Cross-Market Integration and Sabotage

Completed Research Paper

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Abstract

Recent industry developments motivate the study of cross-market firm integrations, which often raises controversies and regulatory concerns due to the potential negative effects through the integrated firms’ sabotage activities. In this paper, we analyze integrations of firms in two interrelated markets that produce complementary products. Two firms compete with differentiated products in each market. A unique phenomenon arises in this setting as the integrated firm could engage in bilateral sabotage, i.e., sabotage its rival in both markets. Interestingly, we find that the integrated firm does not always engage in bilateral sabotage. Depending on market conditions, it may engage in unilateral sabotage or no sabotage at all. Our findings provide important managerial and policy implications.

Keywords: Integration, sabotage, complementary markets

Introduction

Integration is a common corporate strategy. In most prior work, integration references the notion that a downstream buyer (or an upstream supplier) considers acquiring an upstream supplier (or a downstream buyer) so as to achieve some form of competitive advantage. From a supply chain perspective, it has been well documented that such forms of vertical integration can lead to larger profits for the integrated firm as compared to the sum of profits of the non-integrated firms with the key driver of this result being the removal of the double marginalization effect. In this study, the type of integration we consider is somewhat different in the sense that we focus on firms which do not necessarily have such a supplier-buyer relationship. More specifically, we consider integration of two firms which provide distinct products/services with the eventual consumer needing to purchase the products/services offered by both firms to obtain some positive utility. This type of cross-market integration possesses two key differences from the traditional upstream-downstream vertical integration setting: First, there may not be any product or money exchange between the two markets, though technical product information may be shared across these two markets to ensure product compatibility and functionality. Second, the two products produced in the two markets are perfect complements and consumers have to purchase both products to realize any value.

There are several recent industry observations which motivate this setting for our paper. For example, Google with its Android mobile operating system entered the smart phone and tablet market through its acquisition of Motorola Mobility (Rusli and Miller 2011). Although Google recently sold its Motorola
Mobility division to Lenovo, it retained the majority of Motorola Mobility's patents (O'Toole 2014) and signed a patent deal with Samsung, the number 1 Android smartphone seller, forcing it to commit to Android and core Android apps and move away from its own TouchWiz proprietary system (Kelly 2014). Microsoft’s acquisition of Nokia strengthens the position of its mobile operating system, Windows Phone, in the smart phone and tablet market. The merger between Comcast and NBC Universal enables the largest cable operator to gain direct control over diverse contents (Arango 2009). In each case, the individual firms operate in different but related markets and the eventual consumers need to purchase the products/services offered by both firms to derive some benefit. This type of cross-market firm integration often raises controversies and regulatory concerns due to its potential negative effects such as reducing competition and social welfare. In practice, the integrated firms often shy away from direct price discrimination activities since they are too obvious and, thus, make the integration deal an easy target for objection. Instead, the main concern is that the integrated firms may pursue not so obvious non-price discrimination activities, i.e., sabotage activities, against their competitors. Recently, the European Union’s top antitrust official warned Google for potential violation of European competition law because of complaints that Google may favor its own products in its search results (Kanter 2013). Cisco challenged the European Union’s approval of Microsoft’s acquisition of Skype with the expectation that the merged firm may have the capability and the incentive to withhold data from rivals to work with its products (Chee 2013).

The focus of this paper is to examine whether firms in two markets producing complementary products have incentive to integrate when there is no obvious integration benefits such as cost savings or double marginalization elimination; and if they do integrate whether the integrated firm has incentive to sabotage its rivals. As noted above, the competing firms often suspect that the cross-market integration enables the integrated firm to sabotage the competing product offerings through non-price discrimination activities such as decreasing consumers’ valuation of rivals’ product through manipulating features and specifications of the integrated firm’s products purchased by rivals’ consumers. For instance, Comcast, an ISP that also owns contents (NBC Universal) may purposely lower the download speed of rival CBS’ contents requested by its Internet service subscribers in favor of its own contents. Google may delay release of the newest Android operating system to rival mobile device makers in favor of its own Android-based devices. Similarly, Microsoft may withhold some information about its Windows Phone system from its rival mobile device makers in favor of its Nokia devices. In these cases, since the integrated firm operates in both of the two complementary markets, the integrated firm has the capability to sabotage its rival in one market through its own product offering in the other market. We investigate whether the integrated firm will engage in bilateral sabotage (i.e., sabotage its rivals in both markets) or unilateral sabotage (i.e., only sabotage its rival in one of the two complementary markets). This research has practical implications as it helps us understand the impact of integration and sabotage on firm competition and consumer welfare.

The remainder of this paper is organized as follows. In the next section, we review two related literatures. We then present the modeling framework for analyzing the cross-market integration and sabotage. Following that we present the analytical results of the cross-market integration with and without sabotage. Finally, we conclude with describing and discussing the key insights stemming from our work.

**Literature Review**

There are two distinct literatures that are relevant for the setting that we investigate in this paper. To start with, firm integration has been studied extensively in prior work, though with inconclusive results. As noted earlier, most prior work in this area focuses on an upstream-downstream vertical integration setting, where the upstream monopolist provides an input to downstream firms. Research questions have been centered on incentives of vertical integration and the impact of such integration on input or output costs/prices, market competitiveness, and social welfare (Greenhut and Ohta 1979; Sappington 2006; Schmalensee 1973; Vernon and Graham 1971). Our work is more closely related to one stream of the vertical integration literature which focuses on incentives for sabotage by the integrated firm.

In the vertical integration context, Economides (1998) finds that an upstream input monopolist, who also operates in the downstream market engaging in Cournot competition, always has an incentive to raise downstream rivals’ costs through sabotage. Mandy (2000) builds upon the Economides (1998) model to further examine the impact of three key parameters (relative downstream efficiency, intensity of
downstream competition, and the upstream margin) on the integrated firm’s sabotage decision. He finds that the upstream monopolist may restrain from sabotage when its downstream rivals are more cost efficient and its upstream profit margin is sizable. Sibley and Weisman (1998) show that because increasing downstream rivals’ cost can benefit the integrated firm in the downstream market but can also reduce sales in the upstream market, a regulated upstream monopolist may not always prefer to sabotage its downstream rivals. They find that, contrary to common beliefs, the monopolist may prefer to lower rivals’ costs under certain market conditions. In a different setting, Beard et al. (2001) consider a dominant firm and a competitive fringe in the upstream market and two downstream firms providing differentiated products engage in Bertrand price competition. They find that incentive for vertical integration always exists but the integrated firm will sabotage the downstream rival only when there is an input price regulation in the upstream market. Our paper contributes to this literature by considering oligopolistic competition in both markets whereas prior research often focuses on an upstream monopolist integrating with one of the downstream firms. In our model, firms in each market provide differentiated products and consumers choose products based on their taste preferences whereas prior research often just considers identical output in the downstream market. In each market, we consider heterogeneous consumers in terms of their taste for the products. Modeling differentiated products enable us to look at the integration issue from a new perspective which is the incentive for the integrated firm to engage in sabotage in both markets. We study firms’ integration incentive, the integrated firm’s incentive to sabotage, its sabotage decision (unilateral or bilateral sabotage), and market conditions that may influence the integrated firm’s sabotage decision.

A second stream of work that is peripherally related to ours is that of product bundling. In general, the bundling literature typically examines a multiproduct monopoly firm’s bundling strategy and view bundling as either a price discrimination technique or a mechanism for foreclosing sales in a second market (Adams and Yellen 1976; Armstrong 1999; Fang and Norman 2006; Whinston 1990). For works that study bundling in a duopoly market, Matutes and Regibeau (1988; 1992) model two firms each produces two complementary components that are horizontally differentiated. In their model, the two firms are already integrated, and they focus on studying firms’ compatibility and pricing decisions in the first paper and the impact of firms’ bundling decisions in the second. Our paper has a similar model setting in terms of consumer preference and distribution, but we model two competing firms in each component market and focus on examining firms’ incentive of integration and engaging in sabotage after integration. Gans and King (2006) and Choi (2008) model four independent firms, two in each product market, which is similar to our model setting. The former consider two unrelated products whereas the latter considers complementary products. They both focus on the integrated firm’s bundling decision and the impact of bundling, and they both show that the integrated firm can internalize the benefit of bundled discount, which helps the integrated firm expand its market at the expense of its rivals. Our work differs from multi-firm bundling literature in that the latter takes integration as given and focuses on the integrated firm’s bundling decision whereas we specifically examine firms’ integration decision, in the absence of the bundling benefits shown in the bundling literature such as bundled discount and foreclosing sales, and study the integrated firm’s bilateral sabotage options.

We extend the above two literatures by examining firms’ incentives of integration and sabotage in a parsimonious setting in which there is no double marginalization issue, no benefit of bundling (as this option may cause further government scrutiny), and integration by itself does not provide any cost advantage or efficiency gain to the integrated firm. Under these conditions, we study if a firm in one market has incentive to integrate with a firm in the complementary market. While in this setting the integrated firm cannot directly price discriminate against its rivals, it can engage in sabotage (defined as non-price discrimination activities that reduce consumers’ valuation of rivals’ products), through delaying information sharing with its rivals, withholding its product information from its rivals, or manipulating features and specifications of its own products selected by rivals’ consumers. More specifically, our paper models duopolistic competition of differentiated products in two markets that are perfect complements. Firms in each market are asymmetric in terms of their production cost (efficient and inefficient). We study various types of cross-market integration: (efficient-efficient), (efficient-inefficient), (inefficient-efficient), (inefficient-inefficient) in the two markets. We further examine market conditions for sabotage and examine the possible incentive for the integrated firm to sabotage its rivals in both markets.
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Modeling Framework

Our stylized setting for investigating cross-market integration and sabotage is as follows. There are two perfectly complementary products A and B (e.g., mobile devices and carrier services) and consumers need to purchase both products to derive some utility. In each product market, there are two competing firms, denoted by A0 and A1 (Bo and B1), both offering product A (product B). Since products A and B are perfect complements, there are four product combination choices that consumers can choose from – A0B0, A0B1, A1B0, and A1B1.

Consumers are assumed to have a unit demand and a common gross valuation v for each unit of a product combination. Consumers are heterogeneous in terms of their preferences for individual products in a particular combination. We capture this consumer heterogeneity using a two-dimensional Hotelling model. In each market, we use a unit line to represent the relative distance between the two competing products, with A0(Bo) at point 0 and A1(B1) at point 1, and we assume that consumers are uniformly distributed along the unit line and incur a unit misfit cost t. Hence, consumers’ preferences for products A and B can be specified as a uniform distribution on a unit square. Each firm (indexed by ij for i = A, B and j = 0, 1) incurs a variable production cost of cij and charges a price pij. The following two assumptions describe the characteristics of the two markets and the two firms in each market.

**Assumption 1:** cA0 ≤ cA1 and cB0 ≤ cB1.

Assumption 1 states that the two firms in each market are asymmetric in terms of their production costs. Using a unit line to represent the relative distance between the two competing firms, we denote the lower-cost (efficient) firm at point 0 and the higher-cost (inefficient) firm at point 1. This assumption is of course, without loss of generality for the no integration analysis. For the analysis with integration, this assumption does not limit our model since we analyze all four possible integration scenarios: A0-B0 (efficient-efficient), A0-B1 (efficient-inefficient), A1-B0 (inefficient-efficient), and A1-B1 (inefficient-inefficient).

We define the cost difference in each market as ΔcA and ΔcB, where ΔcA = cA1 - cA0 and ΔcB = cB1 - cB0. In order to focus on analyzing the impact of the cost efficiency asymmetry, we consider that the two product markets have the same degree of cost efficiency asymmetry, i.e., ΔcA = ΔcB = Δc.

**Assumption 2:** Δc < 3t.

This is a technical assumption to ensure that all product combinations have positive market share in equilibrium in the no integration case. This assumption implies that in the no integration case the inefficient firm A1(B1) is always able to serve some loyal customers who prefer its product, i.e., the inefficient firm A1(B1) will not be forced out of the market.

In addition, following prior studies using Hotelling models, we assume that consumers’ common gross valuation v is high enough such that the market is fully covered, i.e., all customers will purchase one of the four product combinations. Focusing on the full market coverage case enables us to eliminate the market expansion effect on firms’ integration and sabotage decisions and, thus, focus on the competition effect.

When there is no integration, let uA0B0(x, y), uA0B1(x, y), uA1B0(x, y), and uA1B1(x, y) represent the net utilities that a consumer located at (x, y) derives from the four possible product combinations. The demand for the four product combinations is dA0B0, dA0B1, dA1B0, and dA1B1. The corresponding demand for each firm is dA0 = dA0B0 + dA0B1, dA1 = dA1B0 + dA1B1, dB0 = dA0B0 + dA1B0, and dB1 = dA0B1 + dA1B1. Each firm chooses its product price pij to maximize its own profit πij = (pij - cij)dij.

We use the case of no integration as our benchmark setting, which is characterized as follows. For a representative consumer (x, y), the net utilities for the four product combinations are as follows:

\[
\begin{align*}
  u_{A0B0}(x, y) &= v - tx - ty - p_{A0} - p_{B0} \\
  u_{A0B1}(x, y) &= v - tx - t(1 - y) - p_{A0} - p_{B1} \\
  u_{A1B0}(x, y) &= v - t(1 - x) - ty - p_{A1} - p_{B0} \\
  u_{A1B1}(x, y) &= v - t(1 - x) - t(1 - y) - p_{A1} - p_{B1}
\end{align*}
\]
Consumer \((x, y)\) evaluates all four product combinations and chooses the one that generates the highest net utility. In order to specify the choice among the four possible purchase alternatives for each consumer, we first define:

\[
\hat{x} = \frac{1}{2} + \frac{p_{A1} - p_{A0}}{2t}, \\
\hat{y} = \frac{1}{2} + \frac{p_{B1} - p_{B0}}{2t}
\]

and as shown in Figure 1, the resulting demand for each product combination is \(d_{A0B0} = \hat{x}\hat{y}, d_{A1B0} = (1 - \hat{x})\hat{y}, d_{A0B1} = \hat{x}(1 - \hat{y}), \) and \(d_{A1B1} = (1 - \hat{x})(1 - \hat{y})\).

![Figure 1: Demands with No Integration](image)

The demand for each firm is \(d_{A0} = d_{A0B0} + d_{A0B1} = \hat{x}, d_{A1} = d_{A1B0} + d_{A1B1} = 1 - \hat{x}, d_{B0} = d_{A0B0} + d_{A1B0} = \hat{y}, \) and \(d_{B1} = d_{A0B1} + d_{A1B1} = 1 - \hat{y}\). Each firm chooses its price \(p_j\) to maximize its profit \(\pi_j = (p_j - c_j)d_j\) and this leads to the results stated in Proposition 1.

**Proposition 1:** Under the no integration setting, the equilibrium prices for each firm are \(p_{A0} = t + \frac{2c_{A0} + c_{A1}}{3}, \quad p_{A1} = t + \frac{c_{A0} + 2c_{A1}}{3}, \quad p_{B0} = t + \frac{2c_{B0} + c_{B1}}{3}, \quad p_{B1} = t + \frac{c_{B0} + 2c_{B1}}{3}\). The corresponding firm profits are \(\pi_{A0} = \pi_{B0} = \frac{(3t + \Delta c)^2}{18t}\) and \(\pi_{A1} = \pi_{B1} = \frac{(3t - \Delta c)^2}{18t}\).

Detailed proof is provided in Appendix A.

Proposition 1 indicates that a firm’s price increases in its own marginal cost and its rival’s marginal cost. In each market, since the low-cost firm (A0 or Bo) is more efficient, in equilibrium it charges a lower price, gains a higher market share, and realizes a higher profit. Furthermore, the low-cost firm’s profit increases in the cost difference between the two firms while the high-cost firm’s profit decreases in the cost difference. Parameter \(t\) represents consumers’ unit misfit cost in each market. Hence it indicates the level of product differentiation in each market. Given that consumer valuation is relatively high, when products offered by firms A0 and A1 (B0 and B1) in the product A (B) market are more differentiated, price competition is relaxed. As shown in Proposition 1, firms’ prices and profits increase in the product differentiation parameter. Given this benchmark result, in the next section, we proceed to evaluate the integration with and without sabotage scenarios.

**Integration and Sabotage**

Given that we focus on cross-market integration, we only consider cases where a firm in market A integrates with a firm in market B. Since the relative locations of firms are based on cost, the four specific...
possibilities we examine can be labeled as: (a) Efficient-Efficient (EE) integration (i.e., A0-B0); (b) Efficient-Inefficient (EI) integration (i.e., A0-B1); (c) Inefficient-Efficient (IE) integration (A1-B0); and (d) Inefficient-Inefficient (II) integration (i.e., A1-B1). For these integration scenarios, we use identical notations as in the benchmark (no integration) case, except that all lowercase letters are replaced by uppercase letters. We first examine firms’ incentives of integration and sabotage when they engage in the simultaneous pricing game and then explore their incentives in the Stackelberg pricing game.

**Simultaneous Pricing Game**

In this subsection, we only show the analysis of the Efficient-Efficient (A0-B0) integration as the analyses and results of other scenarios are qualitatively the same. For a representative consumer \((x, y)\), the net utilities for the four product combinations are as follows:

\[
\begin{align*}
U_{A0B0}(x, y) &= v - tx - ty - P_{A0} - P_{B0} \\
U_{A0B1}(x, y) &= v - tx - t(1 - y) - P_{A0} - P_{B1} \\
U_{A1B0}(x, y) &= v - t(1 - x) - ty - P_{A1} - P_{B0} \\
U_{A1B1}(x, y) &= v - t(1 - x) - t(1 - y) - P_{A1} - P_{B1}
\end{align*}
\]

The resulting demand for each product combination is

\[
\begin{align*}
D_{A0B0} &= \tilde{x} \tilde{y} \\
D_{A0B1} &= (1 - \tilde{x}) \tilde{y} \\
D_{A1B0} &= \tilde{x}(1 - \tilde{y}) \\
D_{A1B1} &= (1 - \tilde{x})(1 - \tilde{y})
\end{align*}
\]

where \(\tilde{x} = \frac{1}{2} + \frac{P_{A1} - P_{A0}}{2x}\) and \(\tilde{y} = \frac{1}{2} + \frac{P_{B1} - P_{B0}}{2y}\). Suppose firms A0 and B0 integrate and the integrated firm competes with independent firms A1 and B1 in a simultaneous pricing game. The profit functions for the integrated and independent firms are as follows:

\[
\begin{align*}
\Pi_{A0-B0} &= (P_{A0} - c_{A0})(D_{A0B0} + D_{A0B1}) + (P_{B0} - c_{B0})(D_{A0B0} + D_{A1B0}) \\
\Pi_{A1} &= (P_{A1} - c_{A1})(D_{A1B0} + D_{A1B1}) \\
\Pi_{B1} &= (P_{B1} - c_{B1})(D_{A0B1} + D_{A1B1})
\end{align*}
\]

Given the parsimonious setting of the model, the integrated firm’s optimal pricing decisions are the same as that when they operate independently. That means, if the integrated firm engages in a simultaneous pricing game with its competitors, there is no benefit or incentive to integrate. This result holds for all four integration scenarios and is somewhat expected since our model eliminates some known benefits of integration such as price discrimination, bundling discount, and cost advantage. Next, we check whether integration is beneficial if the integrated firm can sabotage its rivals in both markets.

Suppose firms A0 and B0 integrate and they can sabotage its rivals in both the A and B markets. After the integrated firm makes its sabotage decision, it competes with A1 and B1 in a simultaneous pricing game. Using backward induction, we first solve firms’ optimal prices simultaneously with the sabotage levels as given, and then solve the integrated firm’s optimal sabotage levels. We find that the integrated firm’s profit function decreases in \(s_A\) and \(s_B\). Thus, we conclude that if A0 and B0 integrate and engage in a simultaneous pricing game with its rivals, the integrated firm has no incentive to sabotage in either market. Next, we investigate whether firms have incentive to integrate and sabotage if they engage in a Stackelberg pricing game.

**Stackelberg Pricing Game**

When two firms decide to integrate, they usually work out the deal in secret. Thus, they can adjust their pricing strategy anticipating rivals’ price moves before publicly announcing the integration deal. Hence the integrated firms often have the upper hand in the price competition. Our analysis in this section therefore focuses on the integrated firm being a Stackelberg leader. The integrated firm sets its prices and sabotage levels first and then the independent firms respond by setting their own prices. Using this Stackelberg setting, we proceed to characterize the impact of integration with or without sabotage in the next two subsections.
Integration and No Sabotage

In this subsection, we study the integration without sabotage scenario. For a representative consumer \((x,y)\), the net utilities for the four product combinations are as follows:

\[
U_{AoBo}(x,y) = v - tx - ty - P_{Ao} - P_{Bo}
\]

\[
U_{AoBi}(x,y) = v - tx - t(1 - y) - P_{Ao} - P_{B1}
\]

\[
U_{AiBo}(x,y) = v - t(1 - x) - ty - P_{Ai} - P_{Bo}
\]

\[
U_{AiBi}(x,y) = v - t(1 - x) - t(1 - y) - P_{Ai} - P_{B1}
\]

The resulting demand for each product combination is \(D_{AoBo} = \tilde{x} \tilde{y}, D_{AiBo} = (1 - \tilde{x}) \tilde{y}, D_{AoB1} = \tilde{x}(1 - \tilde{y}),\) and \(D_{AiB1} = (1 - \tilde{x})(1 - \tilde{y})\), where \(\tilde{x} = \frac{1}{2} + \frac{P_{Ai} - P_{Ao}}{2t}\) and \(\tilde{y} = \frac{1}{2} + \frac{P_{B1} - P_{Bo}}{2t}\). In the Ao-Bo integration scenario, in the first stage, the integrated firm chooses its prices \(P_{Ao}\) and \(P_{Bo}\) to maximize its profit \(\Pi_{Ao-Bo} = (P_{Ao} - c_{Ao})(D_{AoBo} + D_{AoB1}) + (P_{Bo} - c_{Bo})(D_{BoBo} + D_{BoB1})\). In the second stage, independent firm A1 chooses its price \(P_{A1}\) to maximize profit \(\Pi_{A1} = (P_{A1} - c_{A1})(D_{A1Bo} + D_{A1B1})\) and independent firm B1 chooses its price \(P_{B1}\) to maximize profit \(\Pi_{B1} = (P_{B1} - c_{B1})(D_{B1Bo} + D_{B1B1})\). For each of the four integration scenarios, key results are summarized in Proposition 2.

**Proposition 2:** With integration but no sabotage, the equilibrium prices and the corresponding profits for each firm under each integration possibility are:

i. Ao-Bo Integration: \(P_{Ao} = \frac{c_{Ao} + c_{A1} + 3t}{2}, P_{Al} = \frac{c_{Ao} + 3c_{A1} + 5t}{4}, P_{Bo} = \frac{c_{Bo} + c_{B1} + 3t}{2},\) and \(P_{B1} = \frac{c_{Bo} + 3c_{B1} + 5t}{4}, \Pi_{Al} = \frac{(3t + \Delta c)^2}{8t}, \Pi_{Ao} = \Pi_{B1} = \frac{(5t - \Delta c)^2}{24t} \)

ii. A0-B1 Integration: \(P_{Al} = \frac{c_{Ao} + c_{A1} + 3t}{2}, P_{Ao} = \frac{c_{Ao} + 3c_{A1} + 5t}{4}, P_{Bo} = \frac{3c_{Bo} + c_{B1} + 5t}{4},\) and \(P_{B1} = \frac{c_{Bo} + 3c_{B1} + 5t}{2}, \Pi_{Al} = \frac{\Delta c^2 + 9t^2}{8t}, \Pi_{Ao} = \Pi_{B1} = \frac{(5t + \Delta c)^2}{32t} \)

iii. A1-Bo Integration: \(P_{A0} = \frac{3c_{Ao} + c_{A1} + 5t}{2}, P_{Al} = \frac{c_{Ao} + 3c_{A1} + 3t}{2}, P_{Bo} = \frac{c_{Bo} + c_{B1} + 3t}{4},\) and \(P_{B1} = \frac{c_{Bo} + 3c_{B1} + 5t}{4}, \Pi_{A0} = \Pi_{B1} = \frac{\Delta c^2 + 9t^2}{8t}, \Pi_{Al} = \frac{(5t + \Delta c)^2}{32t} \)

iv. A1-B1 Integration: \(P_{A0} = \frac{3c_{Ao} + c_{A1} + 5t}{4}, P_{Al} = \frac{c_{Ao} + 3c_{A1} + 3t}{2}, P_{Bo} = \frac{c_{Bo} + 3c_{B1} + 5t}{4},\) and \(P_{B1} = \frac{c_{Bo} + 3c_{B1} + 5t}{2}, \Pi_{A0} = \Pi_{B1} = \frac{(3t + \Delta c)^2}{8t} \)

Detailed proofs are provided in Appendix B.

As would be expected, given the Stackelberg setting, the first mover (i.e., the integrated firm) will charge a higher price and earn a higher profit than in the no integration case. In each scenario, the integrated firm as the first mover charges a higher price in both markets and in response the followers (independent firms) also increase their prices compared to the no integration case. However, the relative price increase for the followers is less than that for the leader. Overall, the intensity of price competition in each market changes when two firms integrate depending on the relative efficiency of the integrated firm. Specifically, if the cost-efficient firm in one market integrates, the price difference in that market decreases, while if the cost-inefficient firm in one market integrates, the price difference in that market increases. In all four scenarios, not only is the total profit of the integrated firm higher than that before integration, the independent firms also can realize a higher profit. Thus, if the integrated firm can act as the price leader and engage in a Stackelberg pricing game with other firms, there is always incentive for integration in all four possible integration scenarios and consumers end up paying higher prices after integration. In the next subsection, we study the case when the integrated firm makes both the pricing decisions and the sabotage decisions as a Stackelberg leader.

Integration and Sabotage

We consider the case when the integrated firm may engage in sabotage by reducing the consumers’ valuation for the product combinations consist of one independent firm’s product and one of the integrated firm’s own offerings. Since the analysis for each integration scenario is similar, we only provide
details of the case where firms A0 and B0 (i.e., EE) integrate. In this case, the integrated firm sabotages the product offerings of each of the two independent firms by reducing consumers’ valuations for these firms’ products. As a result, consumers’ valuation becomes \( v - s_A \) for the product combination A1B0 and \( v - s_B \) for A0B1. For a representative consumer \((x, y)\), the net utilities for the four product combinations are:

\[
U_{A0B0}(x, y) = v - tx - ty - P_{A0} - P_{B0} \\
U_{A0B1}(x, y) = v - s_B - tx - t(1 - y) - P_{A0} - P_{B1} \\
U_{A1B0}(x, y) = v - s_A - t(1 - x) - ty - P_{A1} - P_{B0} \\
U_{A1B1}(x, y) = v - t(1 - x) - t(1 - y) - P_{A1} - P_{B1}
\]

As indicated in the above utility functions, the integrated firm (A0-B0) has the capability to costlessly sabotage its rival A1 in the market of product A, denoted by \( s_A \), by reducing consumers’ valuation for product combination A1B0 through its own offering of product B0. Similarly, the integrated firm also has the capability to costlessly sabotage its rival B1 in the market of product B, denoted by \( s_B \), by reducing consumers’ valuation for product combination A0B1 through its own offering of product A0.

In order to specify the choice between the four possible purchase alternatives for each consumer, we first define:

\[
x_{B0} = \frac{1}{2} + \frac{P_{A1} - P_{A0} + s_A}{2t} \\
x_{B1} = \frac{1}{2} + \frac{P_{A1} - P_{A0} - s_B}{2t} \\
y_{A0} = \frac{1}{2} + \frac{P_{B1} - P_{B0} + s_B}{2t} \\
y_{A1} = \frac{1}{2} + \frac{P_{B1} - P_{B0} - s_A}{2t}
\]

The resulting demand for each product combination is shown in Figure 2a and the demand for each product combination is \( D_{A0B0} = x_{B0}y_{A0} - \frac{(x_{B0} - x_{B1})(y_{A0} - y_{A1})}{2} \), \( D_{A0B1} = x_{B1}(1 - y_{A0}) \), \( D_{A1B0} = (1 - x_{B0})y_{A1} \), and \( D_{A1B1} = (1 - x_{B1})(1 - y_{A1}) - \frac{(x_{B0} - x_{B1})(y_{A0} - y_{A1})}{2} \). Assuming the same Stackelberg setting as before, in the first stage, the integrated firm is the leader and chooses its non-negative product prices \((P_{A0} \text{ and } P_{B0})\) and non-negative sabotage levels \((s_A \text{ and } s_B)\) to maximize its own profit \( \Pi_{A0-B0} = (P_{A0} - c_{A0})(D_{A0B0} + D_{A0B1}) + (P_{B0} - c_{B0})(D_{A0B0} + D_{A0B1}) \) subject to \( 0 \leq x_{B1} \leq x_{B0} \leq 1 \) and \( 0 \leq y_{A1} \leq y_{A0} \leq 1 \). Subsequently, independent firm A1 sets its price \( P_{A1} \) to maximize profits \( \Pi_{A1} = (P_{A1} - c_{A1})(D_{A1B0} + D_{A1B1}) \) and independent firm B1 sets its price \( P_{B1} \) to maximize profits \( \Pi_{B1} = (P_{B1} - c_{B1})(D_{A0B1} + D_{A1B1}) \).

In the A0-B0 integration scenario (Figure 2a), the integrated firm may choose to sabotage the A1B0 combination by adjusting features of its product B0 so that consumer valuation for the A1B0 combination is reduced by \( s_A \). As illustrated in Figure 2a, sabotaging market A has an interesting countervailing effect. Specifically, sabotaging the A1B0 combination increases the demand for the A0B0 combination and thus, the integrated firm can sell more A0. However, simultaneously the A1B1 combination becomes less attractive, and hence, some consumers who prefer A1 will choose A1B1 instead. Thus, the integrated firm will sell less of product B0 due to its own sabotage activity. Another interesting observation is that sabotaging in both markets through \( s_A \) and \( s_B \) inevitably increases the market share of the independent product combination A1B1.
Cross-Market Integration and Sabotage

For each of the other integration scenarios (i.e., A0-B1, A1-B0, and A1-B1), we follow a similar process and based on the demands for each product combination for each possibility shown in Figures 2b through 2d, we formulate the profit maximization problems for each case. The product combination demand curves in Figures 2b-2d show similar effects.

Proposition 3 summarizes the integrated firm’s pricing and sabotage decisions.

**Proposition 3**: When two firms in two interrelated markets that produce perfect complements integrate, the integrated firm may have the incentive to sabotage in all four integration scenarios. Specifically, in the Ao-Bo integration scenario,

i. If $\Delta c \geq C_1(t)$, then the integrated firm will engage in severe bilateral sabotage and product combinations A1B0 and AoB1 will be driven out of the market, i.e., $s_A = s_B > 0$ with $x_{B0} = y_{A0} = 1$;

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1 Solution procedures for all four integration scenarios are similar. The Ao-Bo integration scenario generates four possible optimal sabotage solutions, whereas only some of these possible sabotage forms are optimal in the other integrations scenarios. Thus, we only present the sabotage results for the Ao-Bo integration scenario.
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ii. If $C_2(t) \leq \Delta c < C_1(t)$, then the integrated firm will engage in severe unilateral sabotage and either product combination $A_1B_0$ or $A_0B_1$ will be driven out of the market, i.e., $s_A > s_B = 0$ with $x_{B0} = 1$, or $s_B > s_A = 0$ with $y_{A0} = 1$;

iii. If $C_3(t) \leq \Delta c < C_2(t)$, then the integrated firm will engage in moderate unilateral sabotage, i.e., $s_A > s_B = 0$ or $s_B > s_A = 0$ and all four product combinations have positive market share;

iv. If $\Delta c < C_3(t)$, then $s_A = s_B = 0$, i.e., the integrated firm will not sabotage.

Detailed proof is provided in Appendix C.

Proposition 3 shows that when $A_0$ and $B_0$ integrate, the integrated firm does have incentive to sabotage its rivals when the cost efficiency asymmetry is sufficiently high relative to the fit cost. There are four possible sabotage outcomes depending on market conditions characterized by the relative magnitude of the cost efficiency asymmetry and the fit cost. When the two markets are extremely asymmetric in terms of the two competing firms’ cost efficiency, i.e., $\Delta c \geq C_i(t)$, the integrated firm will sabotage in both markets and force both product combos $A_1B_0$ and $A_0B_1$ out of the market. When the degree of cost efficiency asymmetry is less extreme but still high, i.e., $C_2(t) \leq \Delta c < C_1(t)$, the integrated firm will sabotage only one market and only force one product combination out of the market. When the two markets are moderately asymmetric in terms of the two competing firms’ cost efficiency, i.e., $C_3(t) \leq \Delta c < C_2(t)$, the integrated firm will engage in moderate sabotage in only one market and none of the product combos will be driven out of the market. Finally, when the degree of cost efficiency asymmetry is low, the integrated firm does not have incentive to sabotage.

Interestingly, we find that even though the integrated firm can costlessly sabotage in both markets, it does not always engage in bilateral sabotage. Under certain conditions, the integrated firm will only engage in unilateral sabotage, i.e., only sabotage in one market, due to the countervailing effect of sabotage illustrated in Figure 2. The countervailing effect of sabotage indicates that the impact of sabotage is a double-edged sword and has both positive and negative effects on the integrated firm’s profit. In the scenario of $A_0$-$B_0$ integration, the integrated firm has the options to increase the sales of $A_0$ by sabotaging $A_1$ through $B_0$ and to increase the sales of $B_0$ by sabotaging $B_1$ through $A_0$. However, sabotaging $A_1$ inevitably hurts the sales of $B_0$ among consumers who favor $A_1$ and similarly, sabotaging $B_1$ hurts the sales of $A_0$ among consumers who favor $B_1$. The integrated firm balances the tradeoffs of the two countervailing effects of sabotage and chooses bilateral sabotage, unilateral sabotage, or no sabotage at all.

Discussions and Conclusions

This paper studies the incentive of cross-market integration and sabotage by firms operating in two markets of perfect complements. We analytically show that even if the integrated firm has the capability to costlessly sabotage in both markets, it may only sabotage in one market or not sabotage at all. This is because the integrated firm competes in both markets and sabotaging its rival in one market can help increase the integrated firm’s sales in that market but at the same time reduce its sales in the complementary market. In the end, sabotage in only one market may be profitable. The integrated firm’s sabotage decision critically depends on the relative magnitude of the cost efficiency asymmetry and the fit cost.

These findings have important managerial and policy implications. We find that firms in markets of perfect complements may still have incentive to integrate and sabotage, even in the absence of gains from removing double marginalization and improving efficiency. The integrated firm’s bilateral or unilateral sabotage behavior may be detrimental to social welfare and therefore require regulatory intervention.

References


Appendix A: Proof of Proposition 1

Since \( \frac{\partial^2 \pi_{A0}}{\partial p^2_{A0}} = \frac{\partial^2 \pi_{A1}}{\partial p^2_{A1}} = \frac{\partial^2 \pi_{B0}}{\partial p^2_{B0}} = \frac{\partial^2 \pi_{B1}}{\partial p^2_{B1}} = -\frac{1}{t} < 0 \), we can solve the equilibrium prices by solving the first-order conditions (FOCs). The resulting prices are \( p_{A0} = t + \frac{2c_{A0} + c_{A1}}{3} \), \( p_{A1} = t + \frac{c_{A0} + 2c_{A1}}{3} \), \( p_{B0} = t + \frac{2c_{B0} + c_{B1}}{3} \), and \( p_{B1} = t + \frac{c_{B0} + 2c_{B1}}{3} \). As a result, \( \hat{x} = \hat{y} = \frac{3t + 4c}{6t} \). The corresponding demands are \( d_{A0} = d_{B0} = \frac{3t + 4c}{6t} \) and \( d_{A1} = d_{B1} = \frac{3t - 4c}{6t} \). Therefore, firms’ profits are \( \pi_{A0} = \pi_{B0} = \frac{(3t + 4c)^2}{18t} \) and \( \pi_{A1} = \pi_{B1} = \frac{(3t - 4c)^2}{18t} \).

Appendix B: Proof of Proposition 2

The integrated firm acts as the market leader and decide its prices first, anticipating rival firms’ price responses. We consider all four possible integration scenarios and solve the game in each case using backward induction. Since the solution procedures are similar for the four integration scenarios, here we only show the proof for the Ao-Bo integration scenario.

In the Ao-Bo integration with no sabotage case, the integrated firm will take into consideration rivals’ prices \( p_{A1} \) and \( p_{B1} \) as it makes its own pricing decisions \( p_{A0} \) and \( p_{B0} \). Thus, by backward induction, it will first derive rivals’ equilibrium prices, with \( p_{A0} \) and \( p_{B0} \) as given, and then substitute rivals’ prices back into its own profit function to solve for the optimal prices.

For the rival firms, since \( \frac{\partial^2 \pi_{A1}}{\partial p^2_{A1}} = \frac{\partial^2 \pi_{B1}}{\partial p^2_{B1}} = -\frac{1}{t} < 0 \), their prices can be derived by solving the two FOCs, which yield \( p_{A1} = \frac{c_{A0} + c_{A1} + 3t}{2} \) and \( p_{B1} = \frac{c_{B0} + c_{B1} + 3t}{2} \). Substituting these prices into the integrated firm’s profit function yields \( \frac{\partial^2 \pi_{A0}}{\partial p^2_{A0}} = \frac{\partial^2 \pi_{B0}}{\partial p^2_{B0}} = -\frac{1}{2t} < 0 \). Thus, we can derive \( p_{A0} \) and \( p_{B0} \) by solving the two FOCs, which yield \( p_{A0} = \frac{c_{A0} + c_{A1} + 3t}{2} \) and \( p_{B0} = \frac{c_{B0} + c_{B1} + 3t}{2} \). Accordingly, we can derive the equilibrium prices for \( A_1 \) and \( B_1 \) as \( p_{A1} = \frac{c_{A0} + c_{A1} + 5t}{4} \) and \( p_{B1} = \frac{c_{B0} + c_{B1} + 5t}{4} \). Taking the equilibrium prices back into the corresponding profit functions yields the result in Proposition 2 (i).

Similarly, we can derive the results for Proposition 2 (ii) to (iv).

Appendix C: Proof of Proposition 3

The integrated firm acts as the market leader and decide its prices and sabotage levels first, anticipating rival firms’ price responses. Since the solution procedures are similar for the four integration scenarios, here we only show the proof for the Ao-Bo integration scenario.

In the Ao-Bo integration with sabotage case, the integrated firm will take into consideration rivals’ prices \( p_{A1} \) and \( p_{B1} \) as it makes its own pricing and sabotage decisions. Thus, by backward induction, it will first derive rivals’ equilibrium prices, with \( p_{A0}, p_{B0} \), \( s_A \) and \( s_B \) as given, and then substitute rivals’ prices back into its own profit function to solve for the optimal prices and sabotage levels.
Because firm A1’s (B1’s) profit function is concave in its own price, solving the two FOCs jointly yields the equilibrium prices \( P_{A1} = \frac{(s_A-s_B)(s_A+s_B)^2+2t(s_A+s_B)(s_A-s_B)+4t^2(s_A-s_B)}{2(4t+s_A+s_B)} \) and \( P_{B1} = \frac{(s_B-s_A)(s_A+s_B)^2+2t(s_A+s_B)(s_B-A1-s_B)+4t^2(s_B-A1-s_B)}{2(4t+s_A+s_B)} \).

Substituting \( P_{A1} \) and \( P_{B1} \) back into the integrated firm’s profit, we have \( \frac{\partial^2 \Pi}{\partial P_{A0} \partial P_{B0}} = \frac{\partial^2 \Pi}{\partial P_{A0} \partial P_{B0}} - \frac{1}{t} + \frac{8t}{16t^2-(s_A+s_B)^2} < 0 \).

Thus, by solving the two FOCs we get the optimal prices \( P_{A0} = \frac{1}{4} \left[ 2(c_{A0} + c_{A1} - s_B) + 6t - \frac{(s_A+s_B)^2}{s_A+s_B+2t} \right] \) and \( P_{B0} = \frac{1}{4} \left[ 2(c_{B0} + c_{B1} - s_A) + 6t + \frac{(s_A+s_B)^2}{s_A+s_B+2t} \right] \).

Substituting all four prices \( P_{A0}, P_{B0}, P_{A1}, \) and \( P_{B1} \), back into the integrated firm’s profit yields \( \Pi(s_A, s_B) = \frac{16t^3[(s_A-s_B)^2+4(3t+\Delta c)]^2+4t^2(s_A+s_B)(s_A-s_B)^2+4(3t+\Delta c)(5t+3s_A)|-4t(s_A+s_B)^2|(s_A-s_B)^2+4(2t+\Delta c)^2}\), \( s_A > s_B = 0 \) or \( s_B = s_A > 0 \) and \( s_A \) solves the equation \( x_{B0} = y_{A0} = \frac{2s^3+8s^2t+2t(3t+\Delta c)+3t(10t+\Delta c)}{4t(s+t)(s+2t)} = 1 \); (2) the severe unilateral sabotage solution with either \( x_{B0} = 1 \) or \( y_{A0} = 1 \), the sabotage levels are \( s_A = s_B > 0 \) or \( s_A = s_B > 0 \) and \( s_B = 0 \) solves the equation \( x_{B0} = \frac{16t^2(3t+\Delta c)+4t^2(19t+\Delta c)+2t(19t-2\Delta c)}{4t(s+t)(s+4t)} = 1 \); (3) the moderate unilateral sabotage solution with all \( x_{B0}, x_{B1}, y_{A0}, \) and \( y_{A0} \) are positive and strictly less than 1, where the sabotage levels are \( s_A = s_B = 0 \) or \( s_A = s_B = 0 \) and \( s_A \) solves the FOC condition \( \frac{\partial \Pi(s_A=s_B=0)}{\partial s} = \frac{\partial \Pi(s_A=0,s_B=s)}{\partial s} = 0 \); (4) the no sabotage solution with \( s_A = s_B = 0 \).

Comparing the above four candidate solutions, we get the thresholds \( C_1(t) \geq C_2(t) \geq C_3(t) \), where \( \Pi(s_A = s_B = s) = \Pi(s_A = s_B = s) = \Pi(s_A = s_B = s) = \Pi(s_A = s_B = s) \) at \( \Delta c = C_1(t) \) , \( \Pi(s_A = s_B = s) = \Pi(s_A = s_B = s) = \Pi(s_A = s_B = s) = \Pi(s_A = s_B = s) \) at \( \Delta c = C_2(t) \), \( \Pi(s_A = s_B = s) = \Pi(s_A = s_B = s) = \Pi(s_A = s_B = s) = \Pi(s_A = s_B = s) \) at \( \Delta c = C_3(t) \). Therefore, if \( \Delta c \geq C_1(t) \), then the integrated firm will engage in severe bilateral sabotage; If \( C_2(t) \leq \Delta c < C_1(t) \), then the integrated firm will engage in severe unilateral sabotage; If \( C_1(t) \leq \Delta c < C_2(t) \), then the integrated firm will engage in moderate unilateral sabotage; If \( \Delta c < C_1(t) \), then the integrated firm will not sabotage.