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The Product Market Impact of Minority Stake Acquisitions

Amrita Nain
Tippie College of Business, University of Iowa, Iowa City, Iowa 52242, amrita-nain@uiowa.edu

Yan Wang
Rotterdam School of Management, Erasmus University, 3062 PA Rotterdam, Netherlands wang@rsm.nl

We show that partial equity ownership of a rival firm reduces product market competition. Acquisitions of a minority equity stake in rival firms are followed by higher output prices and higher industry profits, particularly when barriers to entry are high. Stock-price reactions of nonparticipating competitors of the acquirer and target are positive while announcement returns of customer firms are negative. Moreover, announcement returns of rivals are significantly higher and those of customers weakly lower when the customer industry is more competitive and when the acquirer and target are larger firms.

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1. Introduction

Corporations often acquire a minority equity stake in a rival firm that allows them to share in the profitability of the rival without obtaining control. In many cases, the acquirer and target agree to share technologies and develop joint products. The strategic alliance aspect of minority stake acquisitions is much touted by the participating firms and has, therefore, been extensively studied in the finance and business literatures.[1] However, the product market impact of partial cross-ownerships among rival firms has received less attention. Existing industrial organization theory suggests that partial equity interests in rivals can reduce competition and lead to higher output prices (see, e.g., Reynolds and Snapp 1986, Farrell and Shapiro 1990, Flath 1991, Malueg 1992, Reitman 1994, Gilo et al. 2006). Despite numerous theoretical arguments about the competitive implications of partial equity ownership (PEO), empirical research on market power primarily scrutinizes horizontal mergers.[2]

In this paper, we explore whether minority stake acquisitions affect the competitiveness of an industry. In models of imperfect competition, PEO between rivals reduces competition even in the absence of cooperative collusion and even if no control rights are granted. Purchasing a rival's stock gives the acquirer a share in the rival's profits. This "internalization" of the rival's profits dampens the acquirer's incentive to compete aggressively in the product markets. Evidence on the competitive effects of partial ownership between rival firms remains sparse. The few papers that do examine equity ownership between rivals focus on specific industries, like banking or utilities, in overseas markets.[3] The objective of this paper is to use a large, cross industry sample of minority stake acquisitions in the United States to examine whether an increase in equity ownership between rival firms increases market power as predicted by industrial organization theory.

Existing research shows that minority acquisitions can help to reduce holdup costs, mitigate financing constraints, and facilitate greater innovation and relation-specific investment. These factors can lead to improvements in operating efficiency. We are careful

[1] See McConnell and Nantell (1985), Desai et al. (2004), Chan et al. (1997), Oxley (1997), Allen and Phillips (2000), Fee et al. (2006), and Ouimet (2013).

[2] For evidence on horizontal mergers, see Barton and Sherman (1984), Borenstein (1990), Kim and Singal (1993), Singal (1996), Akhavein et al. (1997), and Prager and Hannan (1998), Eckbo (1983), Stillman (1983), Eckbo (1985), Eckbo and Wier (1985), Fee and Thomas (2004), Shahrur (2005), and Bhattacharyya and Nain (2011).

[3] Flath (1993) studies the Japanese keiretsu, Alley (1997) examines collusion in the Japanese and U.S. automobile industry, Parker and Röller (1997) study the cell phone industry, Dietzenbacher et al. (2000) study the Dutch financial sector, Amundsen and Bergman (2002) study the Nordic power market, and Trivieri (2007) studies the Italian banking industry.

throughout our analysis to contrast predictions of these efficiency arguments with selling power and attempt to distinguish between the two. Although existing PEO theory does not speak to the impact of minority acquisitions on suppliers, we are mindful of the possibility that, like mergers, minority acquisitions may have implications for suppliers.

Unlike horizontal mergers, minority equity investments in rival firms usually go unchallenged by antitrust authorities (see Gilo 2000, Gilo et al. 2006). Consistent with this argument, we find that fewer than 1% of the minority acquisitions in our sample are challenged by the Federal Trade Commission (FTC) or the Department of Justice (DOJ), and even fewer are blocked outright. It is possible that antitrust authorities allow the vast majority of minority acquisitions to proceed because their potential to affect market power is small. In this case, we should find no change in product market competition following acquisitions of minority equity stakes.

To analyze the product market impact of minority stake acquisitions, we focus on 774 completed acquisitions in manufacturing industries in which less than 50% of the target's equity is acquired. The sample is restricted to deals announced between 1980 and 2010. We employ both industry-level and firm-level tests. To our knowledge, this is the first paper to conduct a coordinated study of both output prices and stock prices to assess the product market impact of equity cross-ownership. In the industry-level tests, we examine changes in the real producer price index (RPPI) and price-cost margins (PCMs). Controlling for production costs, wages, demand shocks, and horizontal merger activity, we find that RPPI is 2% higher after minority stake acquisitions than before. We also find that PCM is 0.7% higher following minority stake acquisitions even after controlling for several factors that are known to affect industry profit margins. Both findings are statistically significant. Moreover, using capital intensity, property, plant, and equipment (PPE) intensity, and change in number of firms as a proxy for barriers to entry, we show that the increase in RPPI and PCM following minority stake acquisitions is observed only in industries with high barriers to entry.

Since minority acquisitions are more common in high R&D industries and often involve technology sharing (Fee et al. 2006), the increase in output prices after PEOs may reflect the joint development of new products. To address this concern, we look at changes in output prices in innovative industries and in industries involving PEOs with technology sharing. In results presented in the online appendix (available as supplemental material at https://doi.org/10.1287/mnsc.2016.2575), we find that innovation and technology are not positively associated with an increase in prices observed after minority stake acquisitions.

We recognize that our industry-level tests do not establish causality. An unobserved exogenous shock in an industry can trigger acquisitions of rivals' equity while simultaneously pushing up output prices and profit margins. To ascertain whether minority stake acquisitions could be responsible for the changes observed in the product markets, we turn to firm-level event studies. Abnormal stock price reactions over short windows reflect new information revealed by the announcement of a minority stake acquisition and are less vulnerable to long-term trends and structural changes in the industry. Following existing research, we look at the wealth effects of minority stake acquisitions on nonparticipating rival firms and customer firms (Eckbo 1983, Stillman 1983, Fee and Thomas 2004, Shahrur 2005). If minority stake acquisitions create selling power, competitors that do not participate in the PEO are expected to benefit from the higher selling prices in the industry. In contrast, customer firms would be worse off because their purchase prices are higher. We look at cumulative abnormal returns (CARs) to rivals and customers of the target and acquirer at the announcement of a minority stake acquisition over three separate windows, namely $(-1, 0)$, $(-2, 2)$, and $(-10, 10)$.[4]

We find that CARs of rivals are positive and statistically significant over all three windows, ranging from 0.15% over the $(-1, 0)$ window to 1.25% over the $(-10, 10)$ window. In contrast, customers have negative and statistically significant CARs of -0.35% over the $(-1, 0)$ window and -0.46% over the $(-2, 2)$ window.[5] Customer CARs over the $(-10, 10)$ windows are also negative but statistically insignificant. Although this pattern of announcement returns for rivals and customers is consistent with higher selling power in the industry, rival CARs may be positive as a result of the creation of buying power relative to suppliers. However, we find that supplier CARs over the three announcement windows are positive and statistically significant, indicating that PEOs are not expected to harm suppliers.

[4] We focus on rivals and customers instead of on CARs of the acquirer and target because the latter benefit not just from any increase in market power but also from other potential benefits of equity ownership like lower contracting costs and reductions in financial constraints. However, for completeness and for comparison with past studies we present CARs of acquirers and targets as well.

[5] Fee and Thomas (2004) also find positive rival CARs for a sample of full-scale mergers. For customers, they observe negative but insignificant CARs. One possible reason that customer response to merger announcements is not negative in Fee and Thomas (2004) is that mergers are more likely to be blocked or modified by antitrust authorities than minority stakes. Second, as suggested by Kühn (2010), merging firms often voluntarily divest assets to preempt an anticompetitive investigation that can be expensive and drawn out. So, mergers that have been actually observed may have already been stripped off their anticompetitive potential.

Positive CARs of rivals may simply reflect new information about opportunities for other firms in the industry to undertake similar transactions. To sharpen the tests of the product-market impact of minority stake acquisitions, we consider two additional factors: concentration of the customer industry and size of the firms participating in the minority stake acquisition. According to Galbraith's (1952) theory of countervailing power, "stronger" customers are more effectively able to counteract upstream pricing power. Using customer industry concentration as a proxy for strong customers, we find consistent evidence. CARs of nonparticipating rivals are lower and those of customers are higher when the customer industry Herfindahl index is above the sample median.

Models of imperfect competition show that PEOs will have a bigger impact on output prices when the firms participating in the equity ownership arrangement are larger (see Reynolds and Snapp 1986, Farrell and Shapiro 1990). In line with this argument, we find that CARs of nonparticipating rivals are higher if the acquirer or target has a larger market share, and if the target is larger in terms of total assets and equity value. In stark contrast, customer CARs are negatively related to measures of target size.

To summarize, we show that industry output prices and industry profit margins increase following minority stake acquisitions. Stock market reactions reflect these product-market changes. Rival firms experience positive CARs while customer firms experience negative CARs when a minority stake acquisition is announced. These CAR results are stronger when customer industry concentration is low and when firms participating in the PEO are larger. We demonstrate the robustness of our results to alternative definitions of PEO events and to alternative performance measures such as the operating performance of rival firms and customer firms. Our findings are supportive of the hypothesis that minority stake acquisitions of rival equity enhance selling power in an industry. Although endogeneity criticisms cannot be completely ruled out, our tests have reduced the subset of alternative explanations that can account for all of these findings.

Our paper adds to a growing literature on the product market impact of financial transactions like capital structure and corporate risk management.[6] It also complements the intraindustry research examining the link between the level of PEO and profit margins. Since PEOs and price-cost margins both depend on industry structure, the causal link between PEOs and industry profitability is hard to establish with levels data. Our paper addresses these empirical challenges in several ways. First, we examine minority stake acquisitions of rival stock, which effectively capture changes in equity ownership. Second, we adopt an event study approach and study stock price reactions as well as output prices and industry profits both before and after the minority stake acquisition. Third, our sample enables us to examine the differential impact of industry structure and participating firm size on the changes in product price, price-cost margins, and stock price reactions of rivals and customers.

The rest of the paper is organized as follows. Section 2 develops the hypotheses. Section 3 discusses antitrust regulation of minority stake acquisitions. Sections 4 and 5 present industry-level and firm-level results, respectively. Section 6 concludes.

2. Hypothesis Development

Full-scale mergers are large events involving operational and organizational changes to the merging firms. Not surprisingly, there is a substantial literature on the market power effects of horizontal mergers as well as on potential efficiency gains from such mergers. Minority equity stakes, in contrast, are devoid of control rights and involve smaller equity acquisition than full-scale mergers. It could be argued that the smaller equity stakes make it unlikely that minority stake acquisitions will have an impact on competition. Yet, empirical studies of minority acquisitions show that, despite the lower equity holding as compared with mergers, minority acquisitions do provide efficiency benefits like alleviating holdup costs and financial market frictions and encouraging relationship-specific investment (see Allen and Phillips 2000, Fee et al. 2006). In a similar vein, the objective of this paper is to determine whether, despite the lower equity stake, minority acquisitions can also have an impact on market power in the industry.

In Section 2.1, we rely on existing theory about the impact of minority equity stakes on selling power to outline our hypotheses. Throughout the discussion, we contrast the implications of selling power with those of efficiency gains and attempt to distinguish between the two. Although theory on minority acquisitions does not speak directly to buying power, existing research on mergers shows that horizontal mergers do affect market power vis-à-vis suppliers. Therefore, in Section 2.2, we discuss the possibility that minority equity stakes also affect buying power.

2.1. Selling Power

Existing literature on the competitive effects of PEOs can be divided into two types of models: models that examine the unilateral competitive effects of owning a rival firm's equity and models that study coordinated

[6] For capital structure and product markets, see Chevalier (1995), Phillips (1995), Phillips and Kovenock (1995, 1997), Campello (2003), and Campello (2006). For corporate risk management and industry competitions, see Campello et al. (2011), Liu and Parlour (2009), and Adam et al. (2007).

competitive effects. The static oligopoly models of Reynolds and Snapp (1986), Farrell and Shapiro (1990) and Flath (1991, 1992) show that PEOs will result in less competition among noncooperating firms. In these unilateral models, a decline in the profit-maximizing output is purely structural and is not a result of an increase in the opportunity for cooperative collusion. Equity ownership links the profits of rival firms and allows the acquiring firm to internalize the negative impact of product market competition on the profitability of the rival firm. Thus, firms holding an equity stake in a rival have a lower incentive to compete aggressively. These firms reduce output, which results in higher prices for all firms in the industry.

Dynamic models of cooperative collusion have similar implications for industry prices. Gilo et al. (2006) show that even a silent minority stake (i.e., no transfer of control rights takes place) can lead to a contraction of industry output and, therefore, an increase in industry prices. Malueg (1992) points out that, in cooperative models, a PEO's impact on competition may be ambiguous because equity cross-ownership has two effects: it reduces the gains from deviating from a collusive agreement but it also softens the punishment that follows from cheating. If the latter effect dominates, then collusion may not be sustainable. However, Gilo et al. (2006) argue that the first effect dominates and show that a PEO never hinders collusion and under certain conditions actually facilitates collusion.

In models of imperfect competition, the impact of PEO on output prices and price-cost margins will depend on the ease of entry into an industry (see Reynolds and Snapp 1986). If there are significant barriers to entry, the contraction of output following PEOs can result in a noticeable increase in output prices and profit margins. But when entry into the industry is easy, an increase in profit margins due to a contraction of output will quickly be competed away. Thus, an increase in prices and profits is not sustainable if entry barriers are low. Since output data are not available at a disaggregated industry level, we focus on output prices and profit margins instead. Our first hypothesis tests the broad implication of both unilateral and cooperative models:

Hypothesis 1. *Horizontal minority stake acquisitions are followed by an increase in industry output prices and price-cost margins, and this increase is more pronounced in industries with greater barriers to entry.*

Aghion and Tirole (1994) argue that in relationship-specific investments, equity cross-ownership among corporations can lower contracting costs and monitoring costs. Consistent with this, Allen and Phillips (2000) find that corporate block ownership carries significant benefits when firms share product market relationships like joint ventures. They also find that target firms in industries with high R&D experience improvements in performance following corporate equity purchases. These findings suggest that minority stake acquisitions may lead to improvements in operating efficiency. Thus, it is imperative that we distinguish the selling power hypothesis from alternative explanations.

If equity cross-ownership lowers operating costs and these costs reductions are at least partially passed on to customers, then the efficiency argument predicts lower post-PEO output prices, not higher. This biases us against finding evidence of an increase in output prices. If efficiency gains are not passed through to customers in the form of lower prices, then an increase in profitability may be observed. Thus, a straightforward efficiency argument suggests a downward pressure on selling prices and an upward pressure on profit margins depending on how much of cost reductions are passed on to customers. Selling power, on the other hand, predicts both higher output prices and higher profits.

Another type of efficiency argument that has implications for prices relates to technology sharing. On the one hand, collaborative innovation that often accompanies PEOs may result in the development of new products that sell at higher prices. On the other hand, if the collaboration is focused on process innovation rather than product innovation, production costs could decline, leading to lower output prices. To explore the role of these alternative explanations, we examine changes in prices and profits for subsamples of industries with high innovation, and deals accompanied by technology sharing.[7]

A limitation of testing Hypothesis 1 is that exogenous shock to industry demand or supply conditions affects output prices and profit margins while simultaneously triggering minority stake acquisitions. To address such endogeneity concerns, we look at firm-level stock price responses to announcements of minority stake acquisitions, since abnormal stock price reactions over a short window are less likely to be endogenous to long-term demand and supply conditions in the industry. Another advantage of studying stock price reactions is that we can explicitly control for deal-level features like R&D sharing, business agreements, acquisitions of board seats, etc.

In efficient markets, stock prices of acquiring firms, targeted firms, nonparticipating rivals, and customers would all be affected if minority stake acquisitions reduced competition. In addition, stock prices of the acquirer and target respond to other facets of the equity acquisition unrelated to market power. For

[7] In robustness tests, we also look at subsets based on whether PEOs involve business agreements, appointment of a board member, joint ventures, rumors of a full-scale merger, financing provided to target, or technology transfer or whether the PEO is for investment purposes only.

example, equity stakes can resolve contracting problems between the acquirer and target or relieve financing constraints for the target. Equity ownership can align the incentives of participating firms, leading to more joint ventures and new product development. The acquiring firm's management may also be able to provide effective monitoring of the target. Since the stock returns of the acquirer and target are likely to reflect all of these aspects of minority stake acquisitions, it is difficult to disentangle the changes in industry competitiveness by looking at the stock returns of acquirer and target. For this reason, our firm-level tests focus on their rivals and customers instead.

If minority stake acquisitions reduce competition, customer firms are adversely affected because of the higher cost of acquiring inputs. In Section 3, we cite examples of antitrust challenges in which joint production by participating firms or sharing of marketing and distribution channels were expected to increase product prices. We formulate the following hypothesis for the abnormal returns of customers at the announcement of a minority stake acquisition.

Hypothesis 2. *Customer firms' stock price reaction to minority stake acquisitions is negative*.

Equity ownership between rivals reduces holdup problems and encourages investment in relationship-specific assets. If this investment results in the development of higher-quality products, customer returns may react positively. Moreover, if strategic alliances that often accompany minority stake acquisitions result in streamlining of production processes, the cost savings may be passed on to customers, thereby resulting in higher customer CARs. Thus, these alternative arguments bias us against finding a negative stock price reaction for customer firms.

Next, we consider the impact of minority stake acquisitions on the stock returns of rival firms. If minority stake acquisitions reduce competition and put an upward pressure on output prices, all firms in the industry, including rival firms, are expected to benefit from the ability to sell at higher prices.

Hypothesis 3. *Announcement returns of nonparticipating rivals are positive*.

Positive announcement returns to rival firms are consistent with greater selling power. However, rival firms' stock prices may react positively to minority stake acquisitions if an acquisition signals opportunities for other firms in the industry to improve incentive alignment and reduce contracting costs by engaging in similar equity transactions.[8]

[8] An alternative argument is that reduction in contracting costs and financial constraints could hurt rivals (and benefit customers) since a more a cost-efficient acquirer or target can compete more aggressively in the product market. This argument biases us against finding support for Hypothesis 3.

We formulate additional hypotheses to further tease out the selling power hypothesis. First, we consider customer industry concentration. When the customer industry has only a few large firms with high market share, these customer firms can effectively countervail upstream pricing power. Galbraith (1952) argues that it is difficult to apply high prices to strong and large customers because such customers can adopt strategies to counteract the high upstream prices. For example, a large customer can concentrate its purchases to a single supplier and, in return for lower prices, provide the supplier with the certainty of volume as well as save the supplier advertising and other marketing costs. Large customers can also induce competition by playing one supplier off another. Moreover, when the customer industry is highly concentrated, the production schedules and investment decisions of suppliers are organized around the orders placed by large customers. A shift in the order schedule can impose heavy losses on suppliers. Galbraith (1952) argues that the threat or fear of such a change by a large customer is sufficient to induce a supplier to surrender some of the rewards of its market power. Based on these arguments, we conjecture that any increase in upstream pricing power will affect competitive customers' industries more adversely as compared to concentrated customers. Thus, if CARs of customer firms are negative because the minority stake acquisition enhanced upstream pricing power, the negative result should be more evident in customer industries that are less concentrated. Similarly, the CARs of rival firms should be higher when the customer industry is less concentrated because the pricing power created by the minority stake acquisition is more sustainable. Thus, our next hypothesis is as follows:

Hypothesis 4. *Announcement returns of rivals will be negatively related to customer industry concentration while announcement returns of customer firms will be positively related to customer industry concentration*.

Our next attempt to separate selling power from alternate explanations is motivated by existing theory on the product market impact of PEOs. In Reynolds and Snapp (1986), a PEO results in a bigger contraction of industry output if the acquirer and target firms are larger. Since output contraction translates into higher output prices and profits, we expect minority stake acquisitions to be followed by higher prices when the acquirer and target are larger firms.

Hypothesis 5. *Announcement returns to rival* (*customer*) *firms are higher* (*lower*) *when firms participating in the minority stake acquisition are larger*.

There are other ways to capture how important a minority stake acquisition is. The impact on prices and profits when two firms in a concentrated industry

are involved in a minority acquisition may be different from the impact when two firms in a competitive industry are involved in a minority stake acquisition. The impact may also depend on how large the equity transaction is and how many different firms in the industry engage in equity cross ownership. We explore these additional factors in Online Appendix A.

2.2. Buying Power

Merging firms exercise buying power in a variety of ways. They can restrict purchases to monopsony levels, pool purchases to obtain quantity discounts, or open up existing contracts for renegotiation and force suppliers to compete. More intense competition among suppliers can lead to lower input prices for all firms in the industry, including rival firms. In this section, we consider the possibility that PEOs also facilitate buying power and discuss implications for output prices, industry price-cost margins, and announcement returns of rivals, customers, and suppliers.

First, we consider the implications of buying power on the PEO industry itself. If the lower input prices extracted from suppliers are passed on to customers in part or in full, output prices in the PEO industry could decline. Industry profits may stay the same or go up, depending on how much of the cost savings are passed on to customers. If none of the cost savings due to buying power are passed on to customers, output prices would be unaffected while average price-cost margins in the PEO industry would increase. In summary, depending on the degree of pass-through, buying power predicts that output prices in the PEO industry could stay the same or decline while profit margins in the PEO industry could stay the same or go up. Extending the intuition to stock returns, the buying power hypothesis predicts that customer and rival announcement returns could be insignificant or positive.

This mixed bag of predictions indicates that both selling power and buying put an upward pressure on profit margins of the PEO industry and imply positive stock returns for rivals. It is difficult to distinguish between buying power and selling power by looking at industry profits and rival returns alone. However, the discussion in the previous paragraph highlights a contrast between selling power and buying power. Enhanced selling power predicts an increase in output prices in the PEO industry and negative announcement returns for customers while enhanced buying power does not.[9] Since some of the predictions can be consistent with all three scenarios—buying power, selling power, and efficiency gains—we provide a table in Online Appendix B that lists each of the five hypotheses listed in Section 2.1 and notes whether or not the prediction tested in each hypothesis supports each of the tree arguments, namely, buying power, selling power, and efficiency gains.

Finally, we consider an immediate implication of enhanced buying power. If PEOs allow participating firms and their rivals to extract lower input prices from suppliers, announcement returns of suppliers will be negative. To test this, we examine supplier abnormal returns at PEO announcement. However, when interpreting supplier announcement returns, we must keep in mind that the improvements in efficiency discussed in Section 2.1 also have implications for supplier announcement returns. If efficiency gains due to a PEO arrangement enable firms to produce the same output with fewer inputs, this could lead to lower demand for inputs and, therefore, lower returns for suppliers.

We conclude with the reiteration that our objective is to look for evidence that PEOs enhance selling power or buying power. We study output prices, industry profits and the performance of suppliers, rivals, and customers to determine whether evidence emerges in favor of either type of market power.

3. Regulatory Issues

The Clayton Antitrust Act was enacted in 1914 to limit anticompetitive actions in their incipiency by prohibiting actions not conducive to a competitive market. These actions include mergers and acquisitions of equity if such acquisitions might lessen competition in the market. Section 7 of the Clayton Antitrust Act, however, allows exemptions for equity acquired for investment purposes only. Gilo (2000) argues that Section 7 has been interpreted expansively by antitrust authorities to allow minority acquisitions to proceed.

We searched archives of the FTC and DOJ for cases in which minority equity acquisitions were challenged on grounds of being potentially anticompetitive. In 1998, the DOJ challenged Northwest Airlines' acquisition of 14% of the outstanding equity of Continental Airlines. The acquisition would have resulted in Northwest controlling more than 50% of Continental's voting stock. The DOJ argued that due to the substantial market share of the two airlines on certain routes, the acquisition would reduce the airlines' incentive to compete aggressively against each other. In 1997 Hearst Corporation invested in a newly created tracking stock that gave it approximately 30% equity stake in MediaNews Group. These two newspapers account for most of the readership of and advertising in daily newspapers in the Bay Area. After investigation by the DOJ, the firms agreed to modify the terms of agreement to mitigate antitrust concerns. In another example, in 1990 the FTC

[9] As discussed in Dobson et al. (1998), an increase in an industry's buying power is unlikely to affect customers adversely unless the industry also has selling power.

challenged Nippon Sheet Glass Company's acquisition of a 20% stake in Libbey–Owens–Ford Company, a wholly owned subsidiary of Pilkington. The FTC alleged that the equity stake would reduce competition in the North American wired glass market. Nippon Sheet Glass Company and Pilkington agreed to a proposed consent order under which the two firms were prohibited from jointly manufacturing or distributing wired glass in North America.

Examples like these indicate that antitrust authorities do consider minority acquisitions to be potentially anticompetitive as suggested by theory. However, Gilo (2000) and Gilo et al. (2006) argue that minority stake acquisitions are investigated considerably less than mergers, thus allowing for the possibility that minority acquisitions that dampen competition are more likely to proceed than mergers. Fee and Thomas (2004), who study majority stake mergers and acquisitions, find that 7% of the deals in their sample are challenged by antitrust authorities. Existing studies do not provide a similar statistic for minority stake acquisitions. Therefore, we hand-collect data on antitrust challenges of the minority stake acquisitions in our sample by searching media sources for news coverage of the acquirer and the target with keywords such as "antitrust," "Federal Trade Commission," "justice," "Hart–Scott–Rodino" and so forth. We find that, of the 774 deals in our sample, 85 deals (i.e., 11%) were mentioned in the news sources as having filed for antitrust clearance. However, only 7 of these deals (i.e., less than 1%) were challenged or modified by the FTC or DOJ.

We find that prominent antitrust investigations of minority acquisitions involve deals between firms that have substantial market share. For example, in the Northwest Airlines, Nippon Glass Company, and Hearst Corporation examples mentioned above, the antitrust case built by DOJ and FTC stressed the high market share of the firms involved either in the United States or in a specific region of the United States. If we look at our sample of minority deals, we find that acquirer and target market share (29% and 27%, respectively) in the handful of challenged deals is greater than acquirer and target market share (17% and 7%, respectively) in the subset that gets no media mention at all about antitrust clearance. In contrast, the average percentage of target shares acquired is approximately 15% in both the subset of challenged deals and the rest of the sample. For this reason, we focus on size and market share of the participating firms to tease out the competitive effect of minority stake acquisitions.

We conclude this section by noting the limitations of working with minority acquisitions. First, since only a small equity stake is acquired in PEOs, the incentive to reduce competition unilaterally or opportunities to increase prices cooperatively may both be low. Thus, there are reasons to expect that a competitive impact may be less likely in PEOs than in horizontal mergers. Second, the generalizability of our findings to mergers is somewhat limited. For example, evidence of a reduction in competition following minority equity stakes would imply a high likelihood that full-scale horizontal mergers also reduce competition. However, since mergers are monitored more aggressively than PEOs, in practice the anticompetitive impact of mergers may be very different from that of minority stakes.

4. Industry-Level Analysis

This section is organized as follows. Section 4.1 describes the data and Section 4.2 describes variables used for the industry-level analysis of output prices and profit margins. Section 4.3 presents the results.

4.1. Data Description

From SDC Platinum, we obtain a sample of 4,294 completed minority stake acquisitions announced between 1980 and 2010 in which fewer than 50% of the target's shares were acquired and the acquirer's ownership in the target after the acquisition remained below 50%. Since output price data are available for manufacturing industries only, our analysis is limited to 1,068 minority acquisitions in manufacturing industries (Standard Industrial Classification (SIC) codes 2000–3999).[10] We briefly describe the full sample of horizontal minority acquisitions in Online Appendix C and hereafter focus on the manufacturing sector only.

We identify all manufacturing sector SIC codes that each target and acquirer operates in and classify minority acquisitions as horizontal if the acquirer and target operate in at least one common SIC code. In some cases, a multisegment acquirer and a multisegment target have two SIC codes in common. We treat such minority deals as two distinct events, one in each industry. The 1,068 unique minority acquisitions translate into 1,432 industry events in manufacturing industries.[11]

We further manually check each of these 1,068 completed deals and use media searches to eliminate several deals that are not acquisitions of a rival's equity although the acquirer and target appear to have the

[10] We exclude 319 deals in the manufacturing sector that were announced but not completed.

[11] In Online Appendix G, we also provide a brief comparison with horizontal mergers over the same period. Minority acquisitions are less common than full-scale mergers. There are approximately four times as many mergers as minority deals. Moreover, since mergers involve majority stake acquisitions (usually more than 90% stake) the amount of money transacted in mergers dwarfs the total transaction value of minority deals. However, the average transaction value per deal of minority acquisitions is approximately a quarter that of mergers. This is quite substantial, considering that percentage acquired in minority acquisitions is on average less than one-fifth the percentage acquired in mergers.

same four-digit SIC code. For example, we drop deals where the acquirer and target have the same CUSIP number, the target is already a subsidiary of the acquirer, the acquirer is an investment firm or an insider, or the target is either a supplier or a customer of the acquirer. We also drop deals that are flagged by the SDC as minority stake acquisitions but which news reports indicate are outright acquisitions resulting in the acquirer having a controlling interest. After this cleanup procedure, we are left with a final sample of 774 unique minority stake acquisitions. These translate into 940 industry-deal observations across 169 distinct SIC codes. Table 1, panel A shows the distribution of our minority stake acquisition sample at the two-digit SIC code level, along with the average percentage acquired and average transaction values per industry. There is significant industry clustering, with the Chemical and Allied Products industry accounting for the largest share (36%) of the sample.[12]

Industrial organization theory shows that minority stake acquisitions reduce competition even if the equity investment is truly passive. However, minority stakes are usually accompanied by business tie-ups or technology sharing. While the theoretical arguments for a product market impact continue to be valid in these cases (e.g., Reitman 1994), we need to be careful about controlling for information spillovers of these tie-ups when analyzing rival and customer firms. We use existing strategic alliance and joint venture data provided by SDC Platinum as well as detailed news searches to classify the 774 minority stake acquisitions into different categories based on any observed interaction between the acquirer and target. For example, 234 deals in our sample are flagged in SDC Platinum's strategic alliance database as deals in which the acquirer and target have a contractual business agreement. News searches indicate that in an additional 274 deals, the acquirer and target have a business arrangement that involves sharing distribution or market networks, codevelopment of products, or a licensing agreement. We categorize all of these 508 deals as having business agreements. In a similar fashion, we identify minority stake acquisitions accompanied by joint ventures or by technology transfers using a combination of SDC Platinum's strategic alliance database as well as news searches. We also use news searches to identify deals in which the acquiring firm obtains a board seat, the acquisition provides the target with much-needed financing, and deals in which there is media speculation about a full-scale merger in the future. Deals that do not fall into any of these categories are classified as passive (i.e., for investment purposes only). Panel B of Table 1 provides a breakdown of our sample into the above-mentioned categories. Deals that fall into more than one category are included in both categories. For this reason, the number of observations in panel B adds up to more than the 774 unique deals in our sample. Panel B shows that only 102 of the 774 minority deals (i.e., 13%) are truly passive. A large fraction (66%) of the minority acquisitions involves some business interaction like sharing marketing and distribution networks or codevelopment of products. For 9% of the deals, news articles speculate about the acquirer's interest in a full-scale merger. Finally, technology transfers or technology sharing occurs in approximately 12% of the deals.

[12] We repeat our tests by dropping the Chemical and Allied Products industry and find that our key conclusions remain unchanged.

4.2. Dependent Variables and Main Explanatory Variables

We study the product market impact of minority stake acquisitions by examining the seasonally adjusted monthly producer price index (PPI) provided by the Bureau of Labor Statistics (BLS) and annual industry price cost margins calculated using Census Bureau data.[13] The PPI measures the average change over time in the selling prices received by domestic producers for their output.[14] We adjust the PPI for inflation to obtain the real producer price index (RPPI). The framework used to study changes in RPPI after a minority acquisition is described in Online Appendix D.

Industry price-cost margins (PCM) are calculated as in Allayannis and Ihrig (2001) using data from the Annual Survey of Manufactures published by the U.S. Census Bureau. For each four-digit SIC code, PCM is calculated as

$$PCM = (\textit{Value of shipments} + \Delta\textit{Inventories} - \textit{Payroll} - \textit{Cost of materials}) \cdot (\textit{Value of shipments} + \Delta\textit{Inventories})^{-1}, \quad (1)$$

where *Value of shipments* includes the received or receivable net selling values of all products shipped. Δ *Inventories* is the change in inventory, which

[13] The U.S. Census Bureau classified industries by the SIC code beforebefore 1997 and by the North American Industry Classification System (NAICS) code after 1997. We use the SIC-to-NAICS correspondence tables provided by the Census Bureau website to match each six-digit NAICS code to the four-digit SIC code and retain only industries that have a one-to-one match between SIC and NAICS.

[14] The Producer Price Index Series reflect price movements for the net output of goods-producing sectors of the U.S. economy. To the extent possible, prices used in constructing the indexes are the actual revenue or net transaction prices that producers receive for sales of their outputs. Scientific (probability) sampling techniques are used to select reporting establishments, products, and transactions for all types and volumes of output. The PPI measures changes in prices received by domestic producers; imported products are not priced in the survey. More details can be found in Bureau of Labor Statistics (2014, Chapter 14).

Table 1 Sample Description

Panel A: Minority stake acquisition events (manufacturing sector only)

Two-digit SIC	1980–1989			1990–1999			2000–2010			Total		
SIC[a]	% acquired	Trans. value	# of PEOs	% acquired	Trans. value	# of PEOs	% acquired	Trans. value	# of PEOs	% acquired	Trans. value	# of PEOs
20	10.7	58.0	7	17.7	691.1	20	14.8	1,154.3	19	14.4	1,903.4	46
22	0.0	0.0	0	11.6	6.2	1	25.0	0.0	1	12.2	6.2	2
23	0.0	0.0	1	12.3	67.2	4	28.0	26.1	11	13.4	93.3	16
24	0.0	0.0	0	0.0	0.0	0	0.0	1.1	2	0.0	1.1	2
25	0.0	0.0	0	49.9	0.8	1	13.2	122.3	2	21.0	123.1	3
26	15.9	376.5	3	0.0	0.0	0	13.6	50.8	3	9.8	427.3	6
27	14.0	192.8	16	31.0	799.1	21	44.3	333.5	18	29.7	1,325.4	55
28	11.0	844.1	38	10.3	3,844.4	177	16.8	3,702.5	125	12.7	8,391.0	340
29	29.9	2,140.3	3	0.0	100.4	2	45.0	0.0	2	25.0	2,240.7	7
30	22.1	22.7	2	14.9	262.2	11	2.8	0.0	2	13.2	284.9	15
31	0.0	0.0	0	0.0	0.0	0	0.0	0.0	2	0.0	0.0	2
32	19.4	235.0	2	12.9	13.8	3	19.9	0.0	4	17.4	248.8	9
33	26.9	571.5	6	10.6	360.8	11	24.3	420.9	9	20.6	1,353.2	26
34	6.3	186.6	2	14.6	9.8	2	16.3	0.0	3	12.4	196.4	7
35	18.2	577.3	16	13.7	1,584.6	58	16.9	473.9	15	16.3	2,635.8	89
36	10.8	1,600.7	30	13.3	2, 341.0	81	19.7	1,677.7	45	14.6	5,619.3	156
37	16.2	60.6	9	28.8	356.4	13	12.9	27.3	11	19.3	444.3	33
38	15.3	127.9	19	15.4	353.7	55	12.4	315.6	44	14.4	797.1	118
39	0.0	0.0	1	8.2	40.0	4	6.6	0.0	3	4.9	40.0	8
Total	11.4	6,993.8	155	14.3	10,791.4	464	18.1	8,305.9	321	14.8	26,091.0	940

Panel B: Minority stake acquisitions by category

	1980–1989			1990–1999			2000–2010			Total		
	% acquired	Trans. value	# of PEOs	% acquired	Trans. value	# of PEOs	% acquired	Trans. value	# of PEOs	% acquired	Trans. value	# of PEOs
Financing	16.1	105.0	7	12.6	399.0	38	13.9	319.0	15	14.2	823.0	60
Business agreement	15.9	976.1	47	13.1	5,788.0	293	17.6	10,963.2	168	15.5	17,727.3	508
Merger speculation	11.1	326.4	27	19.0	633.0	20	21.0	480.5	22	17.1	1,439.9	69
Board seat	22.6	315.7	10	15.1	345.5	17	19.9	249.5	16	19.2	910.7	43
Joint venture	20.7	2,266.6	11	13.9	1,168.9	22	24.0	776.1	8	19.5	4,211.5	41
Tech transfer	11.1	143.0	9	10.2	729.5	55	19.0	923.0	28	13.4	1,795.4	92
Investment purposes	13.4	2,991.8	32	14.0	700.4	48	17.3	121.2	22	14.9	3,813.5	102

Notes. Panel A shows the distribution of 940 industry events comprising 774 unique horizontal minority stake acquisitions in the manufacturing sector for the sample period 1980 through 2010. Average percentage of shares acquired (*% acquired*), the number of PEOs (*# of PEOs*) and the total transaction value of all PEOs in the industry (*Trans. val.*) are presented. Panel B classifies the 774 unique minority acquisitions in the manufacturing sector into different categories based on any observed interaction between the acquirer and target. The classifications are based primarily on media searches. Minority stake acquisitions are classified in the *Business agreement* category if SDC Platinum's strategic alliance database indicates that the acquirer and target have a contractual business agreement or if media searches reveal that the acquirer and target have a business arrangement that involves sharing distribution or market networks, codevelopment of products, or a licensing agreement. The *Joint venture* category includes deals that appear in SDC Platinum's strategic alliance database as joint ventures or deals that are classified as involving a joint venture based on media coverage. *Tech transfer* includes deals in which the acquirer and target agreed to share technology, *Board seat* includes deals in which the acquirer obtained a seat on the target's board, *Financing* includes deals in which the minority stake acquisition is expected to alleviate financing constraints of the target, *Merger speculation* includes deals that involve media speculation about a possible full-scale merger between the acquirer and target. *Investment purposes* includes deals that are not classified into any of the above-mentioned categories. Since a minority stake acquisition can be classified into more than one category, the number of deals across all categories adds up to more than 774.

[a]20—Food and Kindred Products; 21—Tobacco Products; 22—Textile Mill Products; 23—Apparel and Other Finished Products Made from Fabrics and Similar Materials; 24—Lumber and Wood Products; 25—Furniture and Fixtures; 26—Paper and Allied Products; 27—Printing, Publishing and Allied Industries; 28—Chemicals and Allied Products; 29—Petroleum Refining and Related Industries; 30—Rubber and Miscellaneous Plastics Products; 31—Leather and Leather Products; 32—Stone, Clay, Glass, and Concrete Products; 33—Primary Metal Industries; 34—Fabricated Metal Products, Except Machinery and Transportation Equipment; 35—Industrial and Commercial Machinery and Computer Equipment; 36—Electronic and Other Electrical Equipment and Components, Except Computer Equipment; 37—Transportation Equipment; 38—Measuring, Analyzing, and Controlling Instruments; Photographic, Medical, and Optical Goods; Watches and Clocks; 39—Miscellaneous Manufacturing Industries.

includes finished goods that are still within ownership of the establishment or are work in process. *Payroll* is the gross earning of all employees on the payroll and includes wages, commissions, bonuses, sick leave pay, etc. *Cost of materials* includes direct charges paid or payable for all raw materials and semifinished goods used, and the fuel and electricity consumed.

Hypothesis 1 states that the change in output price and profit margins will depend on barriers to entry.

Table 2 Descriptive Statistics of Industry-Level Variables

	Mean	Median	P25	P75	*N*
RPPI	129.36	123.95	109.18	140.33	8,220
Δ *log* (*RPPI*) (%)	0.13	0.07	−0.09	0.35	8,219
PCM (%)	34.91	34.09	27.75	40.07	684
Cost of materials	6,955.45	3,488.70	1,779.43	7,074.50	684
Wages	28.28	24.65	18.32	32.54	684
Sales growth	0.04	0.04	−0.01	0.09	684
R&D intensity	2.96	2.08	0.53	4.12	684
Leverage	0.41	0.40	0.30	0.50	684
Capital intensity	1.00	0.96	0.80	1.16	684
PPE intensity	0.53	0.49	0.37	0.67	684
Δ *number of firms* (%)	−1.05	0.00	−5.41	3.53	684
Number of patents	328.55	41.00	3.00	142.50	684
Number of citations	1,935.97	261.00	3.00	1,003.50	684

Notes. The table summarizes industry-level variables for 137 industry events announced in 106 four-digit SIC codes during the period 1980 through 2010. For each industry event, data are summarized from two years before the deal is announced until two years after. *RPPI* is the real producer price index calculated as the monthly producer price index divided by the GDP deflator. The producer price index is obtained from the Bureau of Labor Statistics, and the GDP deflator is obtained from the Federal Reserve Board. Δ log(RPPI) is RPPI in log differences. Since the producer price data are monthly, the level of observation is event month. All remaining variables (described next) are available at an annual frequency, and the level of each observation is event year. *PCM* is the price-cost margin calculated using data from the Annual Survey of Manufactures (ASM) conducted by the Census Bureau. It is calculated as the value of shipment plus the change in inventory net of the cost of materials and payroll divided by the value of shipment plus the change in inventory. *Cost of materials* (in millions), also obtained from ASM, includes direct charges paid or payable for all raw materials and semi-finished goods used, and the fuel and electricity consumed. *Wages* are the average earnings of production workers scaled by total number of working hours, both obtained from ASM. *Sales growth* is the annual growth in the value of shipments obtained from ASM. The following variables are calculated using data from Compustat. Change in number of firms is based on the number of firms that appear in the Compustat database in a given SIC code. *R&D intensity* is the total research and development expenditures scaled by total assets of the industry (missing values of R&D are treated as 0). *Leverage* is the ratio of total industry debt divided by the sum of total industry debt and industry market equity. *Capital intensity* is industry total assets divided by industry total sales. *PPE intensity* is computed as total property, plant, and equipment divided by total assets. Δ *number of firms* is the percentage change in the number of firms in a given industry. The following data are obtained from the National Bureau of Economic Research's Patent Data Project. *Number of patents* is the number of patents applied for by all firms in the PEO industry. *Number of citations* is the number of patent citations received by all firms in the PEO industry. Patent and patent citation information is obtained from the U.S. Patent and Trademark Office. When patent data or data obtained from Compustat do not match the Census Bureau data at the four-digit SIC level, we match at the three-digit SIC level instead.

We use three proxies for barriers to entry. In his seminal work on entry barriers, Bain (1956) argued that high capital requirements serve as a barrier to entry and allow firms to maintain positive rents. Following Harris (1988), we use capital intensity as one proxy of capital requirements. Specifically, capital intensity is computed as the sum of industry total assets over industry total sales where assets and sales are both obtained from Compustat. We use PPE intensity, computed as total gross industry property, plant, and equipment divided by the total industry assets, as a second proxy for capital requirements. We also use change in the number of firms in the industry as a third proxy for entry barriers. The change in the number of firms is based on the number of firms that appear in the Compustat database and effectively captures the change in the number of publicly traded firms.[15] We find that both capital intensity and PPE intensity have a negative and statistically significant correlation with the change in the number of firms. Thus, these appear to be reasonable measures of entry barriers.

Additional industry level variables like cost of materials, wages, patent count, patent citation, a proxy for industry demand, etc., are described in Online Appendix E. Table 2 shows descriptive statistics of our industry-level variables.

4.3. Results of Industry-Level Analysis

We begin this section by testing Hypothesis 1, which states that minority stake acquisitions are followed by an increase in product prices and price-cost margins. We use an event study approach by comparing the producer price index (RPPI) and price-cost margins (PCMs) before and after minority stake acquisitions. For this analysis, we define an industry event as any industry year in which at least one minority stake acquisition occurred and examine the change in the industry's RPPI and PCM from two years before the event year until two years after the event year.[16] To have clear preevent and postevent periods, we require events in the same industry to be at least four years apart. After dropping events for which sufficient RPPI

[15] In unreported tests, we use the number of IPOs or the number of new listings (both scaled by the lagged number of firms in the industry) as proxies for firm entry into the industry. We also check the robustness of our findings with the Census Bureau's data on the number of establishments, which capture both public and privately held firms. Our results are qualitatively similar and available upon request.

[16] Alternative definitions of an event are considered in Online Appendix A.

Table 3 Change in RPPI and PCM Conditional on Entry Barriers

	(1) Before		(2) After		(3) After − Before		(4) High barriers − Low barriers	
	Mean	*N*	Mean	*N*	Difference	*p*-value	Difference	*p*-value
				Panel A: RPPI				
All	126.306	3,288	132.542	3,288	6.236***	[<0.001]		
Low barriers: Low capital intensity	124.936	1,632	130.12	1,632	5.183***	[<0.001]		
High barriers: High capital intensity	127.656	1,656	134.929	1,656	7.273***	[<0.001]	2.090***	[0.004]
Low barriers: Low PPE intensity	128.562	1,764	133.359	1,764	4.797***	[<0.001]		
High barriers: High PPE intensity	123.694	1,524	131.596	1,524	7.901***	[<0.001]	3.104***	[<0.001]
Low barriers: Δ number of firms > 0	125.278	1,104	128.919	1,104	3.641***	[<0.001]		
High barriers: Δ number of firms ≤ 0	126.826	2,184	134.373	2,184	6.061***	[<0.001]	3.906***	[<0.001]
				Panel B: Δ Log(RPPI) (%)				
All	0.136	3,287	0.137	3,287	0.000	[0.491]		
Low barriers: Low capital intensity	0.174	1,631	0.098	1,631	−0.076***	[0.007]		
High barriers: High capital intensity	0.1	1,656	0.175	1,656	0.076***	[0.005]	0.152***	[<0.001]
Low barriers: Low PPE intensity	0.134	1,763	0.104	1,763	−0.03	[0.109]		
High barriers: High PPE intensity	0.139	1,524	0.175	1,524	0.036	[0.165]	0.066*	[0.063]
Low barriers: Δ number of firms > 0	0.175	1,104	0.114	1,104	−0.062**	[0.037]		
High barriers: Δ number of firms ≤ 0	0.117	2,183	0.149	2,183	0.032	[0.121]	0.094**	[0.020]
				Panel C: PCM (%)				
All	34.58	274	35.313	274	0.733	[0.196]		
Low barriers: Low capital intensity	33.091	136	33.795	136	0.704	[0.271]		
High barriers: High capital intensity	36.049	138	36.811	138	0.762	[0.269]	0.058	[0.466]
Low barriers: Low PPE intensity	36.430	147	37.113	147	0.683**	[0.019]		
High barriers: High PPE intensity	32.441	127	33.231	127	0.790**	[0.045]	0.107	[0.423]
Low barriers: Δ number of firms > 0	34.940	92	35.800	92	0.861**	[0.021]		
High barriers: Δ number of firms ≤ 0	34.399	182	35.068	182	0.688***	[0.007]	−0.192	[0.371]

Notes. This table summarizes the following variables for 137 minority stake events announced during the sample period 1980–2010. Panel A shows the monthly real producer price index (RPPI) for the two years preceding and two years following the minority stake event. The event year itself is excluded in the comparison. Panel B similarly presents log difference of the monthly real producer price index (in percentages), Δ Log(RPPI). Panel C shows *annual* price-cost margins (PCM). Definitions of RPPI, Δ Log(RPPI), and PCM are provided in Table 2. Three proxies of barriers to entry are used. Capital intensity is industry total assets divided by industry total sales. High (low) capital intensity industries are defined as those for which the two-year average value of capital intensity before the minority stake acquisition is above (below) the sample median. PPE intensity is total gross value of property, plant, and equipment divided by industry total assets. High (low) PPE intensity industries are defined as those for which the two-year average value of PPE intensity before the minority stake acquisition is above (below) the sample median. Δ number of firms is the percentage change in number of firms in a given industry, as captured by Compustat. Industries experiencing an increase (decrease) in number of firms are classified as having low (high) entry barriers. Column (3) of panel A (panels B and C) shows the difference in RPPI (Δ Log(RPPI) and PCM) before and after minority stake acquisitions. Column (4) shows the difference-in-differences tests of the change in RPPI and PCM conditional on barriers to entry.

*, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

and PCM data are not available, we are left with 137 industry events in 106 four-digit SIC codes. Note that there can be more than one minority acquisition per industry event. We have 211 acquisitions contributing to these 137 industry events. Panel A of Table 3 presents mean RPPI during the 24 months before and 24 months after minority stake acquisitions. The event year itself is excluded. Average RPPI during the 24 months following PEO is higher than the average RPPI during the 24 months preceding PEO. We split the sample by the three proxies for barriers to entry, namely, capital intensity, PPE intensity, and change in the number of firms. Although RPPI after the PEO is higher in both the high entry barrier and low entry barrier subsamples, we find that the increase in RPPI is significantly greater in the high-barriers-to-entry subsample (column (4) of panel A).

Dickey–Fuller tests indicate the existence of a unit root in output prices. This nonstationarity leads to time dependence of the mean and variance, rendering ordinary least squares (OLS) estimates invalid. As recommended by Hamilton (1994), we remove nonstationarity in output prices by converting RPPI into a log-differenced series. Panel B of Table 3 shows log difference of RPPI during the 24 months before and 24 months after minority stake acquisitions. Log-differenced RPPI also indicates that industries with higher entry barriers exhibit a greater increase in RPPI. Finally, Table 3, panel C presents average PCMs two years before and two years after the minority stake acquisition. PCMs display similar patterns but without any statistical significance.

Next, we analyze RPPI and PCM in a multivariate setting to control for several factors that affect output prices and price-cost margins. We estimate a panel regression using the log-differenced monthly RPPI from 1980 to 2010 as the dependent variable. The regression is estimated using pooled ordinary least

Table 4 RPPI, PCM, and Entry Barriers

	Full sample (1)	Low capital intensity (2)	High capital intensity (3)	Low PPE intensity (4)	High PPE intensity (5)	Δ firms > 0 (6)	Δ firms ≤ 0 (7)
			Panel A: Dependent variable is Δ Log(RPPI)				
$POST_{i,t}$	0.083***	0.043	0.126***	0.064	0.095***	0.038	0.097***
	(3.771)	(1.604)	(4.441)	(1.631)	(3.391)	(1.038)	(3.759)
Δ log ($RPPI_{i,t-1}$)	0.201***	0.222***	0.172***	0.076	0.297***	0.107***	0.254***
	(7.258)	(7.082)	(3.646)	(1.122)	(7.879)	(2.728)	(7.265)
Δ log ($materials_{i,t}$)	0.367***	0.274*	0.404***	0.385*	0.337**	0.478***	0.360***
	(3.747)	(1.919)	(3.354)	(1.710)	(2.336)	(2.835)	(3.038)
Δ log ($wages_{i,t}$)	0.359***	0.821***	0.103	0.424***	0.358**	0.585	0.281**
	(2.678)	(4.102)	(0.608)	(2.661)	(2.266)	(1.603)	(2.488)
Δ log ($y_{i,t}$)	0.239*	0.318**	0.143	0.302	0.197	0.197	0.290*
	(1.948)	(2.528)	(0.730)	(1.573)	(1.312)	(1.165)	(1.824)
Δ $M\&A_{i,t}$	0.051	0.051	0.185	0.046***	0.045	0.298	0.053
	(1.000)	(1.037)	(0.354)	(10.351)	(0.854)	(0.242)	(1.088)
Test: High − Low > 0			0.083**		0.031		0.059**
p-value			[0.014]		[0.123]		[0.038]
Observations	6,482	3,218	3,264	3,299	3,183	2,169	4,313
R-squared	0.063	0.077	0.053	0.029	0.111	0.030	0.090
			Panel B: Dependent variable is PCM				
$POST_{i,t}$	0.007**	0.002	0.011***	0.006	0.011*	0.005	0.009
	(2.227)	(0.303)	(2.456)	(0.674)	(1.920)	(0.402)	(0.795)
Capital intensity	0.001**			0.001	0.001***	0.001***	0.001**
	(2.210)			(1.311)	(3.247)	(5.271)	(2.578)
Sales $growth_{i,t}$	0.179***	0.177***	0.184*	0.094	0.272***	0.273***	0.134***
	(3.050)	(3.620)	(1.933)	(1.525)	(5.056)	(3.028)	(2.600)
R&D $intensity_{i,t}$	0.002	0.002	0.003	0.001	0.003	−0.000	−0.000
	(1.162)	(0.939)	(0.713)	(0.486)	(0.911)	(−0.088)	(−0.006)
$Leverage_{i,t}$	−0.077***	−0.086***	−0.048	−0.084***	−0.072	−0.277***	−0.054***
	(−3.994)	(−2.942)	(−0.998)	(−2.774)	(−1.251)	(−4.403)	(−3.842)
$M\&A_{i,t}$	0.003	0.004	−0.039	−0.002	0.029***	−0.071	0.003
	(0.753)	(0.961)	(−0.251)	(−1.078)	(4.145)	(−0.332)	(0.932)
Test: High − Low > 0			0.009		0.005		0.004
p-value			[0.112]		[0.327]		[0.417]
Observations	546	271	275	277	269	183	363
R-squared	0.142	0.165	0.089	0.113	0.207	0.394	0.161

Notes. This table presents multivariate analysis of monthly Δ Log (RPPI) in panel A and annual PCM in panel B for 137 minority stake events announced during the sample period 1980–2010. Δ Log(RPPI) and PCM are as described in Table 2. Our variable of interest is the *POST* dummy, which equals 1 during the two years after the minority acquisition event and 0 for two years before the event. Column (1) in each panel shows the full-sample regression. Columns (2)–(7) present multivariate analysis conditional on proxies for barriers to entry. The proxies for entry barriers are industry capital intensity, PPE intensity, and change in the number of firms in an industry. Capital intensity is industry total assets divided by industry total sales. High (low) capital intensity industries are defined as those for which the two-year average value of capital intensity before the minority stake acquisition is above (below) the sample median. PPE intensity is total gross value of property, plant, and equipment divided by industry total assets. High (low) PPE intensity industries are defined as those for which the two-year average value of PPE intensity before the minority stake acquisition is above (below) the sample median. Δ number of firms is the percentage change in number of firms in a given industry as captured by Compustat. Industries experiencing an increase (decrease) in number of firms are classified as having low (high) entry barriers. Control variables are as follows. The cost of materials (*Materials*) in log differences, hourly wages (*Wages*) in log differences, *Sales growth*, *R&D intensity*, and *Leverage* are as described in Table 2. The variable y_{it}, in log differences, captures demand conditions and is described in Appendices E and F. *M&A* is calculated as the total transaction values of horizontal majority mergers and acquisitions in each industry year scaled by total industry asset. In the RPPI regressions, standard errors are clustered at the year-month level and time fixed effects are included. Since the PPI regression is estimated in log differences, industry fixed effects are differenced out. The PCM regressions include both industry fixed effects and time fixed effects, and standard errors are clustered by both year and industry.

*, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

squares with time-fixed effects and standard errors clustered by year-month. The main explanatory variable is *POST*, a dummy variable equal to 1 for the 24 months following the event and equal to 0 for the 24 months preceding the event. We control for demand shocks (y_{it}), cost of materials (*Materials*), and wages (*Wages*). These control variables are described in Online Appendix E. To allow for sticky prices, we also include lagged RPPI on the right-hand side. Finally, since full-scale mergers are expected to affect output prices and may coincide with minority stake acquisitions, we use horizontal merger activity, *M&A*, as a control variable. All control variables are also in log-differences. Since the regression is estimated in log-differences, industry-fixed effects are differenced out.

Results of the RPPI regression are presented in panel A of Table 4. Since the dependent variable is in log differences, the coefficient on *POST* captures the change in growth rate of RPPI. In column (1) of panel A, we see that the RPPI growth rate is, on

average, 0.083% higher during the 24 months following minority stake acquisitions as compared with the 24 preceding months.[17] Assuming that the RPPI index is 100 just before the minority acquisition and that growth in RPPI is 0 before minority acquisition, the coefficient indicates that RPPI will grow by 0.083% per month after the acquisition. Thus, over the 24-month period, RPPI increases to $100(1 + 0.083\%)^{24} = 102.01$; that is, RPPI grows by 2.01%.

To provide a benchmark for comparison purposes, we note the economic magnitude reported in Amundsen and Bergman's (2002) study of the Scandinavian power generation market. Using data from two large utilities firms (Statkraft and Vattenfall), they estimate that a partial equity acquisition corresponding to 1200 megawatts worth of production (approximately the capacity of two nuclear power reactors) leads to a 5% increase in electricity prices. The economic magnitude in this example is understandably larger than in our sample because it relates to two dominant players in the Scandinavian power generation market, whereas our sample has some heterogeneity in firm size.[18]

Columns (2)–(7) of Table 4, panel A, present regressions in subsamples of high and low entry barriers. Low (high) entry barriers are captured by subsamples of below-median (above-median) capital intensity and below-median (above-median) PPE intensity. Moreover, industries experiencing an increase (decrease) in number of firms are classified as having low (high) entry barriers. We see that the dummy variable *POST* is insignificant in the low capital intensity sample, in the low PPE sample, and when change in the number of firms is positive. *POST* is positive and statistically significant in the high capital intensity sample, in the high PPE intensity sample, and when change in the number of firms is zero or negative. These findings are consistent with Hypothesis 1, which states that price increases are more likely in industries with high barriers to entry. The test for the difference in the coefficient on *POST* across the entry barrier subsamples is presented in the table at the bottom of the subsample regressions. We note that, as expected, higher cost of materials and higher wages are associated with higher output prices. Positive demand shocks are also associated with higher output prices, albeit with weaker statistical significance. The coefficient on horizontal merger activity is insignificant. Tests presented in Online Appendix A suggest that the increase in output prices is not due to new product development in innovative industries.

Panel B of Table 4 presents regressions of PCM on the dummy variable *POST*, controlling for several factors that affect industry profits. Here the variable *POST* is equal to 1 for the two years following the PEO event and 0 for the two years preceding the event. Since the PCM series are stationary, the regression analysis of PCM uses levels data and explicitly accounts for industry fixed effects. We also include year fixed effects, and standard errors are clustered by both industry and year. In column (1) of panel B, which presents the full sample, the coefficient on *POST* is positive and statistically significant and indicates that profit margins are 0.7% higher one year after the minority stake acquisition than before. Columns (2)–(7) present subsample regressions based on capital intensity, PPE intensity, and change in number of firms. When using capital intensity and PPE intensity as measures of entry barriers, regression coefficients are consistent with Hypothesis 1, with *POST* being positive and significant only in the high-barriers-to-entry sample. In columns (6) and (7), the coefficient on *POST* is statistically insignificant in both subsamples of change in number of firms. Despite the lack of statistical significance, we note that the relative magnitude of the coefficient on *POST* is consistent with Hypothesis 1. Moving to control variables, capital intensity is positive, indicating that price-cost margins are higher in industries with higher barriers to entry. Faster-growing industries have higher price-cost margins, and highly levered industries have lower profit margins.

5. Announcement Returns

Next, we examine stock price reactions to the announcement of minority stake acquisition. The primary focus of this section is on the CARs of nonparticipating rivals, customer firms, and supplier firms. For completeness, we present CARs for acquirers and targets as well. In Section 5.1, we describe how CARs are calculated for acquirers, targets, nonparticipating rivals, customers, and suppliers. In Section 5.2, we present the CAR results.

5.1. Announcement Returns Methodology

Following Brown and Warner (1985), we calculate the acquirer's and target's market-adjusted returns around the minority stake acquisition announcement dates as follows:

$$AR_{i,t} = R_{i,t} - R_{m,t}, \tag{2}$$

where $R_{i,t}$ is the return on the acquiring firm or the target firm and $R_{m,t}$ is the return on the Center for Research in Security Prices (CRSP) value-weighted index for day t. CARs are calculated by cumulating the market-adjusted returns over three different

[17] For presentation clarity, the log-differenced RPPI series in Table 4, panel A, is scaled up by a multiple of 100. Thus, a coefficient of 0.083 indicates 0.083% and not 8.3%.

[18] Another example of economic magnitudes can be found in past research on full-scale horizontal mergers. Kim and Singal (1993) examine airline mergers and find that routes affected by an airline merger experienced a 9.44% increase in airfares relative to unaffected routes.

short-run windows surrounding the deal announcement date, namely, $(-1, 0)$, $(-2, 2)$, and $(-10, 10)$. The deal announcement date, obtained through SDC Platinum, is the date on which either the acquirer or the target makes a public announcement of the minority stake acquisition. Following Bradley et al. (1988), we also estimate the combined wealth effect for acquirer and target as the cumulative abnormal return (CAR) to a value-weighted portfolio of the bidder and target. The weights are the respective market values of equity of the bidder and target 10 days before the announcement date. The target equity market value excludes the value of target shares held by the bidder before the announcement.

To test the market power hypothesis, we focus on CARs of rival firms and customer firms. We define a rival as any single-segment firm that operates in the four-digit SIC code affected by the minority stake acquisition.[19] For example, if the acquirer and target are both single-segment firms, a rival is any single-segment firm with the same SIC code as the acquirer and target. If either the acquirer or the target (or both) is a multisegment firm, then a rival is any single-segment firm that operates in the four-digit SIC code that is common between the acquirer and target. To identify customer firms, we follow Fee and Thomas (2004) and Dasgupta et al. (2008). Compustat's customer segment names files provide the identity and sales information of customers representing more than 10% of the total sales of a firm. We obtain names of the customers of all publicly traded acquiring firms and targeted firms in our sample for up to five years before the minority stake acquisition. Customer names are matched to CUSIP numbers using the customer segment names file provided by Compustat. Customer names that cannot be matched using the customer segment names file are carefully hand-matched to CUSIP numbers.[20] Since customer data are available only for public acquirers and targets, the sample size of our customer-based tests is smaller. To identify supplier firms, we invert the customer segment names file data. Specifically, we search the entire database of customer segment names files for firms that report the acquirer or target (legal name or possible abbreviation of their legal names) as their major customers.[21]

To estimate CARs of rivals, corporate customers, and supplier firms, we follow existing literature and create equally weighted portfolios to account for any contemporaneous cross correlation of returns (see Eckbo 1983, Song and Walking 2000, Shahrur 2005). For each deal, we create equally weighted portfolios of rival firms, customer firms, and supplier firms. We estimate market-adjusted returns for the rival, customer, and supplier portfolios by substituting the portfolio return for $R_{i,t}$ in Equation (2).

5.2. Announcement Return Results

In Table 5, we present CARs of acquirers and targets to see how our sample compares with existing evidence. In panel A, CARs of acquiring firms are statistically insignificant for all three windows. In contrast, CARs of target firms (panel B) are positive and statistically significant ranging from 7% for the $(-1, 0)$ window up to 12% for the $(-10, 10)$ window. In Allen and Phillips (2000), acquirer CARs are also statistically insignificant while target CARs over the $(-10, 10)$ window are a positive 7%.[22] The difference in magnitude of target CARs in our paper and in Allen and Phillips (2000) is probably attributable to the difference in samples. We focus exclusively on acquisitions of rival firms' equity whereas the sample in Allen and Phillips (2000) mostly involves equity stakes between nonrival firms. Panel C of Table 5 shows that combined CARs to the acquirer and target are positive and statistically significant. The positive combined wealth gains to acquirer and target indicate that minority stake acquisitions generate value for participating firms.

Next we test Hypothesis 2 (Hypothesis 3), which states that customer (rival) CARs will be negative (positive). Panel E of Table 5 shows that CARs to customers are negative and statistically significant in the $(-1, 0)$ window and the $(-2, 2)$ window. Customer CARs are negative but not statistically significant in the $(-10, 10)$ window. Thus, CARs of customer firms are supportive

[19] Following Shahrur (2005), we restrict our analysis to single-segment rivals for two reasons. First, multisegment customer firms and rival firms will have divisions in industries that are not affected by the minority stake acquisition. Second, multisegment firms may have divisions that operate in both the industry experiencing the minority stake acquisition as well in the downstream customer industry. That is, such firms may be both a rival and customer of the firms participating in the minority stake acquisition. For this reason, including multisegment firms is likely to reduce the power of our tests.

[20] Compustat's customer segment names file contains abbreviated names of customer firm, and these abbreviations change from one year to another. For example, the "diesel engine and parts" segment of Cummins Engine reports FORD MOTOR as one of its principle customers in 1980 and 1981, and FORD MTR as its customer in the subsequent two years. When using the customer segment names file, we are careful about accounting for these differences in abbreviations. Finally, we note that customers that are government or defense agencies such as the U.S. Navy are excluded from our sample.

[21] In untabulated results, we check robustness of our results to identifying customers using the Bureau of Economic Analysis (BEA) input–output tables instead of using Compustat segement files. This alternate approach assumes that each firm operating in the downstream industry is a customer of the acquirer or target. We find that our customer results are consistent but have weaker magnitude and significance. The weaker results are to be expected, given the noise of introducing downstream firms that may not actually be customers of firms participating in the PEO.

[22] See Table IV (on p. 2803) of Allen and Phillips (2000).

Table 5 Announcement Returns

Window	Mean	*p*-value	*N*
	Panel A: Acquirer CAR (%)		
(−1, 0)	−0.272	[0.146]	334
(−2, 2)	−0.428	[0.117]	334
(−10, 10)	0.099	[0.425]	334
	Panel B: Target CAR (%)		
(−1, 0)	6.920***	[<0.001]	314
(−2, 2)	10.584***	[<0.001]	314
(−10, 10)	11.583***	[<0.001]	314
	Panel C: Combined CAR of acquirer and target (%)		
(−1, 0)	0.400*	[0.089]	108
(−2, 2)	0.994**	[0.029]	108
(−10, 10)	1.537**	[0.031]	108
	Panel D: Nonparticipating rival portfolio CAR (%)		
(−1, 0)	0.145**	[0.022]	892
(−2, 2)	0.322***	[0.003]	892
(−10, 10)	1.250***	[0.000]	892
	Panel E: Customer portfolio CAR (%)		
(−1, 0)	−0.351***	[0.008]	288
(−2, 2)	−0.463**	[0.049]	288
(−10, 10)	−0.402	[0.221]	288
	Panel F: Supplier portfolio CAR (%)		
(−1, 0)	0.847***	[0.003]	316
(−2, 2)	1.885***	[0.004]	316
(−10, 10)	2.771***	[0.003]	316

Notes. This table presents cumulative abnormal returns (CARs) of acquirers, targets, their rivals, and their customers around the announcement of minority stake acquisitions. CARs are the market-adjusted returns cumulated over (−1, 0), (−2, 2), and (−10, 10) windows surrounding announcement of a minority stake acquisition. Panels A and B present the average CARs of acquirers and targets, respectively. Panel C presents CARs on a value-weighted portfolio of the acquirer and target combined. Panels D and E present CARs for rivals and customers, respectively. Panel F shows CARs for suppliers. Rivals are defined as single-segment firms operating in the same four-digit SIC code as the acquirer and target. Major customers representing more than 10% of the total sales of either acquirer or target are identified using Compustat customer segment names files. Suppliers are identified as the firms who report either acquirer or target as their major customers using Compustat customer segment names files. For each minority stake acquisition, we construct equal-weighted portfolios of rival firms, customer firms, and supplier firms and calculated market-adjusted returns as the portfolio return less the market return. The portfolio market-adjusted returns are then cumulated over the three windows.

*, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

of Hypothesis 2. CARs of rivals in panel D are positive and statistically significant across all three windows. This is in line with selling power and supportive of Hypothesis 3. To get an idea of the wealth loss for customers and gain for rivals, we estimate cumulative dollar abnormal returns (CDAR) for customer and rival portfolios by modifying Ahern's (2012) method. We estimate the dollar wealth loss to customers as follows. First, we calculate the dollar abnormal return for a customer portfolio on each day in an event window as the percentage abnormal return on the customer portfolio on that day times the average market value of equity of the customer portfolio on the previous day. We then cumulate these dollar abnormal returns over all the days in the event window to obtain CDAR for the customer portfolio. We find that over the (−2, 2) window, for example, the mean CDAR for customer portfolios is −$2.32 million. We repeat the process for the rival portfolio and find that the mean CDAR over the (−2, 2) window for the rival portfolios is $1.77 million. These numbers suggest that antitrust authorities may not be adequately monitoring the competitive effects of PEOs.

We note that enhanced buying power and information spillovers about efficiency gains from possible future deals can also lead to positive CARs for rivals. We check the buyer power hypothesis by examining supplier CARs. Panel F of Table 5 shows that CARs of suppliers are positive and statistically significant, which is not consistent with the buyer power hypothesis.[23] So, positive rival CARs are not explained by buying power. However, efficiency gains may still be an explanation for positive rival CARs.

To further distinguish selling power from efficiency explanations, we move on to Hypotheses 4 and 5. Hypothesis 4 states that rival CARs will be lower and customer CARs higher when customer industry concentration is greater. To test Hypothesis 4, we need measures of customer industry concentration. We use the Herfindahl–Hirschman Index (HHI), the four-firm concentration ratio (CR4), and the fitted SIC-based industry concentration measure from Hoberg and Phillips (2010) (fitted HHI) to capture customer industry concentration. The acquirer and target can have customer firms that operate in different four-digit SIC codes. In such cases, we calculate a deal-level average of the concentration measure of all customer firms' SIC codes. HHI and CR4 are obtained from the Annual Survey of Manufactures. For each four-digit SIC code, CR4 is the percentage of the value of shipments accounted for by the four largest firms in the industry. The HHI is calculated by summing the squares of the individual company percentages (of value of shipments) for the largest 50 companies or all the companies in the industry, whichever is lower. Finally, Hoberg and Phillips' fitted HHI measure is obtained directly from the Hoberg–Phillips data library.[24] For 271 deals in our sample, we are able to calculate all of the three concentration ratios for customer industries. These are summarized in Table 6.

[23] In untabulated tests, we examine operating performance of suppliers and find that operating performance of suppliers after the PEO is statistically indistinguishable from the operating performance before PEO. Thus, there is no consistent evidence of the impact of PEOs on suppliers.

[24] The data are obtained from http://hobergphillips.usc.edu (last accessed October 3, 2016). Hoberg and Phillips (2010) use a two-step procedure to calculate a measure of concentration that accounts for privately held firms by combining Compustat data with Herfindahl index data from the Commerce Department and employee data from the Bureau of Labor Statistics (BLS). First, for the subsample of manufacturing industries, they regress actual five-yearly HHI obtained from the Commerce Department on the following variables: the Compustat public-firm-only Herfindahl index, the

Table 6 Descriptive Statistics of Deal-Level and Firm-Level Variables

	Mean	Median	P25	P75	*N*
Deal-level variables					
Percentage acquired (%)	15.26	11.60	6.00	20.00	650
Transaction value	40.77	8.00	2.87	22.00	641
Equity value	691.80	89.54	24.92	333.36	492
Acquirer characteristics					
Acquirer total assets	10,330.48	2,090.39	468.43	8,672.80	334
Acquirer market share (%)	19.45	9.11	2.02	28.62	334
Target characteristics					
Target total assets	596.02	61.07	26.37	236.16	314
Target market share (%)	5.96	0.48	0.00	4.41	314
Customer industry					
Customer industry HHI	783.21	634.70	462.40	1,011.00	271
Customer industry CR4 (%)	42.64	42.00	35.58	51.90	271
Customer industry FitHHI (%)	5.45	4.72	4.50	5.31	271

Notes. This table presents summary statistics of the deal-level and firm-level variables related to minority stake acquisitions announced between 1980 and 2010. Industry concentration ratios are also summarized. *Percentage acquired*, obtained from SDC Platinum, is the percentage of the target firm's outstanding shares purchased by the acquirer. *Transaction value* (in millions), obtained from SDC Platinum, is the total value of consideration paid by the acquirer, excluding fees and expenses. *Equity value* (in millions) is calculated by multiplying the total number of target shares outstanding by the offer price per share and is also obtained from SDC Platinum. If either offer price or shares outstanding are missing, SDC Platinum estimates equity value from the transaction value excluding liabilities assumed. *Acquirer* (*Target*) *total assets* (in millions) is the book value of total assets of the acquirer (target), obtained from Compustat. *Acquirer* (*Target*) *market share* is the acquirer's (target's) total sales divided by total industry sales, where firm sales are obtained from Compustat. *Customer industry CR4* (*Customer industry HHI*) is the average per deal of the four-firm concentration ratio (Herfindahl–Hirschman index) of customers' industries. *Customer industry fitHHI* is obtained from the Hoberg–Phillips Data Library (http://cwis.usc.edu/projects/industrydata/) and is described in Hoberg and Phillips (2010). Both CR4 and HHI measures are obtained from the Annual Survey of Manufactures. CR4 is the percentage of the value of shipments accounted for by the four largest firms in the industry. HHI is calculated by summing the squares of the individual company percentages (of value of shipments) for the largest 50 companies or for all of the companies in the industry, whichever is lower.

To test Hypothesis 5, which states that rival CARs will be higher and customer CARs lower when the acquirer and target are larger, we need proxies for acquirer and target size. We use total assets and sales market share to capture acquirer and target size. *Acquirer* (*target*) *total assets* is the book value of total assets of the acquirer (target), obtained from Compustat. In the regressions, we use acquirer or target adjusted size, which is total assets of the acquirer (target) less the average value of industry total assets divided by the average value of industry total assets. *Acquirer* (*target*) *market share* is the acquirer's (target's) total sales divided by total industry sales, where firm sales are obtained from Compustat. In Table 6, we summarize acquirer (target) size measures for 334 (314) observations for which both of these size measures are available in Compustat.

From SDC Platinum we also obtain information on two additional proxies for target size, namely, equity value and transaction value. Equity value captures the total value of the target's equity based on the offer price of the minority stake acquisition. It is calculated by multiplying the total number of target shares outstanding by the offer price per share. When data on shares outstanding or offer price are not available, SDC Platinum estimates equity value using deal transaction value excluding liabilities assumed. Finally, transaction value is the total value of consideration paid by the acquirer, excluding fees and expenses.[25] Summary statistics of these variables are presented in Table 6. Transaction value is well populated in SDC Platinum with 641 observations available. Equity value is available for 492 observations. In subsequent regressions, we use industry-adjusted versions of these variables.

In Table 7, we examine the relation between customer industry concentration and CARs earned by rivals and customers. The main explanatory variables in these regressions are dummy variables capturing high customer industry concentration. *High customer HHI* (*High customer CR*4) equals 1 for deals for which the average customer industry HHI (CR4) is above sample median, and 0 otherwise. The dummy variable *High customer FitHHI* is defined in a similar way for fitted HHI. Note that sample sizes in Table 7 are smaller than the 271 observations of concentration ratios shown in Table 6 because for some deals concentration data are available but rival or customer CARs are not. For example, of the 271 deals for which customer concentration data are available, only 262 (256)

average number of employees per firm using BLS data, and the number of employees per firm for public firms using Compustat data. In the second step, Hoberg and Phillips use the coefficient estimates from this regression to compute fitted HHI for all industries. This fitted method captures the influence of both public and private firms and is available annually.

[25] We note that, in minority stake acquisitions, transaction value is only a rough measure of target size since it depends on the percentage of target shares acquired. However, for a given fraction of target shares acquired, transaction value will be greater for larger targets.

Table 7 Rival or Customer CARs and Customer Industry Concentration

	(1) Rival CAR	(2) Rival CAR	(3) Rival CAR	(4) Customer CAR	(5) Customer CAR	(6) Customer CAR
High customer HHI	−0.808*			1.050**		
	(−1.671)			(2.019)		
High customer CR4		−1.143**			1.185**	
		(−2.170)			(2.128)	
High customer fitHHI			−1.465**			0.352
			(−2.364)			(0.614)
Financing	−0.224	−0.345	−0.792	−0.520	−0.362	−0.324
	(−0.211)	(−0.340)	(−0.799)	(−0.409)	(−0.279)	(−0.251)
Business agreement	−0.447	−0.456	−0.637	0.406	0.435	0.558
	(−0.534)	(−0.541)	(−0.785)	(0.580)	(0.634)	(0.778)
Merger/Board	−1.817**	−1.699**	−1.677*	0.029	−0.096	−0.078
	(−2.129)	(−1.978)	(−1.934)	(0.017)	(−0.056)	(−0.045)
Joint venture	−0.675	−0.691	−0.842	0.649	0.723	0.742
	(−0.547)	(−0.552)	(−0.637)	(0.811)	(0.886)	(0.906)
Tech transfer	0.945	0.893	0.565	0.268	0.320	0.304
	(1.307)	(1.271)	(0.800)	(0.402)	(0.474)	(0.442)
Intercept	2.093**	2.140**	2.690***	−1.186*	−1.137*	−0.935
	(2.537)	(2.415)	(3.376)	(−1.675)	(−1.690)	(−1.410)
Observations	262	262	262	256	256	256
R-squared	0.033	0.041	0.051	0.021	0.025	0.007

Notes. This table presents regressions of rival and customer cumulative abnormal returns (CARs) on customer industry concentration. CARs are cumulative market adjusted returns calculated over the $(-10, 10)$ window surrounding the announcement of minority stake acquisitions. Rivals and customers are identified as described in Table 5. The main explanatory variables, *High customer HHI* (*High customer fitHHI* or *High customer CR4*), are dummy variables equal to 1 for deals where the average customers industry HHI (fitted HHI or CR4) is above the sample median, and 0 otherwise. Control variables are as follows. *Financing* is a dummy variables equal to 1 if the minority stake acquisition in our sample is expected to reduce financing constraints for the target and 0 otherwise. *Tech transfer* is a dummy variable equal to 1 if the minority stake acquisition is accompanied by an agreement to share technology. *Joint venture* is a dummy variable equal to 1 if the equity acquisition is accompanied by a joint venture between the target and acquirer and 0 otherwise. *Business agreement* is a dummy variable that takes a value of 1 if the equity acquisition is accompanied by any business agreement between the acquirer and target. *Merger/Board* is a dummy variable that takes the value of 1 if the minority stake acquisition is accompanied by speculation of a possible merger or if the acquirer appointed a member to the target's board. Standard errors are clustered at the deal level. *t*-statistics are in parentheses.

*, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

have rival (customer) CAR data available. To alleviate concerns that this listwise deletion approach introduces a bias in our regression analysis, we confirm that the dependent variable is not correlated with the probability of an explanatory variable having a missing value.

Looking at regressions of rival CARs first (columns (1)–(3)), we see that the coefficients of *High customer HHI*, *High customer CR4*, and *High customer FitHHI* are all negative and statistically significant.[26] Thus, rival CARs are higher in the subgroups with low customer industry concentration as compared with the high concentration subgroup. Looking at customer CARs in columns (4)–(6), the coefficient on the concentration dummy variable is positive in all specifications and statistically significant in two of the three regressions. Thus, we find support for Hypothesis 4.[27]

Table 8 presents regressions to test Hypothesis 5. Panel A presents regressions of rival CARs on several measures of acquirer and target size, while panel B shows regressions of customer CARs on acquirer and target size. The sample size of each regression varies depending on whether the size variable (summarized in Table 6) and either customer CAR or rival CAR are available. For example, of the 334 deals for which acquirer size data are available, only 287 have rival CAR data available.

In panel A, we see that acquirer market share, target market share, target adjusted size, equity value, and transaction value are all positively associated with

[26] In unreported tests, the results are qualitatively similar when we use customer industry HHI and CR4 as continuous variables instead of converting to dummy variables. Our findings are also similar if we use CARs over the $(-1, 0)$ window and $(-2, 2)$ window in the multivariate regressions. Moreover, in unreported tests, we estimate demand elasticity for customer industries and use high demand elasticity as a proxy for a competitive industry. We find similar but statistically weaker results.

[27] Concentration ratios are an appropriate measure of competition in Cournot competition, but not Bertrand. We use the concept of competition in strategic complements and strategic substitutes to identify customer industries that are likely to follow Bertrand competition (which resembles competition in strategic complements). Using the competitive strategy measure (CSM) of Sundaram et al. (1996), we identify 79 deals in which customer industries likely follow Bertrand competition. Our results are qualitatively unchanged if we drop these observations from the regressions.

Table 8 Rival or Customer CARs and Firm Size

	(1)	(2)	(3)	(4)	(5)	(6)
			Panel A: Dependent variable is rival CAR			
Acquirer adjusted size	−0.003					
	(−0.881)					
Target adjusted size		0.027*				
		(1.813)				
Acquirer market share			3.136*			
			(1.673)			
Target market share				17.942**		
				(2.497)		
Adjusted equity value					0.226***	
					(4.232)	
Adjusted transaction value						3.928***
						(2.851)
Financing	−2.053*	−3.873**	−2.220*	−3.757**	−1.322	−1.319
	(−1.683)	(−2.352)	(−1.814)	(−2.281)	(−0.955)	(−0.952)
Business agreement	0.701	−0.796	0.524	−0.788	−1.461	−1.462
	(0.610)	(−0.597)	(0.463)	(−0.587)	(−0.998)	(−0.998)
Merger/Board	−2.131*	−2.929**	−1.786	−3.399**	−4.005***	−4.007***
	(−1.922)	(−2.139)	(−1.604)	(−2.386)	(−3.137)	(−3.137)
Joint venture	0.390	0.330	0.031	0.185	−1.530	−1.555
	(0.247)	(0.221)	(0.021)	(0.130)	(−1.021)	(−1.034)
Tech transfer	1.662*	2.308**	1.824*	2.352**	0.517	0.509
	(1.680)	(1.999)	(1.797)	(2.157)	(0.411)	(0.404)
Observations	287	275	287	275	241	241
R-squared	0.039	0.070	0.047	0.084	0.054	0.052
			Panel B: Dependent variable is customer CAR			
Acquirer adjusted size	0.008					
	(1.307)					
Target adjusted size		−1.018***				
		(−12.727)				
Acquirer market share			−0.842			
			(−0.244)			
Target market share				−5.099		
				(−0.564)		
it Adjusted equity value					−3.661**	
					(−2.146)	
Adjusted transaction value						−39.560**
						(−2.126)
Financing	−2.506	0.498	−1.792	0.623	−0.881	−0.774
	(−0.585)	(0.232)	(−0.419)	(0.275)	(−0.393)	(−0.347)
Business agreement	0.849	0.650	1.131	1.213	1.702	1.781
	(0.436)	(0.409)	(0.576)	(0.620)	(0.916)	(0.934)
Merger/Board	4.824*	−2.293	4.533	−4.118	3.287	3.485
	(1.779)	(−0.781)	(1.610)	(−0.887)	(1.258)	(1.339)
Joint venture	3.026	2.153	3.319	0.371	0.525	0.765
	(1.298)	(0.828)	(1.419)	(0.204)	(0.289)	(0.410)
Tech transfer	−1.135	1.649	−1.056	1.132	1.033	1.164
	(−0.508)	(1.066)	(−0.471)	(0.758)	(0.508)	(0.567)
Observations	151	165	151	165	137	137
R-squared	0.046	0.209	0.037	0.050	0.039	0.036

Notes. This table presents regressions of rival and customer cumulative abnormal returns (CARs) on measures of acquirer and target size. In panel A, the dependent variable is the CAR earned by nonparticipating rivals of the acquirer and target over the $(-10, 10)$ window surrounding the announcement of a minority stake acquisition. In panel B, the dependent variable is the CAR earned by customers of the acquirer and target over the $(-10, 10)$ window. CARs are cumulative market-adjusted returns, calculated as the raw return less the value-weighted market index. Rivals and customers are identified as described in Table 5. The main explanatory variables are as follows. *Acquirer* (*Target*) *adjusted size* is calculated as total assets of the acquirer (target) less the average value of industry total assets divided by average value of industry total assets. *Acquirer* (*Target*) *market share* is acquirer (target) total sales divided by total industry sales. *Adjusted transaction value* is the total consideration paid by the acquirer for the target firm's shares divided by the industry average value of total assets. *Adjusted equity value* is calculated as the actual number of target shares outstanding times the offer price per share divided by industry average value of total assets. All control variables are as described in Table 7. Standard errors are clustered at the deal level. *t*-statistics are in parentheses.

*, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

rival CARs. When the dependent variable is the customer CAR instead (panel B), five of the size variables have a negative coefficient with three of the five coefficients being statistically significant. The negative signs on the size measures stand in stark contrast to the positive and significant coefficients on the same variables in the rival CAR regressions. Table 8 indicates that acquisition of minority equity in larger targets is expected to benefit nonparticipating rival firms and hurt customer firms.

We briefly note the control variables in Tables 7 and 8. If a minority stake acquisition signals opportunities for other firms in the industry to engage in similar transactions and reduce financing costs or improve efficiency through sharing technologies, then rivals' stock returns may react positively. Therefore, we include a dummy variable called *Financing* that is equal to 1 if the minority stake acquisition in our sample was expected to reduce financing constraints for the target, and 0 otherwise. Technology sharing and strategic partnerships between the acquirer and target may lead to the development of newer, higher-quality products that are sold at higher prices. To control for this possibility, we include a dummy variable, *Tech transfer*, that is equal to 1 if the minority stake acquisition is accompanied by an agreement to share technology. We also include two dummy variables to capture other business partnerships. *Joint venture* equals 1 if the equity acquisition is accompanied by a joint venture between the target and acquirer. The second dummy variable, *Business agreement*, takes a value of 1 if the equity acquisition is accompanied by a strategic alliance or any other business agreement between acquirer and target as described in Section 4.1. We also control for the possibility that the positive reaction of rival firms is attributable to the likelihood of a change in corporate control. We account for this by including a dummy variable *Merger/Board* that equals 1 if the minority stake acquisition is accompanied by rumors of a possible merger or if the acquirer appointed a member to the target's board.

Customer CARs are unrelated to all these control variables. Rival CARs in Table 8, on the other hand, are lower if acquisition eases the target firms' financial constraints. Rival CARs are also smaller if the acquiring firm obtains a board seat or if there is a speculation of a merger deal in the future. The latter finding suggests that rival firms react negatively to the likelihood that the acquirer obtains some control rights over the target firm. Finally, we note that rival CARs are higher if the acquisition involves a technology transfer.

6. Conclusion

Many of the arguments that predict a decline in industry competition following horizontal mergers are also applicable to minority stake acquisitions. Industrial organization theory shows that partial ownership of rivals' equity results in a unilateral decline in competition and also encourages cooperative collusion. In this paper, we empirically examine the product market impact of partial equity ownership between rival firms. Using a relatively large, cross industry sample of U.S. manufacturing industries, we examine changes in output prices and price-cost margins following minority stake acquisitions. We find that there is a significant increase in product prices and industry profit margins after minority stake acquisitions. Consistent with market power arguments, the increase in prices and profits is most pronounced in industries that face high barriers to entry. We test the product market impact further by looking at announcement returns to nonparticipating rival firms and customer firms. We find that rival firms experience positive returns and customer firms experience negative returns when horizontal minority stake acquisitions are announced, particularly when the customer industry has a low concentration index. Existing theory indicates that equity ownership between rival firms will have a larger impact on industry prices if the firms participating in the PEO are larger. In line with this, our empirical tests show that the stock price reactions of rivals are positively related to several measures of the size of the deal. We also find evidence that the negative stock price reaction of customer firms is more pronounced when the target firm is larger. Our paper provides the first large sample evidence that minority stake acquisitions of rival equity reduce competition in an industry.

Supplemental Material

Supplemental material to this paper is available at https://doi.org/10.1287/mnsc.2016.2575.

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