The Welfare Consequences of Mergers with Product Repositioning

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Abstract

Merger simulations focus on the price changes that may occur once previously independent competitors set prices jointly and other market participants respond. This paper considers an additional effect – the possibility that market participants will choose to change their product offerings after a merger. Using a model that endogenizes both product choice and pricing, we conduct equilibrium market simulations for mergers including the potential for offering changes in a variety of scenarios. We find that allowing for repositioning can have substantial effects, particularly in cases where the merging parties offered relatively similar products prior to the merger. Cost synergies may also affect product offering decisions, potentially leading to increases in consumer welfare if more products are introduced. The results suggest that analysts carefully consider the impacts of product choice, along with prices, when simulating potential welfare changes associated with mergers.

1 Introduction

Over the past several decades, advances in industrial organization economics have had an increasing impact on the analysis of horizontal mergers. In particular, much progress has been made in developing new econometric techniques for estimating demand functions. Applying these methods, along with data from the industry of the proposed merger, can allow an analyst to assess the relationship between market concentration and price changes, providing critical information about market definition. In addition, economists can make a prediction regarding how prices would adjust following the merger of two industry participants. The process of empirical demand elasticity and marginal cost estimation followed by merger simulation (i.e., simulated with the proposed ownership change and the estimated parameters) has been increasingly used as suggestive evidence of the likely effects of a merger on prices charged to consumers.1

Crucially, the prices charged by industry participants are endogenized in estimating the demand models. Valid econometric instruments are needed to ensure that quantity differences that accompany price differences are caused by fundamental consumer preferences rather than supply-side factors. Indeed, appropriately endogenizing prices is among the most difficult challenges involved with applying these methods to actual merger scenarios. Such instruments are difficult to find in practice, particularly in a complex market where competing firms offer differentiated products. Without them estimated price elasticities can potentially contain serious bias. In the context of merger simulation, furthermore, the industry participants’ optimal response to the proposed change in market structure

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1Budzinski and Ruhmer (2010) provide a recent survey of the use of merger simulation in competition policy.
resulting from the merger can be captured if prices are endogenized in the demand model. Once the “identity” of the various players are modified in the simulation, (i.e. the proposed merging firms are treated as a single profit maximizing firm for the purpose of price-setting) prices will adjust, generating a more realistic prediction regarding post-merger consumer surplus.

This paper focuses on an important potential shortcoming inherent in this approach to estimating demand and marginal cost and simulating the effects of mergers. While prices are explicitly included as choice variables of the industry participants, their product characteristics are treated as exogenous – they cannot adjust after the merger. This abstraction has consequences for the accuracy of some merger simulations to the extent that merged firms may cull duplicate products or competitors may introduce new varieties post-merger. Simulating mergers using the method sketched above constrains the set of differential products offered by market participants to be identical pre- and post-merger. Actual firm behavior and its effect on consumer surplus may well be more complex. If the resulting product variety in the industry exhibits more overall differentiation, price competition may be softened beyond the effect of removing one competitor. Alternatively, industry participants may choose to expand their product offerings given the new market structure. Reductions in consumer welfare associated with price increases can potentially be offset if consumers value characteristics of products that are made more available after a merger.

The analysis and discussion presented here proceeds in three parts. First, we will present some background from the economics literature on horizontal combinations that indicates the potential importance of accounting for endogenous product choice among industry participants. In addition, we will provide some context on the issue by referencing a series of merger cases in which the issue of post-merger product repositioning was considered by the court or regulatory body evaluating the proposed merger. Second, we will outline an empirical modeling approach that estimates product differentiated demand parameters while allowing firms to have flexibility regarding their product offerings. As such, the approach endogenizes both price and product varieties, allowing both to update as a result of changed industry structure in the context of a merger simulation.\(^2\) In the last part of the paper, we show how merger simulations can be carried out using such a model, allowing for both pricing and product offering changes post-merger. The results from simulations demonstrate the tradeoffs described above and indicate the key factors that affect the welfare implications of allowing product choice.

2 Background

This section will proceed in two parts. First, we will review some of the relevant literature from economics on the relationship between market concentration and product variety. A small number of papers have focused directly on the effects of mergers on firm choice and market heterogeneity – these papers are highlighted. Then, we provide a brief survey of merger cases in which positioning of products after a proposed merger figured into the court’s decision. Both the academic literature and the court records suggest a potentially important role for an analytical framework that endogenizes product choice.

\(^2\)The approach here is based on the work of Draganska, Mazzoe, and Seim (2009) and is part of a growing literature proposing approaches for endogenizing product choice in empirical models of product differentiated demand. Crawford (2011) is a good summary of this growing literature.
2.1 Economics Literature

In the economics literature, a small number of empirical studies have addressed the related questions of (1) what is the relationship between product characteristics offered by competing firms and their industry's market structure and (2) what effect do mergers (i.e., changes in market structure) have on the set of products that competing firms offer. Evidence of a relationship between product offerings and market structure suggests that empirical analysis of mergers that do not allow firms to optimally adjust their product portfolios may be incomplete. This issue may be particularly serious in differentiated product industries, where consumers have heterogeneous preferences over the range of product characteristics that firms could potentially offer. In such environments, price changes can either be mitigated or exacerbated by differences in product offerings when calculating consumer welfare. While not an exhaustive collection, the papers described below provide a flavor of the sort of empirical evidence researchers have compiled that relates to this problem.

To begin, a series of papers has investigated the relationship between observed market structure in a particular industry and the product offerings of competing firms. For example, Alexander (1997) presents data from the music recording industry that suggests a nonmonotonic relationship between competition indices/concentration ratios in the market for music distribution and overall variety (on various technical dimensions) of the hit songs produced by the studios. In his study, high and low levels of concentration were associated with lower levels of product variety, while there was less product variety overall in industries under intermediate levels of concentration. A similar paper by George (2007) examines the effect of market structure on product positioning and product variety in the market for US daily newspapers. Again, the data analyzed include detailed measures (e.g., papers' assignment of reporters to particular topical areas) of product offerings of competing firms. In terms of both the variety of topics and the number of topics covered, more concentrated markets tend to have more variety. Interestingly, the difference in product offerings is not associated with any changes in newspaper readership. This suggests that merging firms would have more strategic instruments available to them – beyond just price – when maximizing profits after an increase in market concentration.

These papers examine the relationship between market structure and the overall level of differentiation and product availability in an industry; the product characteristic choices of individual firms underlie such market-level measures. A series of recent papers (e.g., Mazzeo (2002); Seim (2006)) have developed new methods for endogenizing the product choice decisions of firms in equilibrium; this literature has expanded to treat more detailed product characteristics in the firms' choice set. Watson (2008) is an excellent example – his paper focuses on the product variety decision, in terms of the number of product offerings sold by retailers (in his case, eyewear retailers). As in the case of recorded music when measured industry-wide, Watson finds that per-firm product variety has a nonmonotonic relationship with competition. When facing a closer rival in geographic space, firms tend to offer more options but the number of product varieties does eventually decline with more competition. This finding again suggests that the optimal response following a merger could be either to increase or decrease product variety, each of which would have an effect on consumer surplus calculations.

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3This literature is not nearly as extensive as the one examining correlations between prices and market structure. Weiss (1989) provides an extensive review of this literature and Whinston (2006) discusses the role of such studies in the literature as evidence in a regulatory/anti-trust context. See Manuszak and Moul (2008) for a recent contribution, that revisits the price-concentration relationship in the office supply retail industry using structural methods (e.g., Mazzeo (2002a)) to address market structure endogeneity.

4In retail environments, the number of product offerings (or product variety) is often used as a summary measure or proxy of the firm's quality. “Quality” can also be a firm characteristic that competitors optimally adjust depending on market structure. See Mazzeo (2003) for an example of an analysis of competition and product quality, and also a discussion of the challenges associated with empirical work in this area.
A small number of papers have directly addressed the issue of product variety and optimal differentiation in response to merger activity. The most influential study is by Berry and Waldfogel (2001) who document the effect of mergers on station format choice in the radio broadcasting industry. The 1996 Telecommunications Act prompted a merger wave in the broadcasting industry; this provided an instrumental variables identification strategy for measuring the effect of concentration on variety (as measured by the number of different radio “formats” represented in the market). The results of the paper indicate that industry consolidation—that is, the decrease in the number of stations that followed from the Telecom Act—increased both variety per station and overall variety in the market. Mergers appear to have motivated competitors to span larger portions of product space with their offerings, as pairs of jointly-owned local stations are more likely to be in different formats. While suggestive, their analysis does not constitute a formal model of product choice, as the authors state “our approach in this paper is to obtain qualitative empirical results that may guide more detailed subsequent modeling.”

In a similar vein, Sweeting (2010)’s paper uses micro-level data on the programming of individual radio stations to look directly at how the stations vary their playlists following mergers. In Fan (2012)’s study of the newspaper industry, competing firms choose prices (both circulation and advertising) and certain product characteristics relative to news quality and type of coverage. These product characteristics are measured as continuous indices, which are allowed to fluctuate after firms merge. The results from these initial papers do seem to indicate that firms make distinct changes to their product characteristics, with potentially important competitive consequences.

The empirical papers cited above are partially motivated by the theoretical literature which (not surprisingly) can make almost any prediction about the optimal product differentiation behavior of competing firms depending on the assumptions in the model. The recent theoretical contribution by Gandhi, Froeb, Tschantz, and Werden (2008), however, is notable for its direct focus on post-merger product repositioning and in its use of novel computational methods for solving out market equilibria in both price and product space location. The paper employs a traditional Hotelling (1929) set-up, with four stores in a unit-length product space and a standard specification for consumer utility. Initially, the stores are independently owned and play a simultaneous-move game in prices and product space locations. The analysis then compares the outcome with a potential “merger” scenario in which two of the establishments become jointly owned.

In particular—and in direct response to the gaps in existing merger simulation methodology—the paper compares outcomes in simulations in which industry participants re-optimize on price but are not allowed to change their product-space locations and with new equilibria computed for both price and location choice. While, again, the results are sensitive to the parametrization of the model (the authors go into detail regarding the effects of altering each of the parameters), the analysis highlights the impact of including product space location as a choice variable of the firms. Merging parties that previously offered similar products tend to move further away from each other in product space, as it is more profitable to avoid cannibalization. In addition, the remaining industry participants

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5 Chu (2010) uses the entry of satellite broadcasting as a “natural experiment” and documents the changes in products offered (channel line-ups) by cable firms in response. The analysis is hampered a bit by the fact that all geographic markets experience satellite entry at the same time, which makes it difficult to separate the effect of competition on product choice from other exogenous factors. However, Chu’s study does demonstrate substantial changes in the cable firms’ offerings over time, which again provides evidence that modeling optimal product choice in the context of mergers would give a more complete picture of the relevant competitive effects.

6 Richard (2003) endogenizes the flight frequency decision of airlines and predicts changes in flight frequency in a merger simulation; however, the model estimated is only a single-firm optimization—the first order conditions of optimal flight frequency do not include the decisions made by competitors.

7 Interestingly, the qualitative results in another paper (Gotz and Gugler [2006]) in a different industry (the Austrian retail gasoline market) generate the opposite inference—mergers that result in more concentrated markets tend to display less product variety. Based on the theoretical results in the literature, it is not surprising that the effect of concentration on product variety could go either way. These authors also note that their results highlight the gap left by structural demand analysis that “neglect a key feature of market power in differentiated markets, namely that a merger between formerly competing firms may change product variety.”
also alter their product space locations. The authors conclude that “the merged firm’s product repositioning both mitigates the reduction in consumer welfare the merger otherwise would produce and allows the merged firm to capture a much larger portion of the profits the merger generates.” While the results cannot be extrapolated directly to any particular industry, the analysis does frame the important issues that an empirical model of this sort should address.

In concluding this subsection, it is worth noting that authors who have proposed the use of product differentiated demand models for merger simulation were well aware of the abstraction from post-merger product selection inherent in their approach. For example, Nevo (2000) states, “this approach is not consistent with firms changing their strategies in other (than price) dimensions that may influence demand. . . .this implies that characteristics, observed and unobserved, and the value of the outside good are assumed to stay the same pre- and postmerger.” Peters (2006) suggests that real-world violation of this assumption might be the source of differences between economically-based merger simulation results and price effects of actual mergers. His paper is among the first to compare actual postmerger prices with the predictions made by models based on ex ante structural demand estimates.8 His analysis uncovers substantial differences between the simulated and actual price changes associated with several airline industry mergers in the 1980s, and goes on to decompose these differences based on other post-merger data from the industry. In particular, Peters attributes a substantial portion of the post-merger price effect to observed changes such as entry/exit, flight frequency and airport presence, as well as unobserved post-merger changes in demand and costs. Again, the takeaway is “while merger simulation can be useful in understanding the effect of a merger on unilateral pricing incentives, such methods are likely to yield unsatisfactory predictions of a merger’s overall effect . . . unless richer models of firm conduct are incorporated into the methodology.”9

2.2 Merger Cases

Courts and regulatory agencies have taken some consideration of changes in the product offerings of differentiated competitors in the process of merger evaluation. However (perhaps because of the lack of an appropriate framework to simulate product changes), specific findings are not often cited as part of the merger case rulings. The discussion that follows is not meant to represent an exhaustive summary of the legal landscape on this issue, but instead includes a survey of the cases and decisions where postmerger product repositioning is explicitly referenced.

One recent relevant case involves the merger between Whole Foods Market and Wild Oats Market – two supermarkets that specialize in organic foods (FTC v. Whole Foods Market, Inc. 533 F.3d 869 (C.A.D.C., 2008.)). The government’s expert testimony in this case argued that the merged firm would close a number of currently existing stores, resulting in a reduction of competition on non-price dimensions (over and above the anticipated price effects), with a loss of consumer surplus as a consequence. However, the identity and number of stores to be closed was not projected by a formal economic model or econometric analysis; instead, plans for the status of particular establishments in the merged company was obtained through discovery. Along with the price effects of the merger, assertions were made regarding consumer harm due to changes in “quality, service, and importantly,

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8 Papers by Ashenfelter and Hosken (2010) and Weinberg and Hosken (2012) perform similar analysis on a variety of industries in which recent mergers have been approved by regulators and have actually occurred.

9 Similar concerns continue to be associated with mergers in the airline industry. For example, more than 40 percent of travel managers surveyed anticipated that the 2008 merger between Delta and Northwest would negatively impact access to smaller US markets and flight schedules/frequencies (Avery (2008)). Policy makers in Montana elicited an ex ante response – executives from the merging airlines wrote a letter to the Montana Senate delegation promising not to cut the total number of flights servicing the state after the merger. Senator Baucus of Montana promised to “keep an eye on this merger if it goes through” and “hold the NWA-Delta CEOs feet to the fire to make sure they follow through on their promises.” (Bond (2008)).
the breadth of product offerings available to consumers.”

The district court, however, focused on the potential repositioning of competitors in response to the merger as mitigating these price and non-price effects in its decision, observing that several supermarkets “have already repositioned themselves to compete vigorously with Whole Foods and Wild Oats for the consumers’ premium natural and organic food business.” Whole Foods, 302 F.Supp.2d at 48. In particular, the court decided that Whole Foods and Wild Oats competed among supermarkets generally and that the cost of other supermarkets expanding their product lines to include organic foods would not be prohibitive. While this conclusion was based on observations of the product lines of existing supermarkets, there was not an underlying empirical analysis on which it was based or an assessment of which markets would be more or less likely to experience supermarkets changing their product lines to become more direct competitors.

Indeed, in several cases, the court seems more inclined to focus on the endogenous repositioning response of competitors following a merger. For example, in approving the merger between Oracle and PeopleSoft (U.S. v. Oracle Corp., 331 F.Supp.2d 1098 (N.D.Cal. 2004.)), the court found that “plaintiffs have not proved that SAP, Microsoft, and Lawson would not be able to reposition themselves in the market so as to constrain an anti-competitive price increase or reduction in output by a post-merger Oracle.” This suggests opposing considerations associated with exploring issues of product choice endogeneity and post-merger product repositioning in the context of antitrust. While only formally considering pricing and constraining merging parties to offer the same products after a merger necessarily understates producer surplus gains, (and potentially underestimates consumer surplus declines if product variety is reduced post-merger) anticipating the consequences of product portfolio changes for merging parties invites consideration of the ability of other market participants to mitigate the merger’s effects through their own repositioning following a merger in their industry. In addition, optimal post-merger repositioning could conceivably result in more product heterogeneity, generating a positive effect on consumer surplus that nets away some of the harm done to consumers by higher prices.

From that perspective, an important issue becomes the relative ability of various industry participants – due to scale economies, sunk costs, or perhaps based on their market power – to introduce new products. For example, in the market for facial tissues (U.S. v. Kimberly-Clark Corp., No. CIV. A. 3:95-CV-3055-P., 1996 WL 351145 (N.D.Tex. April 04, 1996)), the court’s decision stated that “because entry into the facial tissue market is difficult, requiring a significant investment in plant equipment and brand building, successful new entry or repositioning after the merger is unlikely to restore the competition lost through Kimberly-Clark’s removal of Scott from the marketplace.” However, the court appears to have been swayed that the merger of the second and third largest manufacturers of jarred baby food would permit additional product innovation in the industry (FTC v. H.J. Heinz Co. 116 F.Supp.2d 190 (D.D.C.,2000)). The court cites the fact that fixed marketing and distribution costs are required to launch new products and “the conditions for increased competition in the form of product innovation and product differentiation will be enhanced by the merger, because the distribution of the combined entities will add Heinz’s all commodity volume to Beech-Nut’s all commodity volume.” The court cites testimony from the defendants’ expert that posited a particular volume threshold at which new product introductions would be pursued in the industry (though it is not clear how such a threshold was derived, or what the specific consequences of the product innovation ability would be).

10 Cited from the expert report of Kevin M. Murphy, PhD, downloaded from the FTC website.
11 In early 2009, a settlement was ultimately reached in this case – Whole Foods is required to sell a prescribed list of stores as a result of the settlement.
This brief summary suggests that the effect of mergers on the extent of product differentiation in an industry is potentially quite important for courts in judging their competitive impact and ruling on whether they should be permitted. Evidence regarding post-merger product repositioning has been used in a variety of ways – to argue that merging firms will cause competitive harm over and above price effects, to justify a merger based on enhanced ability to introduce products against a more formidable competitor, or to dismiss concerns regarding anti-competitive behavior of merged parties based on the product differentiation of other industry participants. Indeed, section 6.1 of the most recent revision of the Horizontal Merger Guidelines suggests that the DOJ and FTC consider competitor repositioning when evaluating potential merger effects. However, consideration seems to be limited to exclude repositioning by the merging parties and techniques for repositioning analysis are not specified. As such, evidence may be limited to circumstances in which explicit product differentiation strategies can be obtained through discovery or else may be speculative in practice. A more formal economic framework through which analysts can simulate how a merger might affect optimal product choice, industry heterogeneity, and ultimately consumer surplus may well assist the agencies and/or courts in addressing this question in a systematic and more comprehensive manner.

3 The N-Product Model with Three firms

We now pose a model of competition under differentiated products. While the model is restricted to three firms for simplicity of exposition it can be easily expanded to include any number of firms.

Consider an industry with three firms identified by $i \in \{A, B, C\} \equiv I$. Each firm is in possession of a set of products with predefined characteristics. $J_i$ represents the set of products firm $i$ is endowed with and $j$ represents one of these products. The game has two stages: in the first stage firms simultaneously choose which products to offer and incur an entry fee for each product. This entry fee may be product specific and can be considered either as a fixed cost of carrying the product or as a sunk cost of offering the product or as a combination of both. In the second stage, after observing which products are offered, firms choose simultaneously prices for each of its offered products.

An equilibrium is a vector of offering choices and of prices $(x^*, p^*)$. In this context, $x^*$ is the entry decisions for each firm: $x^* = (x^*_A, x^*_B, x^*_C)$ where $x_A = (x_{1A}, x_{2A}, ..., x_{JA})'$ and $x_{1A}$ is one if the product is offered and zero if it is not. The price vector $p^* = (p^*_A, p^*_B, p^*_C)$ are the prices that will arise given $x^*$ is the set of offered products. If a product is not offered, let its price be defined as $\emptyset$. Such a definition of an equilibrium implies we focus only on pure strategy equilibria.

We characterize the equilibrium by solving the game through backward induction. For a given offering choice $x$ we find the equilibrium prices of the subgame and calculate the subsequent profits and consumer surplus. Using these profits we then model the entry game and characterize the equilibrium in the entry game. We give more details on the profit functions and the fixed costs in the next subsections.

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12 Games in which firms choose location on a continuous variable (i.e., quality) can be accommodated under the framework presented here by discretizing the continuous variable into buckets and having all firms endowed with all buckets of such variable. We believe, however, that products with predefined characteristics represent a useful characterization of post-merger activity insofar as industry participants can easily add or subtract existing products in response to the merger. Designing new products optimally may be a longer-term prospect.
3.1 The Pricing Game

The offering choices are given by \( x \) and are taken as fixed in this subsection. Here we characterize the pricing game given the offering \( x \). We define \( K_i \) to be the set of active products of firm \( i \), so that \( K_i \subseteq J_i \) and \( K \) be all the products offered in the market: \( K \equiv \bigcup_{i \in I} K_i \).

We model the pricing game under discrete choice demand functions. A consumer \( s \) has a specific preference for each product and has a utility from each product given by

\[
 u_{js} = \theta_{js} - \alpha_s p_j + \epsilon_{js} \tag{3.1}
\]

where \( \alpha_s \) is the consumers price coefficient (his utility of income) and \( (\theta_{js}, \epsilon_{js}) \) are two idiosyncratic taste shocks. The distinction between the two is in that \( \epsilon_{js} \) is drawn from a Type 1 Extreme Value distribution with variance \( \sigma \) and \( \theta_{js} \) is drawn from an arbitrary distribution that allows for correlated shocks across products and non-zero means: \( \theta_s = (\theta_{1s}, \theta_{2s}, ..., \theta_{Js})' \sim F(\theta|\mu, \Sigma) \). The utility of not purchasing is given by \( u_{0s} = \epsilon_{js} \) and the total market size is \( M \).

The additivity and independence assumptions between the two idiosyncratic shocks allows us to integrate the probability of purchase in two steps, where the demand for good \( j \) will be given by

\[
 s_j(p) = M \int \frac{e^{\frac{1}{\sigma}(\theta_{js} - \alpha_s p_j)}}{1 + \sum_{n \in K_i} e^{\frac{1}{\sigma}(\theta_{ns} - \alpha_s p_n)}} dF(\theta_s|\mu_F, \Sigma_F) \tag{3.2}
\]

Equation 3.2 is very informative: \( \theta_{js} \) can be interpreted as a random coefficient on the intercept of each product. It can also be thought of as the transportation cost for an individual traveling to product \( j \) in a Hotelling model.\(^{14}\) The variance \( \sigma \) plays two roles in this model: on the one hand, it defines how important price and the correlations across products are relative to other unobserved characteristics. On the other hand, it controls how “smooth” the integrand is. In this sense, one can think of the idiosyncratic shock \( \epsilon \) as a convenience tool that allows to form a Kernel to approximate the outer integral (the integral over random coefficients: \( \theta_{js} \)) and in which the variance \( \sigma \) controls the bandwidth of such Kernel.

Assuming a product-specific constant marginal cost \( c_j \), profits in the pricing game are then given by

\[
 \pi^i(p) = \sum_{j \in K_i} s_j(p) (p_j - c_j) \tag{3.3}
\]

and the equilibrium prices are defined as the solution to

\[
 \frac{\partial \pi^i(p)}{\partial p_j} = 0 \quad \forall j \in K_i \quad i = \{A, B, C\} \tag{3.4}
\]

Conditions for existence and uniqueness of equilibrium are given in Nevo (2000).

Let \( p_x \) define the equilibrium prices when the offering choice is \( x \) and let \( \pi_x \) denote the associated equilibrium variable profit. Before moving on to the entry game, we present the calculations for consumer surplus. Given the

\(^{13}\) Since many distributions will be used throughout the model, we subscript \( \mu \) and \( \Sigma \) by ‘F’ to denote they refer to the distribution \( F \).

\(^{14}\) Any Hotelling model in which all consumers can reach all products without having to travel over another product can be represented with this model by specifying an appropriate distribution \( F \) and setting \( \sigma \) (from the TIEV distribution) to zero. Two examples of such Hotelling models are Salop (1979)’s circular city model with two firms and a spherical city with three firms.
current setup, for an offering vector $x$, consumer surplus can be defined as

$$CS_x = \int M \ln \left[ 1 + \sum_{n \in K} e^{\frac{1}{2}(\theta_n - \alpha_s) x_n} \right] dF(\theta_n | \mu_F, \Sigma_F)$$ (3.5)

which is a measurement of the equivalent variation, as given as in McFadden (1973) and slightly modified to account for the random coefficients. We now solve the entry game given profits $\pi_x$.

### 3.2 The Entry Game

We model a simultaneous move entry game. For this game, we take the vector of profits $\pi_x$ as the subgame outcomes of the entry game and assume no discounting. Firms incur a cost $g_{ji}$ of offering product $j$, which we group together in the vector $g_i \equiv (g_{i1}, g_{i2}, ..., g_{iJ})'$. In summary, the ex-post net profits for firm $i$ of offering products $x_i$ are

$$\Pi_i(x_i, x_{-i}) = \pi(x_i, x_{-i}) - g_i' \cdot x_i$$

All players know $\pi_x$ but do not know rivals per-product fixed costs $g_{ji}$. These assumptions imply the game is of incomplete information. Firms prior beliefs on these fixed cost coincide with the population distribution of fixed costs and are given by $G(g_i | \mu_G, \Sigma_G)$. This distribution allows costs to be correlated across products of the same firm but assumes they are independent across products of different firms.\textsuperscript{15}

The game described above is very similar to traditional games of incomplete information as in Seim (2006). We modify this traditional game by introducing new information. We allow all firms to observe a public signal of each other’s fixed cost. If this public signal is uninformative, then the game proceeds unchanged. If the signal is fully informative, then the game converts to one of complete information. If the signal is somewhat informative, the game will be a mixture of the two as we show next. The advantage of this approach is that it lets us nest both complete information and incomplete information models into a single model. This way we can do sensitivity analysis to the information structure of the game relatively easily.

To the best of our knowledge Greico (2012) is the only other work that has bridged both complete and incomplete information entry games into a single model. Greico allows for firms to have two distinct and additive profit shocks, one of which is common knowledge; the other is private information. Both Greico’s model and ours deliver qualitatively similar results. The advantage of our model is that we model the degree of information asymmetry (the variance on the public signals) separately from the profitability of the industry (the variance in the fixed cost shocks). In Greico’s model a change in the variance of the private shock affects both the degree of information asymmetry and the profitability of the firms. Thus, in his model, the public profit shocks have to be re-sized appropriately so that the profitability of the industry remains constant when changing the degree of information asymmetry.

The degree of information asymmetry (the noise in the public signal) can be identified from the coordination in entry decisions. In a complete information game firms coordinate entry decisions on both observable and unobservable (to the econometrician) factors, so as to not have negative post-entry profits. In the fully incomplete information entry game firms coordinate only on observable factors, but not on unobservable factors. In a par-

\textsuperscript{15}This last assumption simplifies significantly the model as firms cannot learn about rivals’ costs by observing their own costs. The model can be easily extended to have common observed factors affect firms profitability (i.e., common labor costs), but these need to be non-random and known to all firms.
tially incomplete information game firms will coordinate on the observable factors and partially coordinate on the unobservable factors (the coordination will not be as strong as it would be in a complete information game). It is also important to note that coordination on entry also depends on the degree of competition. Thus, information asymmetry and competition cannot both be estimated solely from entry/exit decisions without strict structural assumptions.\footnote{One such structural assumption could be that the competitive pressure a rival entrant imposes on an incumbent is the same as that of a rival entrant imposing on two incumbents. This competitive pressure can then be estimated from the coordination on entry between two firms deciding to enter and the degree of information asymmetry from the coordination between these two firms and a third firm.} An alternative approach to identification is to use price and quantity data to identify the degree of competition and entry/exit patterns to identify the degree of information asymmetry.

Getting back to our model, we model the public signal as a draw from a distribution centered at the true values: \( \eta_{ji} \sim H(g_{ji}, \nu_H) \) where \( \nu_H \) is the variance in the signal. All players update their beliefs given the realization of signals and prior beliefs. Let the updated beliefs be given by the distribution \( G(G, H, \eta, \nu_H) \) which is a function of prior distributions \( G \) and \( H \), signals \( \eta \), and commonly known variance \( \nu_H \). Since the signals are public information, all firms can form the updated beliefs \( G \).

These signals can be interpreted as publicly available information that firms know but not the econometrician. Examples include local labor costs, real estate and utility costs, or permits and government fees, with which firms can estimate rivals’ costs without knowing them with certainty.

Firms use the signals to calculate the probability of entry of each rival given rivals’ assessment of the firm’s own probability of entry. Formally, let \( P_{x_i} \) be the probability that all firms give to firm \( i \)'s entry decision \( x_i \) given the posterior distribution \( G \). Let \( P_{x_{-i}} = \Pi_{n \neq i} P_{x_n} \). A firm’s entry decision is then given by:

\[
\hat{x}_i(g_i, P_{x_{-i}}) = \arg \max_{x_i} \sum_{x_{-i} \in \Pi_{n \neq i} \mathcal{J}_n} P_{x_{-i}} \pi(x_i, x_{-i}) - g'_i \cdot x_i
\]

and the entry probabilities \( P_{x_i} \) are given by:

\[
P_{x_i} = \mathbb{E}_G [\hat{x}_i(g_i, P_{x_{-i}})] \quad \forall i
\]

Equation 3.7 is a fixed point equation whose solution \( (P_{x_i}^*) \) is used to determine entry decisions by each firm. These entry decisions are given by \( \hat{x}_i(g_i, P_{x_{-i}}^*) \) in which the fixed point \( P_{x_{-i}}^* \) is a function of the realized signals \( \eta_{ji} \). This fixed point equation may have more than one fixed point. That would be the case when there is multiple equilibria. An equilibrium selection rule will need to be applied to obtain a unique solution, although that rule may depend on the public signals. It may not depend on the fixed costs since then the equilibrium selection rule would reveal to other players more information about rivals’ costs.

### 3.2.1 Expected Entry Patterns and Market Outcomes

The expected entry patterns differ from the entry probabilities in that they are not a function of the signals \( \eta_{ji} \). To obtain the expected entry probabilities one must integrate over the distribution of signals and the distribution of fixed costs. Since the distribution of signals is a function of the realized fixed costs, one must solve the integral

\[
\bar{x}_i = \int \int \hat{x}_i(g_i, P_{x_{-i}}^*) \, dH(\eta|g, \nu_H) dG(g)
\]

\[\tag{3.8}\]

\[\text{16}\]
to obtain the expected entry patterns $\bar{x}_i$.

Similarly, one can obtain the expected consumer surplus, producer surplus, and other market outcomes by engaging in a similar procedure:

$$CS = \int \int CS \bar{x} dH(\eta|g,\nu) dG(g)$$

(3.9)

$$PS_i = \int \int \Pi_i(\bar{x}_i, \bar{x}_{-i}) dH(\eta|g,\nu) dG(g)$$

(3.10)

### 3.3 Merger Analysis

When two firms merge, there are several mechanisms that could potentially generate incentives for industry participants to change their product offerings. We provide intuitions for the most important mechanisms here, and will present corresponding merger simulations to illustrate each in the following section.

**Increasing Prices** A first, straightforward mechanism may occur as a consequence of post-merger price changes. Holding product offering constant, merged firms increase their prices. Since competition is in strategic complements, other industry participants would also raise price. The net effect is that, holding product offerings fixed, average prices rise following the merger. The post-merger price increases may induce more entry, as the firms may now find it profitable to offer a product that wouldn’t have been profitable under the lower pre-merger prices. This increase in entry may subsequently reduce the initial price effect as new products generate additional price competition.

**Saving on Costs** A second major effect arises from the merging firms internalizing the effect their entry decisions have on each other’s profitability. To the extent that products are partial substitutes for each other, the merging firm might want to reduce its offering (the number of products offered), decreasing the cannibalization of their own products, increasing price on the remaining products and saving on the fixed costs of the products being eliminated. In the merger case between Whole Foods and Wild Oats, the government’s expert testimony argued that this effect would be likely. In response to such a reduction in offerings, other industry participants may increase their product offerings.\(^{17}\) The net effect would be a reduction in total product offerings, following the same rationale behind competition in strategic substitutes.

**Preempting Rivals** A third mechanism involves the merging firm’s ability to preempt rivals. Since it now jointly determines the offering decisions for more products, the merged firm has effectively increased the set of actions it can undertake. It may utilize these actions to preempt rival entry. A simple example may illustrate this: three firms can potentially enter a market. Firm A’s profits are such that it will always enter independently of rivals’ actions, but would rather compete against B than C. Firm B would never enter if either A or C enter. C enters only if A and B do not both enter. The unique equilibrium in this game is for firm A and C to enter while firm B chooses not to operate. If firm A and B were to merge, a new equilibrium would arise in which A and B enter and C does not.\(^{18}\) Prior to the merger, firm A could not force B to enter at a loss, even though this would be valuable to A as it would deter C from entering. This effect is opposite to the court’s assessment of the Oracle-PeopleSoft merger, in

\(^{17}\)In an incomplete information game as the one modeled here, a firm has a cutoff for fixed costs below which it offers a product (when fixed costs are low enough, the firm offers the product). Increasing this threshold results in the firm offering the product more often. This is what we imply when we state that firms increase their product offering.

\(^{18}\)This requires that the difference in A’s profits from competing against B instead of C be larger than the losses B incurs when entering the market jointly with A.
which the court stated the plaintiffs had not proven how rivals would fail to reposition themselves in the market to constrain anti-competitive price increases by the merging party. In the example above, although the total number of firms active in the market didn’t change, monopoly pricing and the different market structure could potentially hurt consumers.

**Information/Coordination** Along with joint optimization, a merger will produce the firm with additional information. Each firm has private information pre-merger; this information is shared between the merging parties post-merger (since they are now the same firm). This additional information allows the merged firm to coordinate entry better, especially when information on fixed costs is imperfect. As coordination improves, entry increases: the merged firm can decrease the mis-matching post entry and thus have a higher incentive to enter. For example, holding the fringe firm’s entry decision constant, pre-merger each merging firm has, for each potential product, a cutoff for fixed costs below which it offers the product. At exactly this cutoff value, the expected losses due to a mis-match (both merging parties offering the product) exactly equal the expected gains from a correct match (the other merging party not offering the product). Since a mis-match causes the firm to lose money, the cutoff is such that a correct match implies strictly positive profits. Thus, fixed costs have to be strictly lower than variable profits obtained when the other merging party does not enter. Improving coordination decreases the probability of a mis-match, thus the expected losses are lower. This implies the cutoff for fixed costs has to be higher (fixed costs can be higher and still justify entry).

**Creating Cost Efficiencies** Finally, mergers may generate cost efficiencies for merging parties. As suggested in Section 2.2, such efficiencies may be in the form of reductions in the fixed costs of offering a product. Depending on the size of this reduction, entry may increase post-merger, offsetting any negative effects on consumer welfare. We illustrate the significance of each of these forces in a set of simulations involving three firms with one product each. The next section lays out these simulations.

### 4 The Three Product Example

Our simulation results are organized around demonstrating the merger effects discussed above. We do this in a setting where each of the three firms is endowed with a single product each. The simulation results show how key market outcomes change as a result of a merger between firms A and B. The presence of the fringe firm, firm C, allows for some competition to exist even after the merger. It also allows for some information asymmetry to exist after the merger.

For all simulations we measure the change in consumer surplus and in producer surplus. To normalize the scale values, we measure percentage changes. We also measure the expected number of products in the market and the change in this value. This allows us to observe how market structure changes due to the merger. Some general primitives common to all simulations are given below.

### 4.1 Primitives

The entry model described above is characterized by a large set of primitives. We fix these primitives to reasonable values. Specifically, we set price elasticities, market shares, and entry probabilities so as to resemble those of
the literature (???). The complete list of primitives and their values are given in the appendix. The cross price
elasticities, market shares, and entry probabilities for the base specification are:

\[
\nabla_p s(p) = \begin{bmatrix}
-1.82 & 0.43 & 0.43 \\
0.43 & -1.82 & 0.43 \\
0.43 & 0.43 & -1.82 \\
\end{bmatrix}
\]

\[
s(p) = \begin{bmatrix}
0.22 \\
0.22 \\
0.22 \\
\end{bmatrix}
\]

\[
\bar{x} = \begin{bmatrix}
0.88 \\
0.88 \\
0.88 \\
\end{bmatrix}
\]

Among other key primitives, we use a censored normal distribution for the distribution of fixed costs \( G(\cdot) \), with censoring at zero and positive mean value. Specifically, we assume a symmetric mean value of 0.28 units and a variance of 0.05. The signal distribution \( H(\cdot) \) is a normal distribution. This allows for the updated distribution \( G(\cdot) \) to be a censored normal distribution (for which a closed form solution is known). When modeling significant information asymmetry, we use a signal variance of 0.5, which is 10 times larger than that of the fixed cost distribution. When modeling almost no information asymmetry (i.e. quasi complete information games), we use a signal variance of 0.001.

As to selecting equilibrium, we use iterative best responses to find the equilibrium and order players movements according to who is most profitable if no one else were to enter. With two players, this would choose the efficient equilibrium; with three players it has the same flavor but it is not guaranteed.

For the random coefficients and the T1EV draw, we use a variance on the T1EV of 0.1 and a variance of all random coefficients of 1. This implies that most variation comes from the random coefficients and the T1EV shock is used mostly as a smoothing kernel for the numerical integration. The covariances on random coefficients are varied across simulations to show how results differ if products are closer or farther apart. We discuss these covariances more in detail below.

4.2 Mergers with Differing Degrees of Product Substitution

The covariance matrix of random coefficients allows to model how close or far products are from each other. Equidistant products are modeled with a covariance matrix of the form

\[
\Sigma_P^{(f)} = \begin{bmatrix}
1 & \rho & \rho \\
\rho & 1 & \rho \\
\rho & \rho & 1 \\
\end{bmatrix}
\]

where \( \rho \) can take values between -0.5 and 1. Large values imply products are close substitutes, where a value of 1 refers to perfect substitutes.

In our first set of merger simulations, we analyze the merger described above for all possible values of \( \rho \).\(^{19}\) The simulations allow for significant information asymmetry in the entry game and thus capture all the effects described above. We break down each of these effects in the following subsections.

Figure 4.1 captures the difference between a world with the merger and a world without it for key market outcome variables. The figure is a double-axis plot. The left axis measures the change in expected consumer surplus and in expected profits generated by each product. The right axis measures the expected number of products offered in the market before and after the merger.

\(^{19}\)The range of possible \( \rho \) values (-0.5 to 1) is broken down into 200 equally spaced intervals and the simulations are calculated at each one of these values.
The x-axis marks how close products are to each other. Instead of plotting the value of $\rho$ that determines how close products are to each other, we show instead the cross-price elasticity between product $A$ and product $B$ relative to product $A$'s own price elasticity (in absolute terms), which also captures product closeness. We believe the cross-price elasticity is a measure that is more readily available to economist and policy makers and is easier to understand than a primitive of a structural demand model.

At the extreme right of the plot, products are perfect substitutes ($\rho$ is one) and the cross-price elasticity divided by the own price elasticity is 0.5 as when firm $B$ increases her price by a fraction firm $A$ gets half of all of $B$'s sales and firm $C$ gets the other half. At the extreme left products are far from each other and cross price elasticities are close to zero.

The size of the effects shown in figure 4.1 are large and vary significantly with the degree of substitution. For intermediate values of product substitution consumer welfare can decrease by up to 16% due to the merger. At the extreme right and the extreme left the merge has minimal effect on consumer surplus nor producer surplus. At the extreme left products are so far from each other that they can be considered local monopolies. A merger does not change market power as each product already had all the market power possible in its 'local' market. At the extreme right products are so close substitutes that the market can support only one product (as shown by the Number of Products in figure 4.1). If two product were to be offred they would price at marginal cost and not recoup their fixed costs. In this case transferring ownership of potential products does not change anything, as the market continues to support solely one product independent of ownership. At intermediate levels of differentiation, merging firms gain substantial market power and have the potential to utilize it. How they utilize it can result in welfare either decreasing or increasing, depending on how much consumers value variety and the incentives of the

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20 The cross price elasticity and own price elasticity are calculated at pre-merger equilibrium prices when all products are offered in the market.

21 Because of the infinite support of the random coefficients (and of the T1EV) there will always be some minimal substitution between all products, which is why cross price elasticities are never exactly zero.
merging parties to offer more or less products.

As can be seen in figure 4.1, these incentives vary significantly across different values of product differentiation. We will explore these forces in detail, each one in isolation, and then come back to this figure.

4.3 Higher Prices Induces Entry

We would like to illustrate how the increase in prices post merger may induce firms to increase the products offered. So as to abstract away from other effects we remove all fringe firms (firm C is endowed with zero products) and we remove all information asymmetry (the variance in the public signals is set to 0.001). We also abstract from any cost synergies by assuming firms have the same costs pre- and post merger. Finally, to abstract from the incentive to cutback on product offering (to save on fixed costs) we model the merger as one in which both firms make entry decisions independent of each other and independent of the effect entry will have on the other’s profits, but acknowledge that they will be pricing jointly after entry. This special merger situation should capture the additional entry induced from being able to joint price without being confounded by other incentives. As with the previous simulations, we analyze market outcomes for all potential values of \( \rho \) in which \( \rho \) captures the covariance between products \( A \) and \( B \).

The outcomes of this merger can be seen in figure 4.2. The number of products increases after the merger for most values of product differentiation. The increase is strongest when products are very close substitutes. It is when products are closest together that the price increase due to joint pricing is greatest. The higher prices induces the firms to offer their product more, and this increase in product offering increases consumer surplus. Notice how for values of the normalized cross-price elasticity of 0.7 the change in consumer surplus is indeed above zero.

\(^{22}\) Covariance with \( C \) is irrelevant as we have removed it entirely from the simulations.
It is also at this cross-price elasticity that the change in profits are at their lowest: a 22% loss in profits. This is due to the excessive entry. Prior to the merger, for most values of fixed costs, only one product would fit in the market and reap monopoly profits. The merger causes firms’ profits post-entry to increase and causes both products to be offered. This reduces firms profits from a large positive value to a small positive value.

While this particular effect on profits is driven partially from the fact that after the merger firms continue to make independent entry decisions, it illustrates how more entry can result simply due to higher prices, that the additional entry is non-negligible and can even be sufficient to benefit consumers despite the higher prices.

4.4 Cull Products to Save on Fixed Costs

As described above, firms may reduce products offered after a merger to save on fixed cost and have the remaining products serve a fraction of the market the culled products served. To illustrate this force and abstract from other effects we remove from the setting fringe firms (firm C), information asymmetries, and cost synergies. We also assume that firms continue to price as if they had not merged after entry decisions are made and that they know they will price so when making entry decisions. Nevertheless, they do make the entry decision jointly, recognizing each others’ interdependencies.

Figure 4.3: Cull Products and Save on Fixed Cost

Figure 4.3 shows the outcomes of such a merger. The drop in consumer surplus due to the culling of products is as large as 40% for some values of product differentiation. This effect is strongest for mid levels of differentiation. At low levels products are so different that they do not cannibalize each others’ sales and there would be no gain in culling a product. At very high levels only one product was being offered pre-merger. Since one product is the minimum required to make any sales, there are no cost savings to be achieved. The cost savings are largest when

---

23 The expected number of products pre-merger is exactly 1.5 at the cross-price elasticity of ~0.5, which is where the change in profits is exactly zero. For cross-price elasticity values above ~0.5, the expected number of products is below 1.5, implying that for most fixed cost values only one product fits in the market.
products cannibalize each other significantly and both are offered prior to the merger. It is also in these cases where the effect on culling a product is largest for consumers, as they are not only deprived of variety but they also see prices of the remaining products increase.

As can be seen in the figure, firms’ profits increase by up to 40% by culling back on products. The ability to close a rival’s stores may be a much larger motive for merger than the ability to jointly price. This also implies that colluding on store location may be much more profitable than colluding on pricing.

4.5 Preempting Rivals

To elicit the magnitude of the preemptive effect we allow for a fringe firm, firm $C$, to compete in the market, both prior to and after the merger. We continue to model a situation with no information asymmetry and no cost synergies. So as to abstract away from the incentives to cull products and from the incentives to increase entry due to higher prices, we focus solely on those markets in which either product $A$ or product $B$ were offered prior to the merger, but not both. It is in these markets in which there is no incentive to cutback on products offered but there is potential in deterring entry from $C$. We also assume firms price as if no merger had taken effect and that they acknowledge this when making entry decisions. In doing so we abstract from the incentive to increase entry due to higher prices in the subgame. Finally, we model products as equally spaced apart (covariance matrix given as in equation 4.1).

4.6 Coordination with Incomplete Information

As described above, when there is incomplete information costly mis-matches may happen. These occur when firms offer products expecting rivals will not offer theirs and rivals behave similarly. The end result is too many products being offered. A merger helps mitigate these costly mis-matches in that private information is shared between the merging parties, eliminating the mis-matching between them. In addition, higher prices due to joint pricing mitigates losses from mis-matches, inducing firms to offer more.\footnote{This second effect is simply a repetition of higher prices induces more entry, but in an incomplete information framework.}

To study the value of information we allow for a setting with significant information asymmetry. Specifically, we let the public signals on firm’s costs to be uninformative, and thus set its variance to 0.5. So as to abstract from other forces at play, we remove from the setting fringe firms (firm $C$) and any cost efficiencies. We also assume that firms continue to price as if they had not merged after entry decisions are made and that they know they will price so when making entry decisions.

In this setting we study two different types of mergers. The first type is one in which the merging parties share information and make entry decisions jointly. The second type is one in which firms internalize each other’s interdependencies but make the entry decisions independently and without knowledge of the other merging party’s entry decision. This merger resembles how two divisions of a firm would act if they did not share information. The contrast between the two types of mergers elicits the value of transferring information.

Figure 4.4 plots the change in consumer surplus and the change in profits for both mergers (change relative to the case without a merger). Since products are symmetric, it is enough to show the profits of one of the two products.

There is not a large difference between the two mergers, implying most of the benefits of the merger arise from...
forces described previously and not from the transfer of information.\textsuperscript{25} For low levels of product differentiation there is a noticeable difference, accounting for a \textasciitilde{}5\% difference in consumer surplus. This difference in consumer surplus is driven by more entry (not shown in graph) in the second merger than in the first. That is, as described earlier, coordination allows the merging parties to avoid costly mis-matches and thus to enter at higher fixed costs. This effect is largest when the expected losses of a mismatch are largest: when the probability of both entering is high and there is significant cannibalization. Both of these occurring jointly is rare and happens only for moderate levels of product differentiation. When products are very different there is little cannibalization so the losses of a mis-match are small. When products are very similar the probability that both are offered is very small. In the above merger simulations, both firms internalize the profit loss that their entry has on the rival product. If products are very close and the probability that the other product is offered is high, the best response is to stay out of the market so as to not cannibalize the other firm’s sales.

4.6.1 Coordination when in the face of a rival

The value of coordination changes significantly in the face of a rival. Figure 4.5 repeats the simulation above but includes the fringe firm, firm \(C\), in the game. The solid lines show the changes in consumer and producer surplus when the merging firms share information and jointly decide on entry. The dotted lines show the changes in consumer and producer surplus when the merging parties act as two different divisions of the same firm. It is important to recall that the variable profits obtained in the subgame are the same both prior to and after the mergers. Thus, we have removed any benefits from joint pricing.

When products are close to each other, very few fit in the market. Firms are very cautious about entering the market, since mis-matches (two firms entering) are very costly. This cautiousness persists even when firms \(A\) and

\textsuperscript{25}The current setting models information asymmetry in a very specific way. There is the possibility that if information affected profits differently than how it is modeled here, the value of transferring such information by much larger than what the simulations suggest.
B internalize the effect of entry they have on each other’s expected profits (the dotted lines). When A and B are allowed to share information in addition to internalizing each others’ interdependencies, they can now coordinate on entry (the solid lines). Because they can coordinate on entry they do not have to be as cautious as before and can increase their entry thresholds. Firm C reacts by reducing its threshold even more, entering less times, which in turn incentives the merged firm to enter even more often. The cascading effect drives firm C completely out of the market.

Nevertheless, when products are identical, firms are so cautious that there rarely are mis-matches, thus coordination does not help in avoiding them. The result is that the merging firm cannot drive the fringe firm out of the market.

4.7 Summary of Effects with No Cost Efficiencies

After illustrating each of the forces independently, it is much easier to understand Figure 4.1. The higher prices induce entry effect and the cull products to save on costs effect dominate. But these two act in opposite directions regarding product offering.

To the left of the plot the culling effect dominates. This is where products are not close substitutes and where almost all three are offered pre-merger. Because there is some degree of substitution between products, the merging parties can change from offering two products to offering one, save on fixed costs, and have the remaining product absorb some of the sales of the culled product. Joint pricing does not have a significant advantage at this level of differentiation as products are still significantly different.

As the culling effect dominates, the fringe firm is the one who benefits the most from the merger. The merging parties reduce their offering and the fringe firm responds by increasing its offering. In addition, the fringe firm enjoys higher prices when all three products are offered.
As products become closer substitutes (middle of the plot) it becomes more rare for the two merging parties to both offer their product pre-merger, and the benefit from culling products diminishes. On the other hand, since products are closer substitutes, joint pricing helps increase prices significantly. This induces the merging parties to offer their products more often, inducing a net increase in the number of products offered. Since consumers value variety, consumers benefit from these actions.

![Figure 4.6: Fringe Firm is Different Than Merging Parties](image)

Now the fringe firm is really hurt by the merger as it is pushed out of the market. It is pushed out in multiple ways. First, as the merging parties increase their offering because of the higher prices they can achieve after entry, firm C has to reduce its offering in response: two fit in the market, three don’t. In addition, the merging parties are able to preempt firm C since the menace of having both products A and B offered jointly increases. This induces firm C to not offer its product as often, increasing even further the merging firms’ profits and decreasing C’s profits. Finally, it is important to note that even as firm C is being pushed out of the market, consumers benefit from this as the merging parties are ‘flooded’ the market with their products. Figure 4.1 illustrates how a merger may be beneficial to consumers without any cost efficiencies and at the expense of non-merging firms.

Before exploring cost efficiencies, we show how the welfare effects discussed above differ when the fringe firm is not positioned to compete against any the merging parties’ products and when the merger is between two non-competing products. We model these two cases with the following two covariance matrices for the random coefficients

\[
\Sigma_F^{(II)} = \begin{bmatrix}
1 & \rho & -\rho \\
\rho & 1 & -\rho \\
-\rho & -\rho & 1
\end{bmatrix}
\]

\[
\Sigma_F^{(III)} = \begin{bmatrix}
1 & -\rho & \rho \\
-\rho & 1 & -\rho \\
\rho & -\rho & 1
\end{bmatrix}
\]

The first one implies products A and B are very close to each other and far from product C when \(\rho\) is high. This is the case in which the fringe firm is not positioned to compete against either of the merging firms. When \(\rho\) is zero
all products are equally spaced, and when \( \rho \) is negative products \( A \) and \( B \) are closer to \( C \) than to each other.\(^{26}\) The second covariance matrix implies products \( A \) and \( C \) are very close to each other and far from product \( B \) when \( \rho \) is high. When \( \rho \) is zero all products are equally spaced and when \( \rho \) is negative \( A \) and \( C \) are closer to \( B \) than to each other. While the full potential range of \( \rho \) is computed for completeness, the discussion below will focus on the cases where \( \rho \) is positive.\(^{27}\)

Figure 4.7: One Merging Party is Different than the Other and Similar to the Fringe Firm

![Graph showing changes in key market outcomes for both sets of simulations.](image)

Figures 4.6 and 4.7 contain the changes in key market outcomes for both sets of simulations. When the fringe firm is well positioned to compete against one of the merging parties (right section of figure 4.6), the merger has very modest effects. Prior to the merger there are two products being offered in the market: \( C \) always and \( A \) or \( B \) depending on equilibrium selection. With the merger, the merging parties reduce significantly the products offered, diminishing cannibalization. The fringe firm cannot steal market share from the merging parties, so most of the market share of the culled product goes to the merging firm. Thus, the benefits from culling products are much larger than those of joint pricing. Furthermore, due to the differentiation of the fringe firm, deterrence is minimal.

The merging parties benefit substantially from this merger, increasing profits by up to 60%. This contrasts with the more modest 30% of figure 4.1. Consumers are also affected, seeing welfare drop by up to 22%, 12 points more than the 10% drop of figure 4.1.

The merger depicted in figure 4.7 is one in which the fringe firm offers a product very close to one of the products of the merging firm. It is in this scenario where multiple of the effects discussed previously come into play. For moderate levels of differentiation, the product culling effect dominates. The merging party reduces the number of products offered, with the reduction mostly happening with the product that is close to that of the fringe firm. By

\(^{26}\) An analogy that may be useful is that \( A, B, \) and \( C \) sit on the corners of a triangle where \( CA = CB \) and \( CA > AB \).

\(^{27}\) We focus the discussion on cross-price elasticities / own price elasticity values greater than 0.33, which is the value at which \( \rho \) is exactly zero.
removing this product the remaining product can recoup some of the market share lost while not facing significant competition from the fringe firm (since the remaining product is significantly different than that of the fringe firm). The fringe firm benefits substantially from such actions, as the close competitor exits the market.

As products $A$ and $C$ come closer together and grow farther apart from $B$, a merger between $A$ and $B$ becomes very beneficial to firm $A$. The merging party enters the market with both products more often. Prior to the merger, even though product $B$ was differentiated from the other two, there was some competition between $B$ and $A$ that prevented from $B$ entering the market always. The merger allows the merging parties to offer both products and deter $C$ from entering. The increased net entry is beneficial to consumers, as they gain in variety and prices do not change much since $B$ and $A$ are significantly different. Firm $A$ benefits much as it is able to displace its close rival, firm $C$, from the market.

4.8 Cost Efficiencies

It is natural to ask: how large must cost efficiencies induced by the merger be so that the merger be beneficial to consumers? Farrell and Shapiro (1990) take a first stance at this question, calculating the size of the cost efficiencies in a symmetric Cournot setting. We follow a similar analysis, and show the consumer surplus change post merger for three different levels of cost efficiencies: 5% and 15% cost reductions in fixed costs. Figure 4.8 shows these results, where the setting is one with significant information asymmetry and with the presence of a fringe firm (same as the setting of figure 4.1).

The effects of cost efficiencies appear to be small. A 15% cost reduction results in some mitigation of the welfare loss post-merger for moderate values of cross-price elasticities. A huge driver of consumer welfare is the number of products being offered in the market. When products are somewhat differentiated, absent cost efficiencies the

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28 Other work in this question is Levin (1990) and McAfee and Williams (1992)
merging firm reduces its product offering to save on fixed costs. Efficiencies in these fixed costs prevents the firm from cutting back on offering as much.

The benefits from cost efficiencies are largest when, without them, the market supports half of the available products. It is at this point that half of the distribution of fixed cost is above an entry threshold and half of it is below. Since the distribution is almost symmetric, the peak of the distribution is located at the mean and as this mean is shifted downwards a significant mass of probability crosses the threshold, resulting in increased entry. On the other hand, when products are very close or very far from each other the thresholds at which entry takes place is at the tails of the distribution. Shifting the distribution downward has little effect in increasing entry.

For those cross price elasticity values at which the merging party would increase its offering without cost efficiencies, having cost efficiencies adds little, because, as explained above, the merging party is already entering with both products. The incentives to deter entry of the fringe firm push for this. The additional incentives in the form of lower costs helps little. But as products become even closer substitutes (far right of figure 4.8) and the merging party cannot profitably enter with both products, having cost efficiencies helps induce more entry. As consumers value variety, additional entry helps consumers substantially.

5 Conclusions

In this paper, we have begun to analyze the potential welfare impacts of post-merger product repositioning. While the industrial organization literature has documented a relationship between differentiation and market concentration and the potential for repositioning has been qualitatively considered by courts and regulatory agencies, merger simulations have almost entirely focused on price effects. We demonstrate that post-merger repositioning can have a substantial impact on industry equilibrium, exacerbating or diminishing the impact on consumer welfare depending on the circumstances. The impacts are particularly acute in cases where the merging firms offered relatively similar products prior to the merger. A simulation that allows for repositioning can also accommodate the impact of fixed cost synergies, which tend to be positive for consumer welfare because the merged firm will offer their products more often when fixed costs are lower.

In future work, we will develop alternative scenarios that may represent industries where mergers may actually occur. The modeling strategy employed here could also, in principle, be adapted to compute post-merger repositioning impacts in an actual merger simulation. As mention in Section 2, a number of researchers have been developing empirical techniques to accommodate product choice into merger analysis - our approach makes most sense for a shorter-run analysis in which the industry’s firms can change their minds about which existing product varieties are optimal to offer after a merger. Incorporating these effects, along with pricing impacts, should make merger simulations more information to regulatory agencies trying to judge the impact of mergers on consumers.

References


A Primitives of the Model

The pricing game is characterized by price coefficients ($\alpha$), the distribution of random coefficients ($F(\mu_F, \Sigma_F)$), market size ($M$) and variable costs ($c_{ji}$). The price coefficient is set to $e^{-0.75}$, which is approximately 0.47. The random coefficients distribution is a multivariate normal with mean $\mu_F = (1.2, 1.2, 1.2)'$. The covariance matrix, $\Sigma_F$, is detailed in the text, has a variance of one, and covariance elements that vary between -0.5 and 1. Market size is 0.76 units and variable costs are $c = (1.5, 1.5, 1.5)'$. The T1EV distribution uses a variance of $\sigma = 0.1$ and the integrals over the distribution of random coefficients are solved using numerical integration, taking one hundred thousand draws from a Sobol sequence.
If all products are present in the market, these primitives imply pre-merger prices of 3.32, market shares of 24.4\%, variable profits of 0.35 and price elasticities of:

$$\nabla_p s(p) = \begin{pmatrix}
-1.82 & 0.43 & 0.43 \\
0.43 & -1.82 & 0.43 \\
0.43 & 0.43 & -1.82 \\
\end{pmatrix}$$

The prices and variable costs described here imply gross margins of 55\%.

The entry game is characterized by a distribution over fixed costs (G) and a distribution over signals (H). We use a censored normal distribution for fixed costs, with censoring at zero, a mean value of 0.28, and a standard deviation of 0.07. H is a normal distribution with variance 0.5. The mean value is given by the realization of the draw of fixed costs. All integrals regarding either H or G are executed through numerical integration. We use forty thousand draws for the G distribution integrals and one thousand draws for the H distribution. All draws are taken from Sobol sequences so as to increase the accuracy of the integrals.

The large variance in the distribution of signals, H, compared to the more modest variance of G, imply the game is close to the classical game of incomplete information: the standard deviation of the updated distributions G is 0.069, calculated as: $$\sigma_G^2 = \left( (\sigma_G^2)^{-1} + (\sigma_H^2)^{-1} \right)^{-1}$$ with these distributions, the expected pre-merger entry probability for a given product is 0.88, which implies the expected number of products offered is 2.64. The expected net profits are 0.09 units (a net margin of 15\% using pre-merger prices of 3.32 and market shares of 24.4\%).

All plots in which the covariance element, $\rho$, is varied are drawn using two hundred distinct values of $\rho$, equally spaced between -0.5 and 1.

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29 Due to symmetry, all prices, market shares, and variable profits are identical.

30 This mean and standard deviation does not coincide with the $\mu_G$ and $\sigma_G$ parameters of the distribution since G is a censored-normal distribution. In this particular case, since the censoring is at zero and zero is more than two standard deviations below the mean value (0.28), $\mu_G$ and $\sigma_G$ are almost identical to the mean and standard deviation values.