it would in principle be possible to remove a duplicate copy of an overlapping capability and to make it available to a competitor without diminishing the merging firm.

The extent to which hoarding like this is of concern is subtle. In some cases it may be infeasible for the capability to be acquired and used by others. This might be the case, for example, for know-how that is embedded in product processes or supplier relationships that are not easily transferrable. On the other hand, capabilities held in the form of human capital, closely related patents and brands are more easily separated from a given business.

---

[7] Specifically, consider two firms A and B which operate in market j. Suppose all A's and B's capabilities are relevant for market j and A's capabilities F_A are adjusted by removing a capability $c \in F_A \cap F_B$ and replacing it with capability $c' \notin F_A \cup F_B$ but which is also valued by market j. Then $|a_{Aj} \cap a_{Bj}|$ will weakly decrease and $|a_{Aj} \cup a_{Bj}|$ will weakly increase. Further, if both firms have the same relevant capabilities for market j, i.e., if $F_A \cap M_j = F_B \cap M_j$, then both products will have the same attributes $a_{Aj} = a_{Bj}$.

The impact on future competition will also depend on whether the capabilities being hoarded are relatively scarce or fairly widely held, and whether it is possible for competitor firms to develop similar capabilities in the longer term (e.g. via investments).

To formalise some of these ideas we consider a hypothetical strongest future competitor for each firm and each market. Take a given market j. The strongest possible future competitor to a firm i in market j is one that holds all the relevant capabilities for market j that firms other than i collectively have, along with any unassigned *relevant* capabilities for market j. Let $\gamma(i,j)$ denote this (hypothetical) strongest future competitor for firm i in market j, and let $F_{\gamma(i,j)}$ denote the corresponding capabilities. Note that if A and B merge to create AB, the relevant capabilities firm AB's strongest possible future competitor has for market j is given by $F_{\gamma(AB,j)} \subseteq M_j$. The capabilities the strongest future competitor of firm A and the strongest future competitor of firm B both have, which are relevant for market j is given by $\left(F_{\gamma(A,j)} \cap F_{\gamma(B,j)}\right) \subseteq M_j$. Note that we must have $F_{\gamma(AB,j)} \subseteq \left(F_{\gamma(A,j)} \cap F_{\gamma(B,j)}\right)$. If the strongest competitor of firm AB has a capability c, then the strongest competitor for both firm A and firm B must also have that capability, but the opposite is not necessarily true. If the strongest competitor for both firm A and firm B has a capability c, the strongest competitor of firm AB need not have it. An example of this is shown in Figure 2.

We say that a merger between A and B into firm AB does not diminish the strongest future competitor to AB in market j if $F_{\gamma(AB,j)} = \left(F_{\gamma(A,j)} \cap F_{\gamma(B,j)}\right)$, while otherwise it does. To better understand this condition, note that $\left(F_{\gamma(A,j)} \cap F_{\gamma(B,j)}\right)$ is the maximal set of capabilities that can be deployed against both A and B, while $F_{\gamma(AB,j)}$ is the maximal set of capabilities that can be deployed against the merged firm AB. Figure 2 provides an example of a merger that diminishes the strongest future competitor.

We show now that it is mergers with overlapping capabilities that are scarce that diminish the strength of the possible future competition, in terms of the strongest future competitor the merged firm could face. To do so we need to define one more concept. We say a capability is scarce with respect to a merger if after the merger only the merged firm holds the capability.

Proposition 3. A merger between firms A and B to create AB diminishes the strongest future competitor of AB in market j if and only if there exists an overlapping capability c (i.e., $c \in F_A$ and $c \in F_B$) that is valued by market j and is scarce post merger (i.e., there does not exist a firm $i \neq AB$ such that $c \in F_i$).

Note that this diminishing of competition can be present in non-overlapping markets as well as overlapping ones. This provides a systematic way to evaluate possible future harms in an unrealized counterfactual, based on current information.

The idea of diminishing the strength of the strongest future competitor for a merging firm provides a metric by which to evaluate the possible implications of a merger on future competition. It is not the only thing that matters, and hence it provides only a partial picture of the overall implications for future competition, but it is informative about potential consumer harms. More generally, this analysis suggests that when there are more overlapping capabilities there will be possible consumer harms to future competition, and when these overlapping capabilities are more scarce these harms are likely to be greater all else equal.

A final remark is that firms may be able to offer remedies that alleviate concerns about future competition. By spinning off companies that contain capabilities that would otherwise be hoarded the possible impacts on future competition can be negated. However, it will depend on the capabilities in question, as to whether such remedies are feasible.

(A) Initial firms   (B) Post merger firms   (C) A's strongest competitor

(D) B's strongest competitor   (E) Capability intersection   (F) AB's strongest competitor
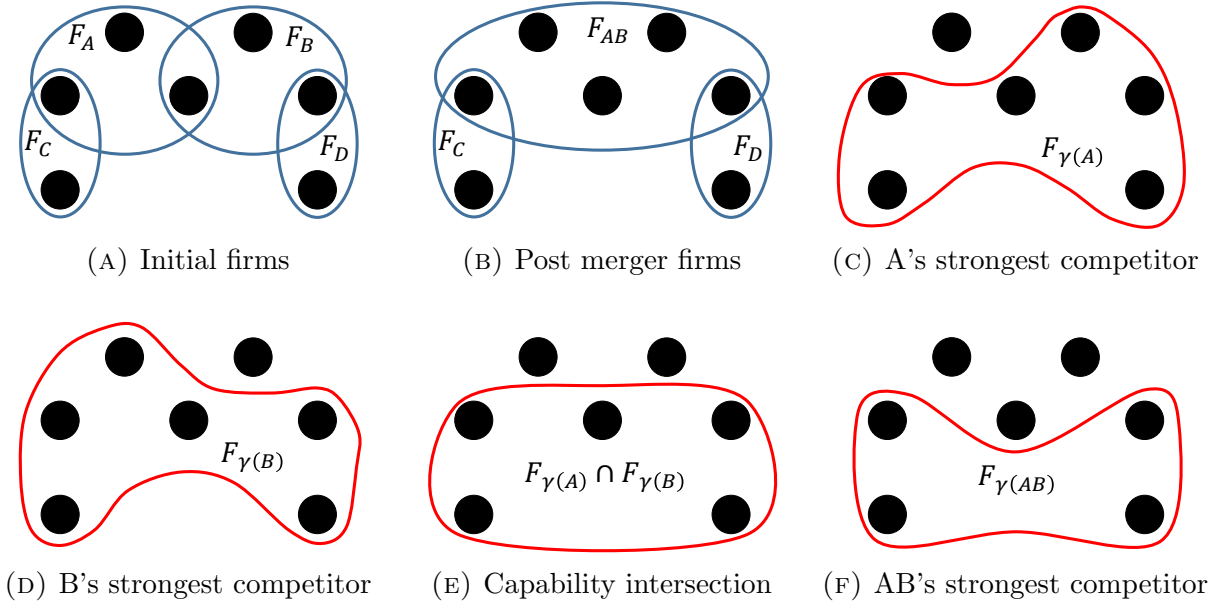
FIGURE 2. The black circles represent capabilities and the lines around them show sets. Panel (A) shows the sets of capabilities of each firm in the market, labeled A, B, C and D respectively have. Panel (B) shows the capabilities firms have after A and B merge to create firm AB. Panel (C) shows the capabilities of firm A's strongest future competitor and Panel (D) firm B's strongest future competitor. Panel (E) takes the intersection of these strongest competitors for firms A and B. This gives a benchmark for the capabilities a competitor to firm AB could have. Panel (F) shows the strongest future competitor to firm AB. As there is difference between panels E and F the merger of A and B is an example of a merger that diminishes the strongest future competitor.

4.3. **Future impact: innovation.** A large literature on innovation, spanning several academic disciplines, takes a combinatorial view (see in economics Weitzman (1998); in biology Kauffman (1993); and in management Nelson and Winter (1977)).[8] The essential idea is that a breakthrough can be made by trying different combinations of inputs. Edison famously tried a huge number of different materials and combinations of materials to make light bulb filaments before finding that carbonized cotton thread could produce light for many hours.[9] Other examples abound. An important part of the modern day search for new medicines can be caricatured as a somewhat brute force search for combinations of molecules with good medicinal properties. Finally, at a more systematic level, the patent citation records evidence how new patents build on combinations of earlier breakthroughs (see, for example, Acemoglu et al. (2016)).

Adopting a combinatorial view of innovation helps reveal the innovation opportunities that mergers can create and destroy. To capture these ideas we consider an extremely simple and stylized model of innovation. We suppose that each firm can try each different combinations of its capabilities, and this experimentation lead to an innovation being realized with some probability. For simplicity, we suppose this probability is constant across all such

---

[8] Some other prominent examples of the literature on combinatorial innovation include Atkinson and Stiglitz (1969) and Nelson (1985).

[9] See https://www.fi.edu/history-resources/edisons-lightbulb.

combinations, and the realizations of specific combinations (whether the combination yields an innovation or not) are independent across firms.[10]

Suppose a merger is proposed between firm A, which has n capabilities, and firm B which has m capabilities. The number of combinations of firm A's inputs prior to the merger, and hence the number of innovation possibilities available to firm A prior to the merger, is 2^n; The number available to firm B is 2^m. For the merged firm AB, the number of capabilities which are overlapping matters. If there are k overlapping capabilities, then the number of innovation opportunities will be 2^{n+m-k}. Thus the change in aggregate innovation opportunities from the merger is $2^{n+m-k} - 2^m - 2^n$.

Proposition 4. There exists a threshold $\bar{k}(m,n) \in (0, \min\{m,n\})$ on the number of overlapping capabilities such that innovation opportunities increase following a merger between firms A and B if and only if $k < \bar{k}(m,n)$.

Proposition 4 shows that mergers will lead to there being more aggregate innovation opportunities if the merging firms' capabilities are not too overlapping. Indeed, the impact of overlapping capabilities on potential innovation opportunities can be quite stark. Suppose both firms A and B have 3 capabilities. The innovation opportunities for firm A and B pre-merger are then $2^3 = 8$. If these capabilities are perfectly overlapping then the merged firm also has 8 innovation opportunities and the change in aggregate innovation opportunities is $8 - 8 - 8 = -8$. In contrast, if the merged firm has no overlapping capabilities then it will have $2^6 = 64$ innovation opportunities and the aggregate change will be $64 - 8 - 8 = 48$. Note that the number of innovation opportunities available to the merged firm is eight time more than when capabilities were perfectly overlapping. At high numbers of capabilities, these comparison are even more stark.[11]

The model presented here of innovation is extremely stylized and abstracts from many important considerations. Nevertheless, despite being rather crude, it helps to establish that innovation opportunities are likely to be greater when firms with different capabilities merge.

The model does not speak directly to whether the innovation opportunities will be realized or not. That will likely depend on various environmental factors. One such factor is whether the merged firm truly combines capabilities and become fully integrated, or whether the constituent firms operates relatively separately from each other.

4.4. **Remedies.** Suppose now that a merging firm with overlapping capabilities can offer a remedy by divesting some of these overlapping capabilities.[12] We model this by making copies of the overlapping capabilities unassigned and hence available to competitors to obtain. Such remedies can make a big difference to post-merger competition, but the scarcity of the divested capabilities will matter; substantially larger competition and innovation benefits can be realized by remedies that make scarce capabilities available for others to acquire.

Consider the example shown in Figure 3. Here there are initially three firms in the market. Firm A has capabilities $1, 2$ and 3, Firm B has capabilities $2, 3$ and 4 and firms C has capabilities $2, 4$ and 5 (see Figure 3a). If firms A and B merge, then the aggregate innovation opportunities go from $3(2^3) = 24$ to $2^4 + 2^3 = 24$. Note that firm A and B have two

---

[10] This is a strong assumption, but one that could be relaxed without affecting the qualitative conclusions below.

[11] For example, if both firms have five capabilities, then when the capabilities are perfectly overlapping there will be 32 combinations to try, and when they have disjoint capabilities, where will be 1024 opportunities, with is 32 times more. The general ratio is $\frac{2^{2n}}{2^n} = 2^n$, which is exponentially increasing in n.

[12] This idea of divesting capabilities to improve competition is from Chen et al. (2022).

overlapping capabilities, 2 and 3. Offering a remedy that divests a copy of capability 2 (hence allowing firm C to acquire this capability), makes no difference to the aggregate innovation opportunities because C already has access to this capability (see Figure 3b). On the other hand, divesting a copy of capability 3 does make a difference. If firm C acquired this capability aggregate innovation opportunities will increase to $2(2^4) = 32$ (see Figure 3c).

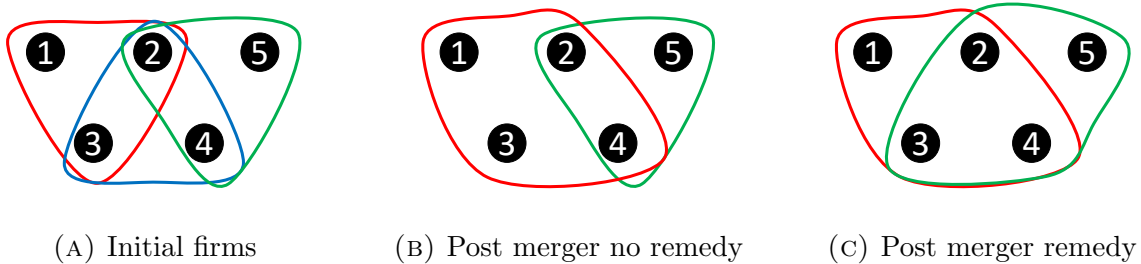(A) Initial firms   (B) Post merger no remedy   (C) Post merger remedy

FIGURE 3. The black circles represent capabilities and the lines around them show sets. Panel (A) shows the sets of capabilities of each firm in the market. Panel (B) shows the capabilities of the firms in the market if firms A and B merge when no remedies are offered, or just capability 2 is made available as a remedy. Panel (C) shows the capabilities of the firms in the market if firms A and B merge and capability 3 is made available as a remedy (and then obtained by the competitor of the merged firm).

While the focus in the example is on how possible remedies affect innovation opportunities, similar conclusions apply to the previous analysis of the strongest future competitor.

5. CONCLUSIONS

This paper sets out four basic and fundamental mechanisms through which mergers with more overlapping capabilities are likely to be more problematic: (i) with more overlapping capabilities the opportunities to enhance competition in non-overlapping markets will be less (Proposition 2); (ii) lost competition in overlapping market is less offset by efficiency gains that reduce market prices when capabilities are more overlapping (Proposition 2); future competition is more constrained when there are more capabilities that are overlapping and scarce (Proposition 3); and future innovation opportunities are likely to be less (Proposition 4).

For all these reasons it can be helpful for antitrust authorities to explicitly consider firms' capabilities when a merger is proposed and particularly so when the traditional product-based analysis would struggle to provide meaningful insights. The results of this paper show that the advice when undertaking such a capability-based assessment is clear; be more wary of mergers when capabilities are more overlapping, particularly if the overlapping capabilities are relatively scarce. While the idea of firm capabilities may appear abstract, it is an idea already ingrained into managers and business leaders. These ideas are part of the core syllabus routinely taught in MBA programmes. As such the concepts being built on here are not alien and abstract ones firms might struggle to grapple with, but part of the way in which they already view their firms. At the more fundamental level the existing product-based approach to merger assessment can be seen as an approximation to the capability-based approach, with the approximation likely to be particularly close for markets where the product space is relatively stable.

It is also helpful that it is standard practice among business managers to think in terms of capabilities when it comes to identifying each firms' competitive advantage. From a careful

reading of companies' shareholder reports it is often possible to identify the capabilities a firm believe drives its competitive advantage. Ultimately it may be possible, via text-based analysis, to automate the identification of capabilities. This has already been done to good effect to identify product attributes (see, for example, Hoberg and Phillips (2010) and Hoberg and Phillips (2018)). Even if automation is not possible, in the context of an antitrust investigation, it should be possible to uncover the capabilities of the merging firms and to use this to better inform the investigation.

This paper highlights that the pro-competitive benefit of a merger are likely to be larger when the merging firms capabilities are less overlapping. However, for those possible benefits to be realized to their full extent, the merging parties would likely need to genuinely integrate the composite businesses. If this does not happen, it will be hard to realize potential synergies.

References

Acemoglu, Daron, Ufuk Akcigit, and William R Kerr, "Innovation network," *Proceedings of the National Academy of Sciences*, 2016, *113* (41), 11483–11488.

Amir, Rabah, Philip Erickson, and Jim Jin, "On the microeconomic foundations of linear demand for differentiated products," *Journal of Economic Theory*, 2017, *169*, 641–665.

Atkinson, Anthony B and Joseph E Stiglitz, "A new view of technological change," *The Economic Journal*, 1969, *79* (315), 573–578.

Barney, Jay B, "Firm Resources and Sustained Competitive Advantage," *Journal of Management*, 1991, *17* (1), 99–120.

Chen, Jun, Matthew Elliott, and Andrew Koh, "Capability accumulation and conglomeratization in the internet age," Technical Report, SSRN Working Paper Number 2753566 2022.

Cunningham, Colleen, Florian Ederer, and Song Ma, "Killer acquisitions," *Journal of Political Economy*, 2021, *129* (3), 649–702.

Hoberg, Gerard and Gordon Phillips, "Product market synergies and competition in mergers and acquisitions: A text-based analysis," *The Review of Financial Studies*, 2010, *23* (10), 3773–3811.

_____ **and** _____ , "Text-based network industries and endogenous product differentiation," *Journal of Political Economy*, 2016, *124* (5), 1423–1465.

_____ **and** _____ , "Conglomerate industry choice and product language," *Management Science*, 2018, *64* (8), 3735–3755.

Jaffe, Sonia and E Glen Weyl, "Linear demand systems are inconsistent with discrete choice," *The BE Journal of Theoretical Economics*, 2010.

Kauffman, Stuart A, *The origins of order: Self-organization and selection in evolution*, Oxford University Press, USA, 1993.

Nelson, Richard R, *An evolutionary theory of economic change*, harvard university press, 1985.

_____ **and Sidney G Winter**, "In search of a useful theory of innovation," in "Innovation, economic change and technology policies," Springer, 1977, pp. 215–245.

Prahalad, Ck and Gary Hamel, "The core competence of the corporation," *Harvard Business Review*, 1990, *68* (3), 79–91.

Vives, Xavier, *Oligopoly pricing: old ideas and new tools*, MIT press, 1999.

Weitzman, Martin L, "Recombinant growth," *The Quarterly Journal of Economics*, 1998, *113* (2), 331–360.

Wernerfelt, Birger, "A resource-based view of the firm," *Strategic Management Journal*, 1984, *5* (2), 171–180.

Appendix A. Calculations to support the example

Pre-merger firm i faces a demand curve $q_i = 1 - p_i + \frac{\sum_{j \neq i} p_j}{3}$.[13] Given these demands, firm i chooses it price to solve

$$\max_{p_i \geq 0} p_i (1 - p_i + \frac{\sum_{j \neq i} p_j}{3}).$$

and hence sets

$$p_i^* = \frac{1}{2} + \frac{\sum_{j \neq i} p_j}{6}.$$

Thus $p_i^* = \frac{3}{4}$.

Consumer surplus can then be found by first finding the price at which demand goes to zero for a firm i. We denote this value by

$$\bar{p}_i = 1 + \frac{\sum_{j \neq i} p_j^*}{3}.$$

As $\sum_{j \neq i} p_j^*/3 = 1/2$ we then have the consumer surplus generated by firm i equal to

$$CS_i = \int_{p=p_i^*}^{\bar{p}_i} \left(1 - p + \frac{1}{2} \right) dp = \frac{9}{32}.$$

We now consider a merger between firms A and B to create firm AB. The demands faced by the two firms are now

$$\hat{q}_{AB}(\hat{p}) = 10/3 - 4\hat{p}_{AB}/3 + 2\hat{p}_C/3$$
$$\hat{q}_C(\hat{p}) = 1/3 - \hat{p}_C + 2\hat{p}_{AB}/3$$

Firm AB solves

$$\max_{\hat{p}_{AB} \geq 0} \quad (\hat{p}_{AB})(10/3 - 4\hat{p}_{AB}/3 + 2\hat{p}_C/3)$$

We hence have

$$\hat{p}_{AB} = \frac{5}{4} + \frac{\hat{p}_C}{4}.$$

Firm C's problem is

$$\max_{p_C \geq 0} p_C (1/3 - p_C + \frac{2\hat{p}_{AB}}{3}).$$

Thus

$$\hat{p}_C = \frac{1}{6} + \frac{\hat{p}_{AB}}{3}.$$

Solving this system

$$\hat{p}_{AB}^* = 1.41$$
$$\hat{p}_C^* = 0.64.$$

To find the consumer surplus we let the new product AB replace both product A and product B, and denote these new product $\hat{A}$ and $\hat{B}$ respectively, while setting $\hat{p}_A^* = \hat{p}_B^* = \hat{p}_{AB}^*$. This allows us to compare the consumer surplus associated with each product prior to the

---

[13] Note that aggregate demand $q = \sum_i q_i = 3 - \frac{\sum_i p_i}{3}$ is decreasing in the prices set.

merger and post merger, and to calculate the consumer surplus in a comparable way pre-merger and post-merger.[14]

Let $\tilde{p}_A$ be the price such that $q_A(\tilde{p}_A, \hat{p}_B^*, \hat{p}_C^*) = 0$. We then have

$$\tilde{p}_A = \tilde{p}_B = \frac{5(7 + 10/3)}{22}$$

and

$$\tilde{p}_C = \frac{6(7/3)}{11}.$$

The consumer surplus generated by products $\hat{A}$ and $\hat{B}$ is

$$\widehat{CS}_A = \int_{p=\hat{p}_A^*}^{\tilde{p}_A} q_A(p, \hat{p}_B^*, \hat{p}_C^*) = 0.44 = \widehat{CS}_B,$$

while the consumer surplus generated by product C is

$$\widehat{CS}_C = \int_{p=\hat{p}_C^*}^{\tilde{p}_C} q_C(p, \hat{p}_A^*, \hat{p}_B^*) = 0.20.$$

We hence have

$$\widehat{CS} = \widehat{CS}_A + \widehat{CS}_B + \widehat{CS}_C = 1.08.$$

We now consider the case in which firms B and C merge and there are no offsetting synergies. In that case we have

$$
\begin{aligned}
\hat{q}_{BC}(\hat{p}) &= 2 - (4\hat{p}_{BC})/3 + (2\hat{p}_A)/3 \\
\hat{q}_A(\hat{p}) &= 1 - \hat{p}_A + (2\hat{p}_{BC}/3)
\end{aligned}
$$

Firm BC solves

$$\max_{\hat{p}_{BC} \geq 0} \ (\hat{p}_{BC})(2 - (4\hat{p}_{BC})/3 + (2\hat{p}_A)/3),$$

and hence chooses

$$\hat{p}_{BC} = \frac{3}{4} + \frac{\hat{p}_A}{4}.$$

Firm A's problem is

$$\max_{\hat{p}_A \geq 0} \hat{p}_A(1 - \hat{p}_A + (2\hat{p}_{BC}/3)).$$

Thus firm A chooses

$$\hat{p}_A = \frac{1}{2} + \frac{\hat{p}_C}{3}.$$

Solving this system

$$
\begin{aligned}
\hat{p}_{BC}^* &= 0.95 \\
\hat{p}_A^* &= 0.82.
\end{aligned}
$$

To find the consumer surplus we let the new product BC replace both product B and product C, and denote these new product $\hat{B}$ and $\hat{C}$ respectively, while setting $\hat{p}_B^* = \hat{p}_C^* = \hat{p}_{BC}^*$.

---

[14] Specifically, if the new product AB is identical to the old products A and B, and if the same price is charged for products A and B pre-merger as is charged for AB post-merger, then the same consumer surplus will be generated.

Let $\tilde{p}_C$ be the price such that $q_C(\tilde{p}_C, \hat{p}_B^*, \hat{p}_A^*) = 0$. We then have

$$\tilde{p}_C = \tilde{p}_B = \frac{5(14)}{44}$$

and

$$\tilde{p}_A = \frac{18}{11}.$$

The consumer surplus generated by products $\hat{C}$ and $\hat{B}$ is now

$$\widehat{CS}_C = \int_{p=\hat{p}_C^*}^{\tilde{p}_C} q_C(p, \hat{p}_B^*, \hat{p}_A^*) = 0.20 = \widehat{CS}_B,$$

while the consumer surplus generated by product A is

$$\widehat{CS}_A = \int_{p=\hat{p}_A^*}^{\tilde{p}_A} q_A(p, \hat{p}_C^*, \hat{p}_B^*) = 0.33.$$

We hence have

$$\widehat{CS} = \widehat{CS}_A + \widehat{CS}_B + \widehat{CS}_C = 0.74.$$

Appendix B. Omitted proofs

In this appendix we prove Propositions 1, 2, 3 and 4. However, before doing so, it will be helpful to prove the following lemma.

Lemma 1. Suppose firm i enters market j when attributes in market j are given by a_j. Suppose we improve i's capabilities in market j. Define $\hat{a}_{kj} = a_{kj}$ for all $k \neq i$ and let $\hat{a}_{ij} \supset a_{ij}$. Then aggregate consumer surplus in market j increases, and for all firms $k \neq i$ active in market j either before or after the change, $p_{kj}(\hat{a}_j) < p_{kj}(a_j)$ (where $p_{kj}(a_j)$ is the equilibrium price set by firm k in market j when firms have attributes a_j).

Proof. Let p_j denote the equilibrium prices in market j when products have attributes a_j and $\hat{p}_j$ denote the equilibrium prices in market j when products have attributes $\hat{a}_j$. We decompose the change to prices from p_j to $\hat{p}_j$ into two steps. First we suppose that i increases its market j prices by exactly the amount required to hold its demand constant. Specifically, we suppose that firm i sets a price $\tilde{p}_{ij} = p_{ij} + (f(\hat{a}_{ij}) - f(a_{ij}))$ and let $\tilde{p}_{kj} = p_{kj}$ for all $k \neq i$. The demands of all firms remain constant at prices $\tilde{p}_j$:

$$
\begin{aligned}
D_{lj}(\tilde{p}_j, \hat{a}_j) &= \alpha_{lj}(\hat{a}_j) + \sum_h \beta_{lhj} \tilde{p}_{hj} \\
&= \bar{\alpha} + \sum_h \beta_{lhj}(\tilde{p}_{hj} - f(\hat{a}_{hj})) \\
&= \bar{\alpha} + \sum_h \beta_{lhj}(p_{hj} - f(a_{hj})) \\
&= D_{lj}(p_j, a_j).
\end{aligned}
$$

As with product attributes $\hat{a}_j$ and price $\tilde{p}_j$ all firms face exactly the same demand as when product attributes are a_j and prices are p_j, consumer surplus is unchanged. In other words, the new prices $\tilde{p}_j$ are constructed so that the consumer surplus generated by all firms is held constant given the change in attributes.

We will now show that, in equilibrium, all firms choose to set prices strictly below $\tilde{p}_j$. First observe that a firm $k \neq i$ best respond to the prices $\tilde{p}_j$ by choosing a price $\tilde{p}_{kj} = p_{kj}$. This can be seen from k's first order condition:

$$\tilde{p}_{kj}\frac{\partial D_{kj}(\tilde{p}_j, \hat{a}_j)}{\partial \tilde{p}_{kj}} + D_{kj}(\tilde{p}_j, \hat{a}_j) = p_{kj}\frac{\partial D_{kj}(p_j, a_j)}{\partial p_{kj}} + D_{kj}(p_j, a_j) = 0 \tag{1}$$

Consider now firm i. By definition p_{ij} maximizes $D_{ij}(p_j, a_j)p_{ij}$ and so

$$p_{ij}\frac{\partial D_{ij}(p_j, a_j)}{\partial p_{ij}} + D_{ij}(p_j, a_j) = 0 \tag{2}$$

After the change in attributes and at prices $\tilde{p}_j$, i's profits are $D_{ij}(\tilde{p}_j, \hat{a}_j)\tilde{p}_{ij} = D_{ij}(p_j, a_j)\tilde{p}_{ij}$. As $\hat{a}_{ij} \supset a_{ij}$ we have $f(\hat{a}_{ij}) > f(a_{ij})$ and so $\tilde{p}_{ij} = p_{ij} + f(\hat{a}_{ij}) - f(a_{ij}) > p_{ij}$. Thus i's profits are higher than before the change in attributes. Further, at prices $\tilde{p}$, i's profits are strictly decreasing in $\tilde{p}_{ij}$. To see this, note that

$$\begin{aligned} \tilde{p}_{ij}\frac{\partial D_{ij}(\tilde{p}_j, \hat{a}_j)}{\partial \tilde{p}_{ij}} + D_{ij}(\tilde{p}_j, \hat{a}_j) &= \tilde{p}_{ij}\frac{\partial D_{ij}(p_j, a_j)}{\partial p_{ij}} + D_{ij}(p_j, a_j) \\ &= (\tilde{p}_{ij} - p_{ij})\frac{\partial D_{ij}(p_j, a_j)}{\partial p_{ij}} < 0 \end{aligned}$$

The first equality comes from how $\tilde{p}_j$ is defined and the second from substituting in equation (2). The final inequality holds because $\tilde{p}_{ij} > p_{ij}$ and $\partial D_{ij}(p_j, a_j)/\partial p_{ij} < 0$.

Although this only indicates firm i's incentives at prices $\tilde{p}_j$ to reduce its prices, there are strategic complements, so each reduction in price by any firm incentivizes the other firms to strictly reduce their prices too (as, by assumption, $\beta_{kij} > 0$ for all $k \neq i$). Indeed, the best response mapping is a contraction (Vives (1999), Chapter 6) and so repeatedly applying it will lead all prices to keep decreasing until the unique equilibrium is reached. As consumer surplus is decreasing in each such price, we then have

$$CS(\hat{p}_j, \hat{a}_j) > CS(\tilde{p}_j, \hat{a}_j) = CS(p_j, a_j).$$

$\square$

B.1. **Proof of Proposition 1.**

Proof. **Part (i):** Suppose there are n firms pre-merger. Note that a_j specifies the product attributes that all firms have even if some of them choose not enter the market (which they will choose to do if at any non-negative price they set their demand would be zero).

Consider the impact of merger between firms A and B in a non-overlapping market j. As the market is non-overlapping at least one of A and B did not compete in it pre-merger. Without loss of generality we let firm B not compete in market j pre-merger. Following the merger the newly created firm has capabilities $F_A \cup F_B$ and hence is able to produce a product in a market j that has all the attributes that firm A had pre-merger, and possibly some additional ones. As the newly created firm produces at most one product, we can think about firm AB replacing firm A and define $\hat{a}_j$ by setting $\hat{a}_{Aj} \supseteq \{a_{Aj} \cup a_{Bj}\}$, $\hat{a}_{Bj} = \emptyset$, and $\hat{a}_{ij} = a_{ij}$ for all firms $i \neq A, B$. It will be convenient to also define $\tilde{a}_j$ by setting $\tilde{a}_{Aj} = a_{Aj}$, $\tilde{a}_{Bj} = \emptyset$ and $\tilde{a}_{ij} = a_{ij}$ for all other firms $i \neq A, B$. We can then compare the attributes of relevant firms pre-merger to the attributes of firms post-merger by comparing $\tilde{a}_j$ to $\hat{a}_j$.

If firm AB cannot enter market j profitably post merger, then neither could firm A or B have entered market j pre-merger given attributes a_j. Hence consumer surplus in market j

remains constant post merger. If instead, firm AB does enter market j post merger, then the change in consumer surplus is given by

$$CS(\hat{a}_j) - CS(a_j) = CS(\hat{a}_j) - CS(\tilde{a}_j) \geq 0,$$

where the last inequality follows from Lemma 1: Either $\hat{a}_j = \tilde{a}_j$ and so trivially the inequality holds, or else $a_{ABj} \supset \{a_{Aj}\}$ and by Lemma 1 the inequality holds strictly.

Part (ii): Without loss of generality we can let $F_B \subseteq F_A$. Then, in all non-overlapping markets j firm B did not enter pre-merger, and post-merger $a_{ABj} = a_{Aj}$. Hence consumer surplus remains constant in these markets.

Part (iii): The example presented in Section 2 proves this result.

$\square$

B.2. **Proof of Proposition 2.**

Proof. Let $\hat{F}_A$ and $\hat{F}_A$ be the capabilities of firms A and B when their capabilities are less overlapping, and let F_A and F_B be their capabilities when their capabilities are more overlapping. Let p_j^* denote the equilibrium prices when capabilities are more overlapping and let $\hat{p}_j^*$ denote the equilibrium prices when capabilities are less overlapping. Note that post-merger we then have $\hat{F}_{AB} \supset F_{AB}$, and hence $\hat{a}_{ABj} \supseteq a_{ABj}$. If $\hat{a}_{ABj} = a_{ABj}$, then competition in market j is the same after both mergers and hence $CS(\hat{p}_j, \hat{a}_j) = CS(p_j, a_j)$. If $\hat{a}_{ABj} \supset a_{ABj}$, then by Lemma 1, $CS(\hat{p}_j, \hat{a}_j) > CS(p_j, a_j)$ and $\hat{p}_{ij} < \hat{p}_{ij}$ for all firms $i \neq AB$. $\square$

B.3. **Proof of Proposition 3.**

Proof. First we show that if the conditions on c (overlapping, valued by j and scarce post-merger) hold, this implies that the merger diminishes the strongest possible future competitor of i. Suppose a capability c is held by A and B (i.e., overlapping for merger of A and B), valued by market j and scarce post merger. As c is an overlapping capability, $c \in F_{\gamma(A,j)}$ and $c \in F_{\gamma(B,j)}$ and thus, $c \in F_{\gamma(A,j)} \cap F_{\gamma(B,j)}$. However, as c is scarce post merger we cannot have $c \in F_{\gamma(AB,j)}$. Thus the merger of A and B to create AB diminishes the strongest competitor in market j.

We now show the reverse implication. Suppose a merger between firms A and B to create AB diminishes the strongest competitor in market j. Then $F_{\gamma(AB,j)} \subset \left(F_{\gamma(A,j)} \cap F_{\gamma(B,j)}\right)$, and hence there must exist some capability $c \in M_j$ such that $c \in F_{\gamma(A,j)} \cap F_{\gamma(B,j)}$ and $c \notin F_{\gamma(AB,j)}$. As $c \notin F_{\gamma(AB,j)}$ no firm other than AB can hold it post merger and hence c is scarce post merger. As $c \in \left(F_{\gamma(A,j)} \cap F_{\gamma(B,j)}\right)$ we must have $c \in F_{\gamma(A,j)}$ and $c \in F_{\gamma(B,j)}$. As $c \in F_{\gamma(A,j)}$ there must exist a firm other than A that holds capability c, but as c is scarce post merger, that firm has to be B. By an equivalent argument, c must be held by firm A. Thus c is also overlapping. $\square$

B.4. **Proof of Proposition 4.**

Proof. Without loss of generality we can let $n = \min(n, m)$. Note that if $\bar{k}(m, n) = \min(m, n) = n$, then and we get $2^m - 2^m - 2^n < 0$ and the merger harms innovation opportunities. Next note that if $\bar{k}(m, n) = 0$ then $2^{m+n} - 2^m - 2^n > 0$. It then follows by the intermediate value theorem, as $2^{m+n-k} - 2^m - 2^n$ is continuous in k, that there exists a value $\bar{k}(m, n) \in (0, n)$ such that $2^{m+n-\bar{k}(m,n)} - 2^m - 2^n = 0$. Further, as $2^{m+n-k} - 2^m - 2^n$ is strictly decreasing in k for all $k < \bar{k}(m, n)$ we have $2^{m+n-k} - 2^m - 2^n > 0$ and for all $k > \bar{k}(m, n)$ we have $2^{m+n-k} - 2^m - 2^n < 0$ as claimed. $\square$