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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[1] Budzinski 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, Mazzeo, 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 analyses 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.[3] 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).[4] 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.

[3] This 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/antitrust 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.

[4] In 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).[5] 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.[6] The results from these initial papers do seem to indicate that firms make distinct changes to their product characteristics, with potentially important competitive consequences.[7]

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 reoptimize 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 parameterization 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

[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 analyses 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,

[8] Papers by Ashenfelter and Hosken (2010) and Weinberg and Hosken (2012) perform similar analyses 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 of 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."[10]

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, 502 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.[11]

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 anticompetitive 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 anticompetitive 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 analyses 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 posession of a set of products with predefined characteristics. $\mathcal{J}_i$ represents the set of products firm i is endowed with and j represents one of these products.[12] 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 $(\mathbf{x}^\star, \mathbf{p}^\star)$. In this context, $\mathbf{x}^\star$ is the entry decisions for each firm: $\mathbf{x}^\star \equiv (\mathbf{x}_A^\star, \mathbf{x}_B^\star, \mathbf{x}_C^\star)$ where $\mathbf{x}_A = (x_{1A}, x_{2A}, ..., x_{jA})'$ and x_{1A} is one if the product is offered and zero if it is not. The price vector $\mathbf{p}^\star \equiv (\mathbf{p}_A^\star, \mathbf{p}_B^\star, \mathbf{p}_C^\star)$ are the prices that will arise given $\mathbf{x}^\star$ 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 $\mathbf{x}$ 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.

[12] Games in which firms choose location on a continuous variable (i.e., quality) can be accomodated under the framework presented here by discretizing the continous 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 $\mathbf{x}$ and are taken as fixed in this subsection. Here we characterize the pricing game given the offering $\mathbf{x}$. We define $\mathcal{K}_i$ to be the set of active products of firm i, so that $\mathcal{K}_i \subseteq \mathcal{J}_i$ and $\mathcal{K}$ be all the products offered in the market: $\mathcal{K} \equiv \cup_{i \in I} \mathcal{K}_i$.

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 α_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 ϵ_{js} is drawn from a Type 1 Extreme Value distribution with variance σ and θ_{js} is drawn from an arbitrary distribution that allows for correlated shocks across products and non-zero means: $\theta_s \equiv (\theta_{1s}, \theta_{2s}, ..., \theta_{Js})' \sim F(\theta|\mu, \Sigma)$.[13] 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

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

Equation 3.2 is very informative: θ_{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 travelling to product j in a Hotelling model.[14] The variance σ plays two roles in this model: on the one hand, it defines how important price and the correlations across products are relative to other unobersved characteristics. On the other hand, it controls how "smooth" the integrand is. In this sense, one can think of the idionsyncratic shock ϵ as a convenience tool that allows to form a Kernel to approximate the outer integral (the integral over random coefficients: θ_{js}) and in which the variance σ controls the bandwidth of such Kernel.

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

$$\pi^i(\mathbf{p}) = \sum_{j \in \mathcal{K}_i} s_j(\mathbf{p}) (p_j - c_j) \tag{3.3}$$

and the equilibrium prices are defined as the solution to

$$\frac{\partial \pi^i(\mathbf{p})}{\partial p_j} = 0 \; \forall j \in \mathcal{K}_i \; i = \{A, B, C\} \tag{3.4}$$

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

Let $\mathbf{p_x}$ define the equilibrium prices when the offering choice is $\mathbf{x}$ and let $\pi_{\mathbf{x}}$ 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 μ and Σ 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 σ (from the T1EV 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 $\mathbf{x}$, consumer surplus can be defined as

$$CS_{\mathbf{x}} = \int M \ln \left[1 + \sum_{n \in \mathcal{K}} e^{\frac{1}{\sigma}(\theta_{ns} - \alpha_s p_{n,\mathbf{x}})} \right] dF(\theta_s | \mu_F, \Sigma_F) \tag{3.5}$$

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 $\pi_{\mathbf{x}}$.

3.2 The Entry Game

We model a simultaneous move entry game. For this game, we take the vector of profits $\pi_{\mathbf{x}}$ 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 $g_i \equiv (g_{1i}, g_{2i}, ..., g_{Ji})'$. In summary, the ex-post net profits for firm i of offering products $\mathbf{x}_i$ are

$$\Pi_i(\mathbf{x}_i, \mathbf{x}_{-i}) = \pi_{(\mathbf{x}_i, \mathbf{x}_{-i})} - g_i' \cdot \mathbf{x}_i$$

All players know $\pi_{\mathbf{x}}$ 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.[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 uniformative, 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 assymetry (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 assymetry and the profitability of the firms. Thus, in his model, the public profit shocks have to be resized appropriately so that the profitability of the industry remains constant when chaning the degree of information assymetry.

The degree of information assymetry (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 partially incomplete information game firms will coordinate on the observable factors and partially coordinate on the

[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.

unobserved 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 assymetry and competition cannot both be estimated solely from entry/exit decisions without strict structural assumptions.[16] 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 assymetry.

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 ν_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 $\mathcal{G}(G, H, \eta, \nu_H)$ which is a function of prior distributions G and H, signals η, and commonly known variance ν_H. Since the signals are public information, all firms can form the updated beliefs $\mathcal{G}$.

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' assesment of the firm's own probability of entry. Formally, let $\mathcal{P}_{\mathbf{x}_i}$ be the probability that all firms give to firm i's entry decision $\mathbf{x}_i$ given the posterior distribution $\mathcal{G}$. Let $\mathcal{P}_{\mathbf{x}_{-i}} = \Pi_{n \neq i} \mathcal{P}_{\mathbf{x}_n}$. A firm's entry decision is then given by:

$$\hat{\mathbf{x}}_i(g_i, \mathcal{P}_{\mathbf{x}_{-i}}) = \arg\max_{\mathbf{x}_i} \sum_{\mathbf{x}_{-i} \in \Pi_{n \neq i} \mathcal{J}_n} \mathcal{P}_{\mathbf{x}_{-i}} \pi_{(\mathbf{x}_i, \mathbf{x}_{-i})} - g_i' \cdot \mathbf{x}_i \tag{3.6}$$

and the entry probabilities $\mathcal{P}_{\mathbf{x}_i}$ are given by:

$$\mathcal{P}_{\mathbf{x}_i} = \mathbb{E}_{\mathcal{G}} \left[\hat{\mathbf{x}}_i(g_i, \mathcal{P}_{\mathbf{x}_{-i}}) \right] \ \forall i \tag{3.7}$$

Equation 3.7 is a fixed point equation whose solution $(\mathcal{P}^\star_{\mathbf{x}_i})$ is used to determine entry decisions by each firm. These entry decisions are given by $\hat{\mathbf{x}}_i \left(g_i, \mathcal{P}^\star_{\mathbf{x}_{-i}} \right)$ in which the fixed point $\mathcal{P}^\star_{\mathbf{x}_{-i}}$ is a function of the realized signals η_{ij}. 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 η_{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

$$\bar{\mathbf{x}}_i = \int \int \hat{\mathbf{x}}_i \left(g_i, \mathcal{P}^\star_{\mathbf{x}_{-i}} \right) dH(\eta | g, \nu_H) dG(g) \tag{3.8}$$

to obtain the expected entry patterns $\bar{\mathbf{x}}_i$.

[16] 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 assymetry from the coordination between these two firms and a third firm.

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

$$CS = \int \int CS_{\hat{\mathbf{x}}} \hat{\mathbf{x}} dH(\eta|g,\nu) dG(g) \tag{3.9}$$

$$PS_i = \int \int \Pi_i(\hat{\mathbf{x}}_i, \hat{\mathbf{x}}_{-i}) dH(\eta|g,\nu) dG(g) \tag{3.10}$$

3.3 Merger Analysis

A merger between two firms has many effects. A first and well known effect is the price effect. Holding product offering constant merged firms increase their prices. Since competition is in strategic complements, the fringe firm would also raise price. The net effect is that, holding product offering fixed, average prices rise with the merger. This rise in pricings may induce more entry, as the merging firms may now find it profitable to offer a product that wouldn't have been profitable under the lower prices pre-merger. This increase in entry may reduce the price effect as new products provide more price competition.

A second major effect arises from the merging firms internalizing the effect their entry decisions have on each others' profitability. To the extent that products are partial substitutes of each other, the merging firm might want to reduce its offering (the number of products offered), decreasing the cannibalization on their own products, increasing price on the remaining products and saving on the fixed costs of the products being cut back. In response to this reduction in offering by the merging parties, the fringe firm will offer its products more often.[17] The net effect would be a reduction in total product offering. This is the basic rationale behind competition in strategic substitutes.

A third effect the merger has is that it changes the information structure. The merged firm shares information on its fixed cost across all potential products - in other words, the previously unknown fixed cost of the merger partner becomes known (since they are now the same firm). This allows the merged firm to coordinate entry better, especially when information on fixed costs is vague. 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 strcitly 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 cut-off for fixed costs has to be higher (fixed costs can be higher and still justify entry).

Additionally, the merger will allow the merging parties to coordinate their entry decisions. This can help the merging parties crowd-out the remaining firms: by offering two products jointly, the merging firm may prevent the fringe's entry. Thus, the merging parties crowd-out rival firms and benefit from joint-pricing. Although the total number of products offered doesn't necesarily change, joint pricing instead of competitive pricing may hurt consumers and benefit the merging firm.

[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 offer the product more often. This is what we imply when we state that the firm offers its product more often.

Finally, along with the pricing effects, mergers may generate cost synergies for merging parties. As suggested in Section 2.2, such synergies 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 mergeroffsetting any negative effects on consumer welfare.

We illustrate the significance 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 assymetry 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. We also calculate the above measures when firms are not allowed to change their product offering. Doing so allows us to observe how important allowing for product repositioning is in merger analysis.

We run three sets of simulations. In the first set we have products equally spaced out - that is, each product is the same distance from each of the other two. This allows us to see the effect of mergers when all products, those of the merging parties and those of the fringe firm, are similar substitutes to each other. In the second set we have the products of the merging firm be closer substitutes to each other than to the product of the fringe firm. This allows us to analyze the effect of a merger when the two merging parties are offering relatively similar products and there are no potential strong substitutes in the market. In the third set of simulations we model one of the products of the merging firm as being close to the product of the fringe firm, while the other product of the merging firm being a poor substitute to the other two products. This allows us to analyze the effect of a merger when the merging parties don't offer close substitutes to each other and there exists other products in the market that can rival the merging firm.

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:

$$\nabla_{\mathbf{p}} s(\mathbf{p}) = \begin{bmatrix} -1.82 & 0.43 & 0.43 \\ 0.43 & -1.82 & 0.43 \\ 0.43 & 0.43 & -1.82 \end{bmatrix} \qquad s(\mathbf{p}) = \begin{bmatrix} 0.22 \\ 0.22 \\ 0.22 \end{bmatrix} \qquad \bar{\mathbf{x}} = \begin{bmatrix} 0.88 \\ 0.88 \\ 0.88 \end{bmatrix}$$

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. The signal distribution ($H(\cdot)$) is a normal distribution. This

allows for the updated distribution $\mathcal{G}(\cdot)$ to be a censored normal distribution (for which a closed form solution is known). The use of a signal variance of 0.5 units and of a fixed cost variance of 0.07 implies the game is very close to the classical incomplete information game.

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 Equally Spaced Products (The 111 Model)

In the first set of simulations, products are always equally spaced and assumed to be symmetric in every way (i.e. fixed costs, variable costs, ...). Table 1 shows the consumer surplus and producer surplus change caused by a merger between firm A and firm B. This table contains results for both cases: when allowing firms to reposition their products (redefine their entry decisions) post merger, and when not allowing for product repositioning.

Not surprisingly, the merger induces a loss of consumer surplus, as prices are increased and products are cut back. What is surprising is the importance that product repositioning has in this loss of consumer surplus. The average number of products in the market drops by 14%. The drop in product offering mitigates the price effect as the merging party does not increase price as much when cutting back on one of the products being offered (to attract some of the consumers who previously purchased the culled product). The magnitude of this effect can be seen when contrasting the change in average market price: when allowing for product repositioning, average market price increases by a modest 2.7% after the merger. If product repositioning is not allowed, price increases almost twice as much: 4.8%.

More importantly, the reduction in the products being offered has large repercusions on consumer surplus. Consumers favor variety, and having a reduction in the offering affects their welfare. We see that consumer surplus drops by 16% post merger when allowing for product repositioning. Not allowing for repositioning results in a more modest drop of 10% in consumer surplus. This 6 point difference is driven by the reduction in the number of products being offered.

Moreover, the ability to reposition benefits the firms hugely and might be a huge driver of the merger. We see that profits for the merging parties (producer surplus) increases by 10% post merger when product repositioning is allowed, and increases by only 6.7% when repositioning is not allowed. Interestingly, the most affected firm is the fringe firm and not the merging firms. Its profits increase by 44% when allowing for repositioning. This increase in profits is drawn from increasing its market share and price, both driven from two sources: (a) conditional on the product offering, the merging firm raises price post-merger, allowing for the fringe firm to gain market share and increase its price -competition is in strategic complements-; (b) in response to the merging party reducing its product offering, the fringe firm offers its product more often.[18] Past merger analysis tends to omit this second

[18] Formally, the fringe firm increases the cutoff below which fixed costs must be to justify entry; thus increasing the probability that it will recieve a fixed cost that justifies entry and making entry more often.

Table 1: Base Simualtions

			Model 111	Model 110	Model 011
With	Repositioning	ΔCS	-16.3%	-22.4%	-9.0%
		$\Delta \bar{p}$	2.7%	4.6%	2.5%
		ΔPS_A	10.1%	49.7%	5.2%
		ΔPS_B	10.1%	49.7%	-23.5%
		ΔPS_C	43.7%	18.2%	54.5%
		N pre-merger	2.7	2.6	2.6
		ΔN	-14.3%	-22.7%	-5.8%
Without	Repositioning	ΔCS	-9.8%	-14.9%	-5.7%
		$\Delta \bar{p}$	4.8%	7.2%	2.7%
		ΔPS_A	6.7%	19.6%	1.7%
		ΔPS_B	6.7%	19.6%	3.0%
		ΔPS_C	19.1%	12.5%	13.4%

* Model 111 uses a correlation value (ρ) of zero for the base specification. Models 110 and 011 use a correlation value of 0.5 in the base specification since using a correlation of zero would result in identical results as in model 111.

effect or just mention it in passing. In this particular setting, the fringe firm more than doubles its gains in profits from allowing for repositioning (44% increase in profits compared to 19%).

The merging firm has a huge incentive to cut back on product offering when fixed costs are very large and products are close enough substitutes that the remaining product can capture a signficant portion of the market that the product being cut back was obtaining. Under what conditions are fixed costs large? We can infer that fixed costs must be large in cases where not all products are offered all the time. To the extent that products have some differentiation (cross-price elasticities are moderate) firms can always make at least some small variable profits. The only justification then for not offering the product is fixed costs that are at least as large as those variable profits. In the current setting, average fixed costs are 0.28 units[19] (cfr. Appendix) while the variable profits a firm would earn if all products were offered is 0.35 units. Thus, fixed costs represent ~80% of operating income. As a reference, WalMart's number for 2012 is 75%.[20]

4.2.1 Bringing Products Closer Together

So far we have described the effects of the merger under the assumption that products are partial substitutes for each other. How would our results be affected if products were very strong substitutes? We now vary the distance between products, to allow for products to be closer or farther apart. We continue to retain equal distance between products, though. Figure 4.1 plots the change in consumer surplus caused by the merger for different values of distance between products. The horizontal axis in these plots shows how close or far substitutes products are from each other by plotting the pre-merger cross-price elasticity[21] when all products are offered in the market. The parameter that varies across simulations is the correlation factor (ρ) in Σ_F, which translates into a cross-price elasticity.[22] Since varying ρ also changes the own-price elasticity, when plotting the cross-price elasticity we normalize it by the own-price elasticity (in absolute terms).

For low values of cross-price elasticity (when the products are highly differentiated) the merger causes consumer

[19] Fixed costs are measured relative to market size: M and μ_G are not separately identified in the entry game. Thus, profits (variable and net), fixed costs, prices, and variable costs are all referred to in terms of units.

[20] From WalMart's 5-year financial summary (http://www.walmartstores.com/sites/annual-report/2012/financials.aspx): Gross profit is 24.5% and operating profit is 6%. Thus, of total gross profit, 75% goes to operating expenses.

[21] Due to symmetry, the cross price elasticity between any two products is the same.

[22] Σ_F has the form [1 ρ ρ ; ρ 1 ρ ; ρ ρ 1]

Figure 4.1: Model 111 (Equally Spaced Products): Changes in Consumer and Producer Surplus

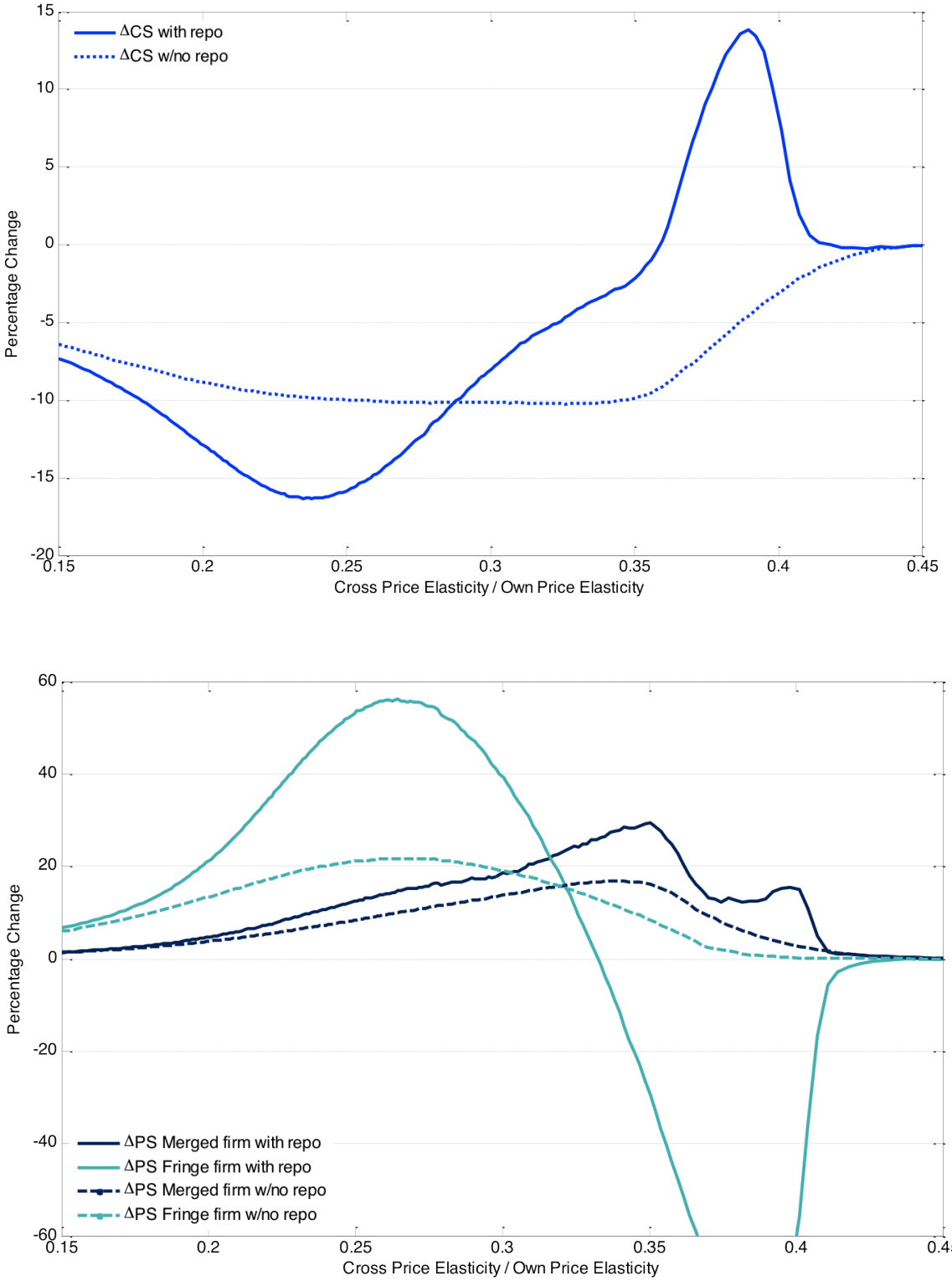
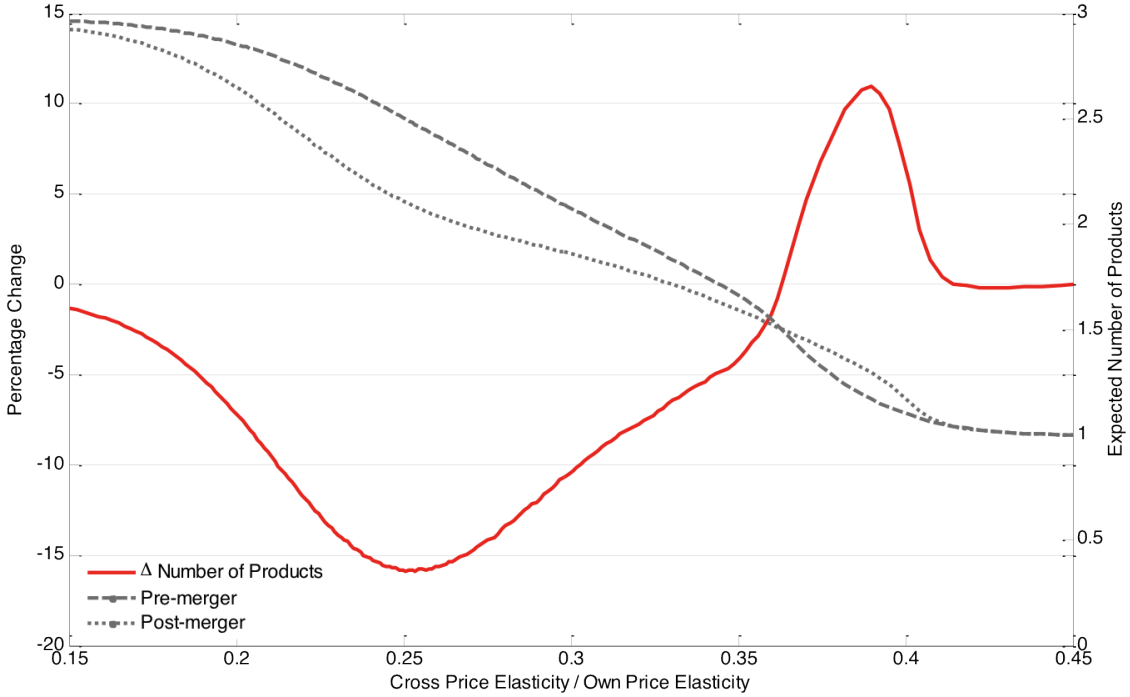


Figure 4.2: Number of Products and Change in Number of Products for Model 111



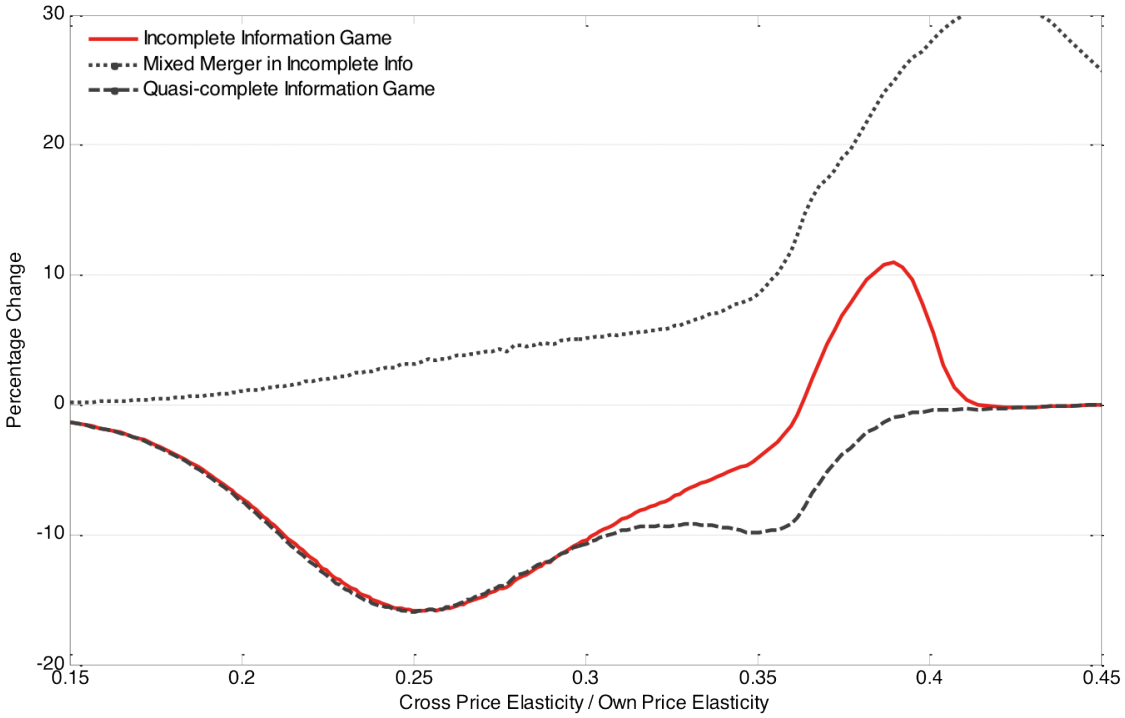
surplus to drop by only 8%. This is because products are so differentiated that they almost don't compete against each other, as if each product served a distinct market. As such, the merger changes firms' market power only slightly, so prices and offerings change little.

In markets where products are closer substitutes they compete more strongly against each other and the merging firms increase prices and reduce offering more heavily. This happens more strongly where we see the solid curve dip. Note how modeling the change in consumer surplus without allowing firms to reposition significantly underestimates the negative effects of the merger. The welfare loss without repositioning is only 10% while allowing for repositioning implies welfare losses of 18%.

As we continue to move towards the right, where products are even closer substitutes, we see the trend reverse and the drop in consumer surplus is not as strong. This is because the amount by which the merging firms cutback on product offering decreases. This is counterintuitive, as the closer products are to each other the higher the benefits from cutting back on a product: you save on the fixed cost and the remaining product absorbs most of the demand. The reason the trend reverses is that pre-merger very few products are being offered, so there isn't a lot of space to cut back on. In the extreme, when products are so close substitutes to each other that only one product fits in the market, the merging firm would never cut back on a product because it was already only offering one product to begin with. Figure 4.2 shows this in more detail.

It is surprising to see consumer surplus *increase* post-merger when products are close substitutes. This happens for normalized-cross-price elasticities of ~0.4. In these simulations we see the merging firm increase the average number of products offered post merger (Fig 4.1, second plot). This increase can arise from two causes: (a) by joint pricing, the merging party will do better whenever a mismatch happens and will thus be more willing to incur such mismatch; (b) the merger allows for the merging party to share information (on each others' fixed costs), thus

Figure 4.3: Change in Number of Products under Alternative Game Structures



improving the coordination in product offering, decreasing miss-matches, and increasing the thresholds at which the firm offers a product. Figure 4.3 disentagles these effects. It plots the change in the merging firms expected number of products, but does so under three different models: the incomplete information model described above, a quasi-complete information model where the variance in the public signal, ν_H, is set to 0.005; and a mixed merger model where firms make entry decisions as if they hadn't merged but use the variable profits under joint pricing when making these decisions. This last scenario captures the first effect described above. The second effect is captured in the differences between the incomplete and quasi-complete information games.

It is clear from figure 4.3 that the increase in product offering is from being able to mitigate the effects of miss-matched entry through joint pricing. The mixed-merger model shows a signficant increase in the number of products post merger when the cross price elasticity is ~0.4. This mixed merger model has firms decide on their entry decisions as if they hadn't merged (no firm internalizes the profitability of a rival when making its entry decision), but has firms use the duopoly variable profits (joint pricing profits) instead of the triopoly variable profits when making their entry decisions. As the merging parties can use pricing to mitigate the profit loss from mismatching after entry, they enter even when fixed costs are not as favorable.

In the quasi-complete information game, a merger never results in increased offering. This is because with complete information, there is never the risk of a mis-match: all firms know what the other firms will do.

Notice that this increase in product offering by the merging firm affects the fringe firm's profits. The fringe

firm's profitability drops post merger (fig. 4.1, second plot), contrary to what had been happening for all other values of cross-price elasticities. As the merging firm coordinates better and offers more often the best response for the fringe firm is to decrease its offering so as to decrease the probability of a mis-match, but this just induces the merging firm to offer more often. Without product repositioning, we would never observe the merger have negative effects on the fringe firm.

Finally, when products are almost homogenous (at the extreme right in the graphs), the merger has a very small effect on consumer surplus as the market can only support a single product. Allowing firms to merge will not change the number of products being offered, which is just one. Since there is only one product being offered there is no price effect either. Thus, even without product repositioning, the welfare consequences of the merger are minimal.

4.3 Merging Products are Strong Substitutes (Model 110)

We now study the effect of a merger when the fringe firm does not offer a suitable substitute to the products of the merging firms. Specifically, we assume a correlation matrix of

$$\Sigma_F = \begin{bmatrix} 1 & \rho & -\rho \\ \rho & 1 & -\rho \\ -\rho & -\rho & 1 \end{bmatrix}$$

so that a higher value for ρ implies the products of the merging firm are closer to each other and farther from that of the fringe firm. The second column in table 1 shows the results of this simulation for a correlation value (ρ) of 0.5.[23] Figure 4.4 shows selected results for the whole span of ρ.[24] As before, we express the horizontal axis in terms of the cross-price elasticity between the two products of the merging firm. Values to the far right signify the merging firms have very similar products that are radically different than those of the fringe firm. Values to the far left signify the merging firms have products that are located as far aways from each other as possible while simultaneously being near the fringe firm's product.

The graph illustrates how harmful a merger between two close substitutes can be when no fringe rival exists. We see consumer surplus loss of up to 24%, in which half of that loss arises from the merging firms increasing price significantly (ΔCS no repositioning). The other half arises from the merging firms cutting back on product offering. These effects are strongest for cross-price elasticity values of 0.3-0.6. It is in this range where the merging firms have products that are close to each other without being so close that they wouldn't be able to compete and make a profit. That is, the merger is worst for consumer surplus when the two products are as close as possible *while still being offered*.

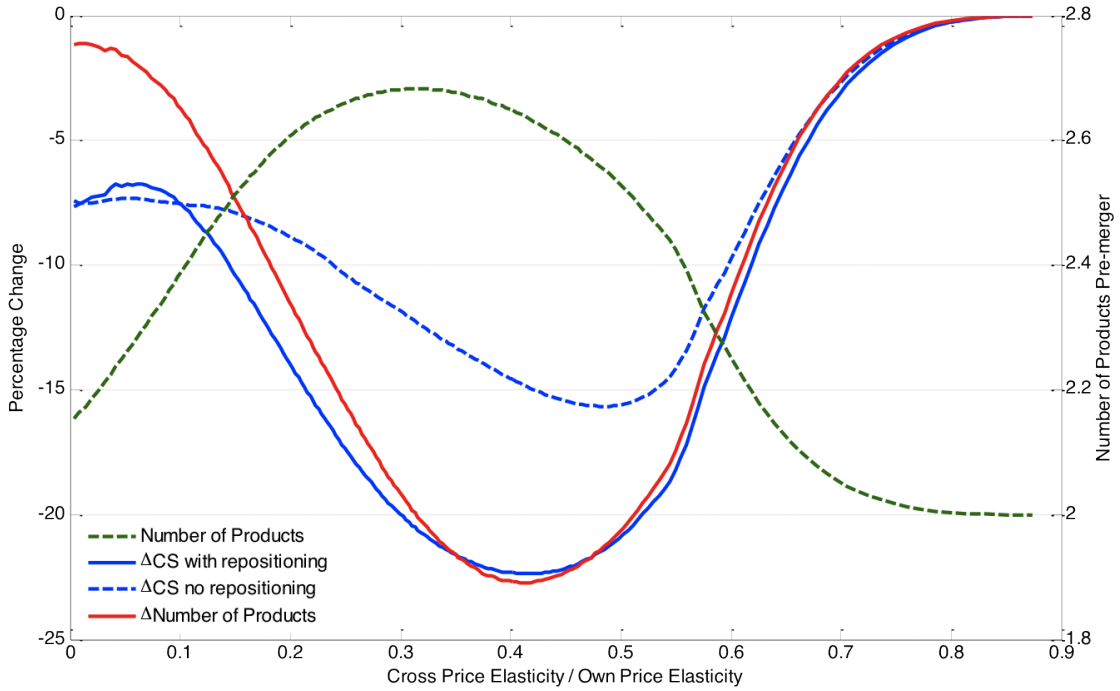
It is in this mid-range where most products are being offered pre-merger. For extremely high values of cross-price elasticity only one of the products of the merging firm is ever offered pre-merger. For extremely low values of cross-price elasticities a completely different analysis applies: the products of the merging firm are close to that of the fringe firm but far from each other. The merger results in modest increases in prices and cutbacks in product offering because the merging parties are serving quasi-different markets.

At high values of ρ, the fringe firm's product is very far away from those of the merging firms. This lack of

[23] The first column reports the results when the correlation value is 0.

[24] We vary this value from -0.5 to 1, which is the full range in which the matrix retains positive definiteness. ρ cannot take a value less than -0.5 since it would imply the products of the merging firm are far away from each other but to close to the fringe firm's product: A cannot be far away from B and close to C when B is close to C too.

Figure 4.4: Model 110 (Merging Products are Strong Substitutes)
Change in Consumer Surplus and in Number of Products



*Cross-price elasticity of product A wrt product B's price, normalized by product A's own price elasticity

a substitute to contest the merger significantly affects consumer surplus. Contrasting figure 4.4 with figure 4.1 we see anywhere between a 5% decrease to a 10% increase in consumer welfare post-merger when the fringe firm can contest it, compared to a 15-20% drop when the fringe firm cannot contest the merger. This sharp contrast highlights the importance of fringe firms in contesting mergers.

We now look at the case when the fringe firm does exist and the merger is between products that are not close substitutes.

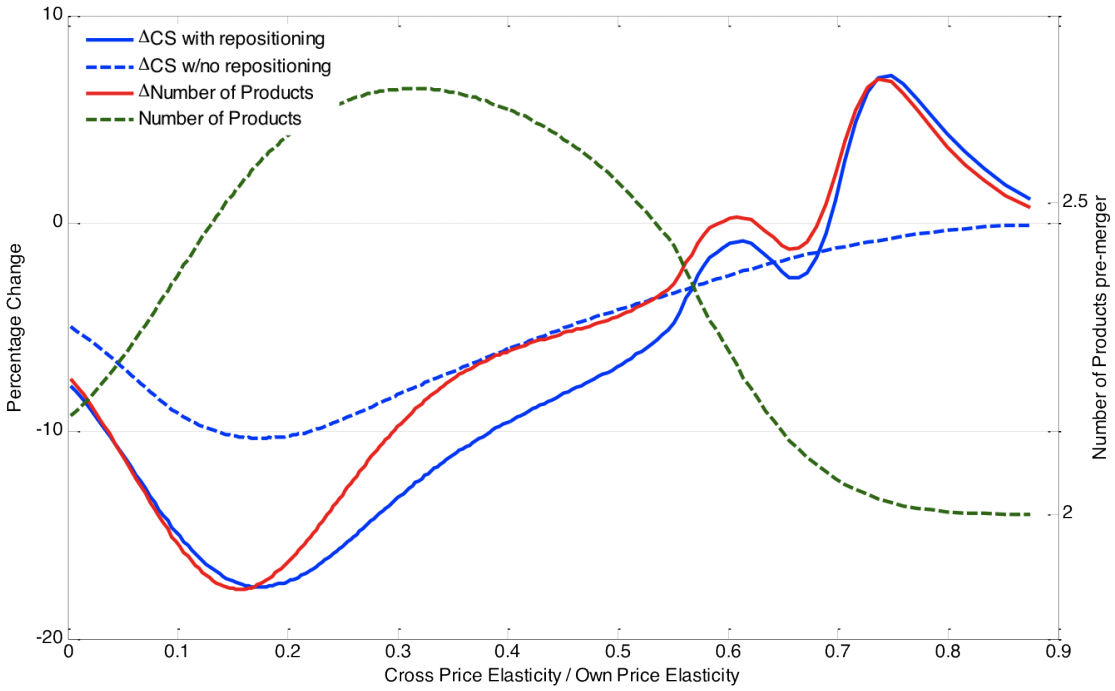
4.4 Merging Products are Weak Substitutes (Model 011)

Now the merging parties offer radically different products, while the fringe firm offers a product that is very similar to one of the products of the merging firm. Thus, we illustrate the case when the merging parties are poor substitutes to each other and there exists a fringe firm that challenges one of the merging firms. Specifically, the correlation matrix used is

$$\Sigma_F = \begin{bmatrix} 1 & -\rho & -\rho \\ -\rho & 1 & \rho \\ -\rho & \rho & 1 \end{bmatrix}$$

Column three of table 1 shows the results of this simulation for a ρ of 0.5. Figure 4.5 shows selected results for the whole span of ρ. The normalized-cross-price elasticity used for the x-axis is the elasticity that exists between products of firm B and firm C normalized by the own-price elasticity of firm B's product. Values to the far right signify that firm B's product is very close to that of the fringe firm while firm A's product is very far away.

Figure 4.5: Model 011 (Merging Products are Weak Substitutes)
Change in Consumer Surplus and in Number of Products

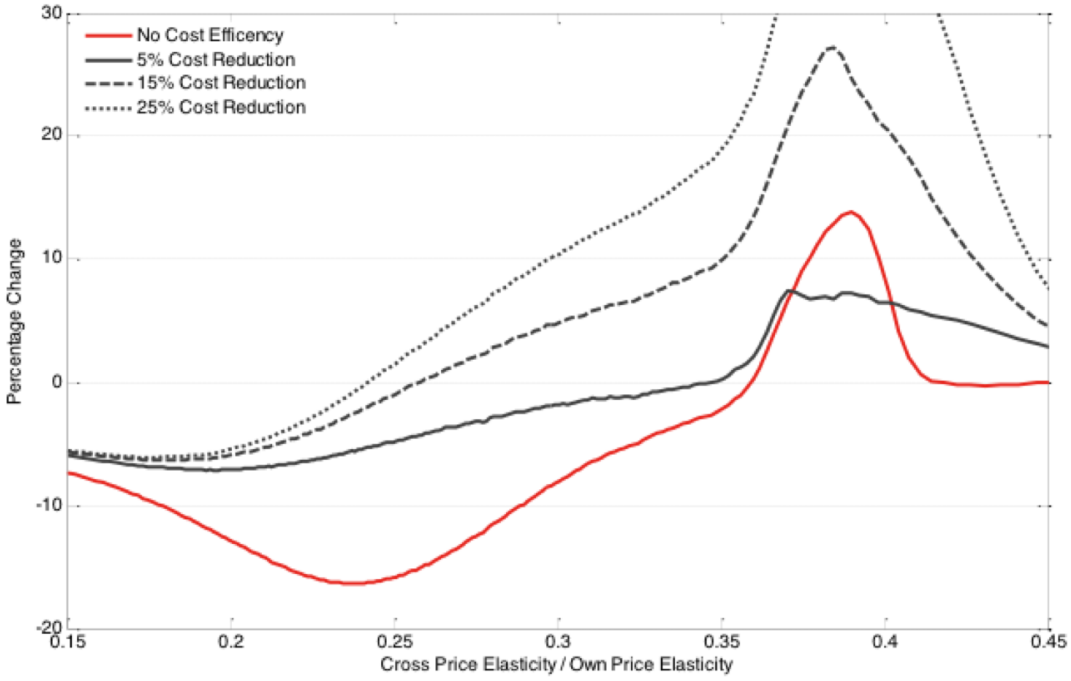


*Cross-price elasticity of product B wrt product C's price, normalized by product B's own price elasticity

The welfare consequences of the merger are more modest. The worst drop in welfare occurs at values near 0.15, which is were both products of the merging firm are actually closer to each other than to the fringe firm (the correlation factor ρ is negative for this value of cross-price elasticity). As we move to the right of the graph, in which the products of the merging parties are far from each other, we see very modest losses in consumer surplus; and for some values we even see gains. Welfare is not significantly affected from the merger because the merging parties offer highly differentiated products, thus post-merger prices do not increase significantly nor does the merging firm cutback on product offering.

It is also interesting to see how calculating the welfare loss with or without repositioning results in very similar estimates (the dotted blue line and the solid blue line are not too far apart). This is driven by the fact that the merging firm does not cutback on its offering post merger, and the price effect dominates. The merging firm does not cutback because the two forces described previously cancel each other: on one hand the merging firm would save on fixed costs from cutting back a product, on the other hand it can mitigate its losses after a mis-match and increases the cutoff on fixed costs below which it decides to enter. Because the merging products are far substitutes, both forces are modest: the firm cannot use the remaining product to recoup sales of the product it cuts back, and mis-matches will not happen too often because the products do not cannibalize significantyl each other's sales.

Figure 5.1: Change in Consumer Surplus when Mergers cause
a X% Cost Reduction for Merging Parties (Model 111)



5 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.[25] We follow a similar analysis, and show the consumer surplus change post merger for three different levels of cost efficiencies: 5%, 15%, and 25% cost reductions in fixed costs. Figure 5.1 shows these results. We use Model 111 (equally spaced products) throughout this section.

Even a modest 5% cost reduction results in substantial mitigation of the welfare loss post-merger for most values of cross-price elasticities. This is because a huge driver of consumer welfare is the number of products being offered in the market. A moderate cost efficiency induces a large increase in firms' probability of offering their products. This is mainly due to the fact that the variance in fixed costs is not large and this distribution is two-sided. Pre-merger, the probability of offering a product is neither large nor small, thus a small change in fixed costs can induce a huge change in this probability as the cutoff at which firms are using for their decision to enter or not is close to the median of the distribution. Given that the distribution has two tails, shifting the distribution down a fixed amount will move a large probability mass across this cutoff value. If the cutoff value where in the tails of the distribution, the same shift in the distribution would have a small repercusion in terms of probability mass being moved across the cutoff.

What is very interesting to note is that when products are highly differentiated, even significant drops in the cost of offering a product have a very small impact on the change in consumer surplus. This is because products are so distinct, that they are being offered regardless of the cost savings. The merger does not change the number

[25] Other work in this question is Levin (1990) and McAfee and Williams (1992)

of products offered, but does change the pricing. This becomes clear when observing the far left of figure 4.2. The cost efficiencies have the highest impact on consumer surplus when products are close substitutes without being perfect substitutes. This is in the same region where the merging firm would increase its product offering regardless of the cost efficiencies. The rationale behind having the largest effect here follows the same lines as the previous arguments. It is at these levels of cross-price elasticities that on average half of the potential products are being offered (fig. 4.2). Thus, this is when the probability of offering a product is neither large nor small, but exactly half: the cutoffs for deciding weather to offer a product or not or very close to the median of the distributions.

6 Discussion

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7 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 demostrate that post-merger repositioining can have a substantial impact on industry equilibrium, exacerbating or diminshing 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 accomodate 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 accomodate 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 varities 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.

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A Primitives of the Model

The pricing game is characterized by price coefficients (α), 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 multi-variate normal with mean $\mu_F = (1.2, 1.2, 1.2)'$. The covariance matrix, Σ_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 twenty thousand draws from a Sobol sequence.

If all products are present in the market, these primitives imply pre-merger prices of 3.32,[26] market shares of

[26] Due to symmetry, all prices, market shares, and variable profits are identical.

24.4%, variable profits of 0.35 and price elasticities of:

$$\nabla_{\mathbf{p}} s(\mathbf{p}) = \begin{bmatrix} -1.82 & 0.43 & 0.43 \\ 0.43 & -1.82 & 0.43 \\ 0.43 & 0.43 & -1.82 \end{bmatrix}$$

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.[27] 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 ten 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 $\mathcal{G}$ is 0.069 – calculated as: $\sigma_{\mathcal{G}}^2 = \left(\left(\sigma_G^2\right)^{-1} + \left(\sigma_H^2\right)^{-1}\right)^{-1}$. 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 covaraince element, ρ, is varied are drawn using two hundred distinct values of ρ, equally spaced between -0.5 and 1.

[27] This mean and standard deviation does not coincide with the μ_G and σ_G parameters of the distribution since G is a censored-normal distribution. In this particualr case, since the censoring is at zero and zero is more than two standard deviations below the mean value (0.28), μ_G and σ_G are almost identical to the mean and standard deviation values.