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Horizontal acquisitions and buying power: A product market analysis ☆

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ABSTRACT

Horizontal mergers exert price pressure on dependent suppliers and adversely affect their performance. Consistent with the theory of countervailing power, concentrated suppliers and those with greater barriers to entry experience larger price declines after consolidation downstream. Time-series results suggest that consolidation in dependent supplier industries follows mergers in main customer industries, indicating that consolidation activity travels up the supply chain. The findings are broadly consistent with pervasive beliefs in the business community about the buying power effects of horizontal mergers.

> " … apparel-company executives say they are bracing for store closures, cutbacks and thinner profit margins. The potential fallout reflects the huge negotiating power that a combined Federated-May would wield and the diminishing clout of suppliers. … it could also accelerate consolidation among apparel suppliers, as they strive to get bigger to better face off against their giant customers."
>
> — Wall Street Journal article[2]

1. Introduction

There is a long-standing debate in the economics and finance literatures on the motives for horizontal mergers. While managers of firms undertaking horizontal mergers usually cite expected improvements in productive efficiencies, i.e., synergies, as the key rationale behind such moves, antitrust authorities frequently express concern that horizontal mergers may increase market power vis-à-

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[2] "Combined Federated-May could stress apparel makers," *The Wall Street Journal*, March 1, 2005.

vis customers and suppliers of the merging firms' industry. The latter view is also often supported in discussions in the business press pertaining to specific deals, as evidenced by the quote above. Academic research has extensively examined the effect of horizontal acquisitions on market power vis-à-vis customers and arrived at conflicting conclusions.[3]

There is, however, a major selection bias inherent in studies that look for signs of selling power created by horizontal mergers. The bias arises due to the fact that horizontal mergers expected to increase selling power and result in higher prices for customers will be anticipated to be blocked by antitrust authorities. Thus, mergers which clearly enhance selling power may never be observed when one looks for evidence in product or stock markets. The same logic, however, does not hold so far as the impact on suppliers is concerned. Horizontal mergers that increase buying power may contribute to lower costs of production downstream. Moreover, enhanced buying power downstream may counteract established selling power upstream and force suppliers to charge competitive prices. In fact, antitrust authorities may very well look upon such mergers favorably. Consequently, we examine the possible creation of buying power through horizontal acquisitions by studying their impact on suppliers. An auxiliary motivation for looking at the effect of horizontal mergers on supplier industries is that the industrial organization literature already shows the importance of being a large buyer: buyer size and buyer industry concentration have long been known to be correlated with lower seller profits.[4] Yet, the upstream effects of a major corporate event – industry consolidation through mergers – that can create large buyers and increase buyer industry concentration remain largely unexamined.[5] Thus, the objective of this paper is to ask one overarching question: do horizontal mergers create buying power?

We answer this question by first examining the effect of horizontal mergers on profits and product prices in the supplier industry. We use a relatively large, cross-industry sample to examine whether horizontal mergers bring about a decline in the profits of supplier industries and whether such a decline can be attributed to a decline in prices at which supplier industries sell. Using mergers and acquisitions (M&A) data from 1984 to 2003, we construct a sample of industries that experienced a significant jump in horizontal merger activity in a specific quarter. Having identified these downstream *merger events*, we ask whether supplier industries more dependent on the downstream merging industry experience greater adverse changes in profits and output prices after the event. We find that supplier industries selling a larger fraction of their output to the downstream consolidating industry have lower cash-flow margins following downstream consolidation. The abnormal cash-flow margin of dependent supplier industries after downstream consolidation is, on average, 3% lower than that of non-dependent supplier industries. Thus, we confirm Fee and Thomas's (2004) finding that some supplier industries suffer declines in operating profits after a horizontal merger downstream.

However, we recognize that a decline in supplier profit margins may also result from changes unrelated to the creation of market power downstream. To attribute deterioration in profit margins upstream to an increase in buying power downstream, we need to also show a decline in upstream selling prices. As a result, we use the Producer Price Index (PPI) as a measure of selling prices to examine changes in selling prices in dependent supplier industries. Controlling for changes in input prices and demand shocks faced by the supplier industry, we first establish that prior to downstream consolidation, changes in the PPI of dependent and non-dependent supplier industries over a three-year period are statistically indistinguishable. In contrast, dependent supplier industries exhibit significantly larger declines in PPI in the three years following downstream consolidation. The differential impact is of the order of 0.1% per month, translating to a difference of up to 3.6% over the three years following downstream consolidation. Our results are robust to alternative regression methods. A difference-in-differences test in the pooled data lends further confirmation of dependent suppliers performing significantly worse than non-dependent suppliers, but only in the post-merger period. To show that such declines are not due to secular time trends independent of downstream consolidation, we create random 'event dates' and use them as break points to further examine the evolution of supplier selling prices. We find that there is no difference in the selling prices of dependent suppliers before and after such random event dates. Based on this battery of tests, we conclude that the decline in supplier selling prices may, indeed, be attributed to consolidation downstream.

While a decline in supplier prices after downstream consolidation is consistent with the creation of buying power, it may also be consistent with merger-induced improvements in efficiency. For example, if downstream consolidation created production efficiencies resulting in a decline in the demand for inputs, this could also lead to lower supplier selling prices. The existence of such a straightforward alternative explanation, therefore, requires us to design additional tests to attribute the decline in selling prices upstream to enhanced buying power downstream.

To this end, we draw on Galbraith's (1952) theory of countervailing acquisitions where he argues that economic power is held in check by the countervailing power of those who are subject to it. Thus, if sellers earn non-competitive rents due to small numbers (oligopoly),

[3] Focusing primarily on announcement returns, Eckbo (1983), Stillman (1983), Eckbo (1985), Eckbo and Wier (1985), Fee and Thomas (2004), and Shahrur (2005) conclude that horizontal mergers do not create selling power vis-à-vis customers. Looking at product prices directly, Barton and Sherman (1984), Borenstein (1990), Kim and Singal (1993), Singal (1996), Akhavein, Berger, and Humphrey (1997), and Prager and Hannan (1998) conclude that horizontal mergers create selling power.

[4] See, for example, Lustgarten (1975), Clevenger and Campbell (1977), McGuckin and Chen (1976), and Schumacher (1991).

[5] Exceptions are Fee and Thomas (2004) and Shahrur (2005). Both these studies find some preliminary evidence that downstream mergers adversely affect suppliers in concentrated industries.

practical barriers to entry, or explicit collusion, buyers have an incentive to develop the power with which they can defend themselves.[6] In Snyder (1996, 1998), mergers between buyers can intensify competition among colluding sellers leading to lower prices. If suppliers held prices above competitive levels prior to downstream consolidation – either unilaterally or through collusion – countervailing theory implies that increased purchasing power created by downstream consolidation would force them to start competing more aggressively on price. Thus, the selling prices of previously non-competitive suppliers would be more adversely affected by downstream consolidation. We test this implication of the countervailing power hypothesis by regressing the change in supplier industry prices after downstream consolidation on empirical proxies of the level of price competition in an industry.

We find that supplier industries with a higher Herfindahl index or a higher four-firm concentration ratio prior to consolidation downstream experience larger price declines post-consolidation. A similar result obtains when we use capital intensity and capital expenditures to proxy for higher barriers to entry upstream. Using proxies for *changes* in supplier industry concentration prior to downstream consolidation, we find that the post-consolidation decline in supplier selling prices is higher when there is a prior increase in the four-firm concentration upstream. Similarly, suppliers experiencing increased horizontal merger activity prior to downstream consolidation suffer larger price declines post-consolidation. These results are all consistent with the creation of buyer power through downstream consolidation to countervail upstream market power.

Our results give rise to several questions about the possible time-series pattern of horizontal merger activity across industries sharing product market relationships. Is downstream consolidation activity exogenous or is it triggered by prior consolidation in supplier industries? Do supplier industries respond to a loss in pricing power by subsequently undertaking horizontal acquisitions of their own? These intriguing questions have not been explored in prior M&A research. Consequently, we make an exploratory attempt to answer these questions using the data on horizontal mergers within industries in the 1984–2003 period. We find that suppliers' horizontal merger activity in a given year is positively related to consolidation activity in main customer industries over the prior four years. This finding is consistent with the Becker and Thomas (2009) result that changes in customer industry concentration are positively related to subsequent changes in dependent supplier industry concentration, and is in line with the finding in Ahern and Harford (2009) that merger waves propagate along connected industries.[7] Although it is hard to definitively establish causality, our result suggests that consolidation by suppliers arises as a reaction to downstream consolidation, consistent with the pattern exposited by our opening quote from the *Wall Street Journal*. In contrast, we find no statistically significant relationship between consolidation activity in customer industries and past merger activity in their main supplier industries.

Our results confirm the Fee and Thomas (2004) finding that supplier operating performance deteriorates after downstream consolidation, but we are also able to attribute such deterioration to adverse price changes. The results are also consistent with Shahrur's (2005) finding that more concentrated suppliers have poorer announcement returns when a downstream merger occurs. Combined, these prior results already point to the possibility of downstream mergers creating buying power. Our paper, in contrast, provides direct evidence that supplier selling prices themselves decline after downstream consolidation. We are also able to attribute this decline to a shift in market power in favor of the downstream merging industry. Our paper is also the first to show that supplier industries subsequently undertake horizontal acquisitions of their own and suggests that such consolidating acquisitions can propagate across industries sharing product market relationships. Finally, in addition to contributing to our understanding of the market power effects of horizontal acquisitions, this paper adds to existing evidence that merger activity is determined by industry-level factors (see Mitchell and Mulherin, 1996; Andrade, Mitchell, and Stafford, 2001).

The paper is organized as follows: Section 2 briefly discusses related research. Section 3 motivates the empirical tests. Section 4 contains methodology, data sources, and results. Section 5 addresses issues of robustness. Section 6 concludes.

2. Existing literature

Two approaches have been employed in the empirical literature to examine whether horizontal mergers create market power. The indirect approach, commonly found in the finance literature, examines the stock price reactions of merging firms, their rivals, suppliers, and corporate customers to M&A announcements. In this event-study based approach, efficient stock prices are assumed to correctly reflect the anticipated effects of horizontal mergers on factor and output prices. For example, if horizontal mergers enhance market power, rival firms should also be affected. Therefore, Eckbo (1983) and Stillman (1983) examine the announcement returns of rivals to merger announcements and to antitrust challenges to such mergers. However, they do not find any evidence consistent with the creation of market power through horizontal acquisitions. Likewise, Eckbo (1985) and Eckbo and Wier (1985) conclude that horizontal mergers are motivated for efficiency reasons and not for enhanced market power. Fee and Thomas (2004) and Shahrur (2005) examine the stock price reactions of rival firms, customers, and suppliers and also conclude that horizontal mergers are motivated primarily by improvements in production efficiencies. They find no evidence of enhanced selling power.[8] However, although this is not

[6] See Chapter 9 of Galbraith (1952).

[7] Ahern and Harford (2009) use techniques from the social-networking literature and determine inter-industry connections based on the strength of supplier and customer relations.

[8] Although our paper focuses on studying the effect of horizontal mergers on buying power, our sample is consistent with these studies.

their primary focus, both Fee and Thomas (2004) and Shahrur (2005) find some preliminary evidence that horizontal mergers increase buying power.

The direct approach, most commonly found in the industrial organization literature, focuses directly on the effect horizontal mergers have on product prices. Borenstein (1990) and Kim and Singal (1993) find increases in airfares on routes served by merging firms relative to a control group of routes unaffected by mergers. Singal (1996) also examines airfares and concludes that airline mergers result in both increased market power and more efficient operations. Prager and Hannan (1998) examine the effect of bank mergers on deposit rates and attribute declines in such rates to increased concentration brought about by the mergers. Akhavein, Berger, and Humphrey (1997) and Barton and Sherman (1984) also find evidence that horizontal mergers increase market power. These product market studies tend to focus on specific industries like banking and airlines and confine their attention to price levels in the consolidating industries themselves. As a result, it is not clear to what extent the results are specific to the characteristics of the particular industries analyzed.

3. Hypothesis development

Merged firms can exercise buying power in different ways. They can, for example, pool purchases to obtain quantity discounts from suppliers, or increase profit margins by squeezing suppliers. Insofar as these actions promote greater efficiency on the part of suppliers, Fee and Thomas (2004) label these as evidence of efficiency-increasing buying power. A merged firm may also exercise buying power by restricting purchases to monopsony levels causing input prices to fall below marginal cost (see Robinson, 1933). In the presence of sunk costs, such price decreases may be sustained in the short-run but will come at a cost to efficiency. In this paper, we are agnostic about the welfare consequences resulting from the use of market power and focus entirely on the possible exercise of market power alone.[9]

If horizontal mergers do, indeed, create buying power, we expect this effect to show up in the operating performance of supplier industries. Since merging firms will be able to exercise buying power more effectively when their supplier industries are more dependent, we hypothesize that dependent supplier industries will suffer a greater decline in performance after downstream consolidation than those less dependent on the downstream industry. Since such effects may take some time to show up in the data, we hypothesize that such performance effects will be evident over a three-year horizon. We choose this horizon because acquisitions of significant size often take six months to a year to be consummated. Thus, our first hypothesis is:

Hypothesis 1. *More dependent suppliers experience greater adverse changes in cash flow margins in the three years subsequent to an announcement of downstream consolidation.*

Declines in operating performance, while consistent with buying power enhancement, are not definitive evidence of the exercise of buying power. Other unrelated factors like increases in production costs or wages may also account for a drop in profitability of supplier industries. If, however, the decline in performance is related to enhanced buying power, we should expect this to also show up in the form of diminished selling prices in the supplier industry. Therefore, our second hypothesis is:

Hypothesis 2. *More dependent supplier industries experience larger declines in selling prices subsequent to downstream consolidation.*

When consolidation downstream is mainly predicated on taking advantage of cost-savings, price declines in supplier industries are suggestive of the creation of buying power. However, there are several other channels through which horizontal mergers can affect supplier prices. For example, efficiency-improving horizontal mergers can have either a positive or a negative impact on supplier prices. An increase in productive efficiency downstream can result in lower marginal costs of production, lower selling prices, and higher output levels. Higher output levels can drive up demand for inputs and, therefore, the prices charged by suppliers. On the other hand, if consolidation enables the merging firms to produce the same output with a lower use of inputs, the demand for inputs, and therefore their prices, will fall. Thus, efficiency improvements alone can also result in observed declines in supplier selling prices. Such declines in supplier selling prices may also be explained by an increase in the selling power of the consolidating industry. Diminished competition resulting from consolidation may result in higher selling prices and lower output levels. These lower output levels would translate into lower demand for inputs and, thus, lower input prices, even in the absence of enhanced buying power.[10]

An observed decline in supplier selling prices could, then, be explained without relying on the enhancement of downstream buying power. Since production efficiencies, monopolistic collusion, and enhanced buying power can coexist when horizontal acquisitions occur, distinguishing clearly between these possible causes for price declines in supplier industries is challenging. We use the hypothesis

(*footnote continued*)
An analysis of selling prices after horizontal mergers provides no evidence of enhanced selling power.

[9] Firms are known to publicly justify mergers with the cost savings that would arise due to increased buying power. A proposed merger between Staples and Office Depot in 1997 was blocked by antitrust authorities on the grounds that it would lead to higher prices for consumers. Staples countered with the argument that the merger would allow it to lower selling prices because of the greater purchasing power the transaction would bring. See "Office Depot Staples deal is blocked," *The Wall Street Journal*, July 1, 1997.

[10] Jensen (1993) presents another 'efficiency' explanation for horizontal mergers where some consolidations are driven by excess capacity. If the need to reduce excess capacity leads to consolidations in both customer and supplier industries, then a decline in supplier prices could be attributed to excess capacity rather than the creation of buying power.

of countervailing acquisitions to see if such price declines can be attributed, at least in part, to enhanced buying power.

Galbraith (1952) contends that in the typical modern market of a few sellers, the active restraint to hold prices close to marginal cost is provided not by competitors but by strong buyers. One implication of this theory is that downstream consolidation acts as a check on non-competitive pricing upstream. More recent models for countervailing power allow for multiple sellers whose ability to collude depends on the characteristics of the buyer. For example, Snyder (1996) presents a dynamic theory of countervailing power in which large buyers are shown to obtain lower prices from colluding sellers. In Snyder (1996, 1998), mergers between buyers intensify competition among colluding sellers. Snyder (1996) shows that mergers in the buyer industry increase profits of all buyers, not just those of the merging firms, at the expense of the seller. Ellison and Snyder (2001), Stole and Zwiebel (1996), and Chipty and Snyder (1999) examine buyer bargaining power relative to a single seller. Their models present reasonable conditions under which large buyers are charged lower prices. Moreover, the notion that large buyers have an advantage in obtaining price concessions from sellers has been verified by a number of empirical studies.[11]

If downstream consolidation creates countervailing power as these theories suggest, then suppliers who enjoyed some form of non-competitive pricing prior to such consolidation should experience larger price declines ex post. Using industry concentration as a measure of competitive pricing, we formulate our third hypothesis as:

Hypothesis 3. *If downstream consolidation generates buying power, supplier industries with higher concentration prior to downstream consolidation will experience larger declines in selling prices subsequent to downstream consolidation.*

In the industrial organization literature, potential entry is viewed as one of the driving forces of competition. In traditional models, an oligopoly can sustain a collusive equilibrium with the credible threat of reversion to lower profits of a non-collusive equilibrium. However, entry threats can break any given degree of collusion provided that entry barriers are low enough.[12] Thus, barriers to entry are a structural source of pricing power that can allow firms to collude and hold prices above marginal cost. Not surprisingly, Galbraith (1952) also recognizes barriers to entry as an anti-competitive element that can be offset by the exercise of countervailing power. Insofar as entry barriers confer the ability to price above marginal costs, we can formulate the following complementary hypothesis:

Hypothesis 4. *If downstream consolidation generates buying power, supplier industries with greater barriers to entry prior to downstream consolidation will experience larger declines in selling prices subsequent to downstream consolidation.*

Hypothesis 4 helps to further distinguish efficiency from the creation of buying power. Downstream mergers that generate demand effects upstream *only* due to enhanced efficiencies should have no effects on prices of supplier industries with low barriers to entry—competitive entry and exit alone will keep prices close to marginal cost. However, the prices charged by suppliers with high barriers to entry will be affected. Efficiency enhancements that increase input demand could increase prices charged by suppliers with market power and increase their profits. In contrast, efficiency enhancements that decrease input demand will have ambiguous effects on the profits of and prices charged by suppliers with market power. While a decreased demand for inputs may result in lower quantity supplied, suppliers with market power will tend to counteract by increasing prices. As a result, there is no strong reason to suspect that, in the absence of newly created buying power downstream, prices facing a supplier with market power will decline. Thus, evidence consistent with Hypothesis 4 would be supportive of the hypothesis that horizontal mergers do create buying power.

Galbraith (1952) contends that countervailing power can act as a restraint on both buying power and selling power. Implicit in the theory of countervailing power is the idea that consolidation in an industry can be a reaction to consolidation upstream or downstream. The possibility that mergers in one industry trigger countervailing mergers in related industries is an intriguing avenue of research that has remained largely unexplored. The hypotheses delineated above lead to a number of follow-on questions. Are downstream mergers exogenous events or are they themselves triggered by consolidation upstream? Do adversely affected supplier industries subsequently undertake mergers to offset the loss of market power engendered by downstream consolidation? Theory provides no guidance as to who merges first and the consequent sequence of countervailing consolidations. Therefore, for most of our analysis, we remain agnostic about who actually merges first and focus primarily on the effect of downstream mergers on upstream profits and selling prices. However, in Section 4.5, we attempt to shed some light on the possible sequencing of consolidation activity across industries sharing product market ties.

4. Data sources, methodology, and results

4.1. Data construction

We begin by constructing a sample of industries that experienced an identifiable increase in consolidation activity in order to obtain distinct pre- and post-merger periods. We obtain from Securities Data Company (SDC) Platinum all acquisitions announced between 1984 and 2003 that meet the following criteria: (i) the target and acquirer both were U.S.-based, (ii) the target and acquirer shared the same primary four-digit Standard Industrial Classification (SIC) code, (iii) the announced acquisition

[11] See, for example, Lustgarten (1975), Clevenger and Campbell (1977), McGuckin and Chen (1976), and Schumacher (1991).

[12] For formal proofs, see Harrington (1989).

was eventually completed, and (iv) the acquirer bought more than 50% of the target's stock. From SDC Platinum we also obtain the transaction value associated with each merger, that is, the total value of consideration paid by the acquirer, excluding fees and expenses. For each four-digit SIC code in the merger sample, we measure quarterly acquisition activity as the total transaction value of all horizontal acquisitions announced in a quarter as a proportion of industry total assets. We classify an industry as having experienced a *merger event* in a given quarter when the following conditions hold: (i) quarterly acquisition activity in the current quarter is greater than 10% and (ii) quarterly acquisition activity in any of the previous 12 quarters did not exceed 2.5%. The first condition ensures that the selected industries experienced significant consolidation in a particular quarter, while the second condition ensures that we have a clean pre-event period during which there was little horizontal merger activity. This definition enables us to identify 259 four-digit SIC codes that experienced at least one *merger event* between 1984 and 2003.[13]

Next, we use the *make* and *use* tables from the 1992 and 1997 Benchmark I–O accounts of the Bureau of Economic Analysis (BEA). The *make* table is a matrix showing the industry production of each commodity in the economy at producer prices. The *use* table is a matrix showing the commodities consumed, or used, by each industry and final consumers at producer prices. We follow the methodology detailed in the Appendix of Allayannis and Ihrig (2001) to create an input–output matrix from the *make* and *use* tables.[14] We use the 1992 input–output matrix to match suppliers to industries consolidating in or before 1994 and the 1997 input–output matrix to match suppliers to industries consolidating in 1995 or after. We are able to find suppliers for 141 merging industries.[15] Table 1, Panel A lists these merging industries along with the number of mergers that contribute to each *merger event* and the ratio of the merger transaction value to industry total assets. In Section 5 of the paper, we discuss robustness of our results to alternative sample selection methods.

Using the input–output matrix, we also calculate the fraction, f_{mj}, of supplier industry j's output sold to the consolidating industry m. Higher values of f_{mj} indicate that the supplier industry j is more dependent on the consolidating industry. For each consolidating industry, we identify up to ten supplier industries with the highest values of f_{mj}. With 141 consolidating industries, we can, at most, get 1,410 consolidating industry–supplier industry pairs. We are able to obtain data on f_{mj} for 1,155 consolidating industry–supplier industry pairs. By choosing to work with as many as ten suppliers per consolidating industry, we include industries selling a very small fraction of their output to the merging industry and are, therefore, unlikely to be affected significantly by downstream merger activity. This allows our cross-sectional tests to have greater power in detecting any relation between supplier dependence and profit or price changes experienced by the supplier industry.

We define *dependent* suppliers as those with values of f_{mj} in the top quintile of the distribution. Remaining suppliers are classified as *non-dependent*.[16] Table 1, Panel B provides the distribution of f_{mj} for dependent and non-dependent suppliers. Dependent suppliers provide, on average, 15.7% of their output to the consolidating industry, while non-dependent suppliers provide 1.7%.

4.2. Supplier industry operating performance

Pursuant to our first hypothesis, we examine the impact of downstream consolidation on supplier industry operating performance. We measure the operating performance of an industry by the cash flow-to-sales ratio of the median firm in the industry. As in Fee and Thomas (2004), the cash flow-to-sales ratio of a firm is the ratio of operating income (Compustat item 13) to sales (Compustat item 12). We then define an industry's abnormal operating performance as the deviation of its operating performance from that of the median industry in the economy.

We first regress abnormal operating performance prior to downstream consolidation on supplier dependence. Separately, we also regress abnormal operating performance after downstream consolidation on supplier dependence. Supplier dependence is captured by a dummy variable, D, that equals one for dependent suppliers and is zero otherwise. Control variables are derived from previous research on the determinants of industry profitability.[17] Profit margins are likely to be higher in less

[13] Existing research provides no specific guidance on whether merger activity should be measured by quarter or by year. In some industries, spurts in merger activity may last longer than in others. Therefore, we also calculate an annual measure of industry merger activity with the same cutoff percentages. We find that using an annual measure results in a slightly smaller merger-event sample that has an 85% overlap with the sample identified using the quarterly measure. The results of the paper remain unchanged if we use the sample based on the annual measure of merger activity.

[14] The *make* and *use* tables are based on IO codes. The BEA provides a mapping from IO codes to SIC codes for the 1992 tables and from IO codes to North American Industrial Classification System (NAICS) codes for the 1997 tables. For 1992, we focus only on industries that have unique IO-SIC codes matching and, for 1997, only those with unique IO-NAICS matching. To convert the NAICS match to SIC codes, we use correspondence tables provided by the U.S. Census Bureau. We restrict our sample to cases where NAICS data are fully derivable from SIC data: an SIC code is matched to a NAICS code when 100% of its sales/receipts are included within the corresponding NAICS code. Note that this allows for matching multiple SIC codes to the same NAICS code. Finally, we match all census data to M&A data using SIC codes provided by SDC Platinum.

[15] Some of the merging industries experience more than one horizontal merger event and, therefore, appear more than once in the sample of 141 industries. Moreover, industries in our merger-event sample can share customer-supplier relationships. We discuss the robustness of our results to these issues in Section 5.

[16] Our findings are robust to changes in the f_{mj} cutoff used to classify suppliers as being dependent. For example, our results continue to hold if we define dependent suppliers as those in the top quartile of f_{mj}. Moreover, instead of defining a binary variable to capture supplier dependence, we have also used the continuous variable f_{mj} as a measure of supplier dependence (unreported). Our results continue to hold, albeit with smaller statistical significance.

[17] See, for example, Schumacher (1991).

Table 1
Description of industries that experienced a horizontal merger event.

Panel A lists the SIC code of 141 industries that experience a horizontal *merger event* between 1984 and 2003, the size of the *merger event*, and the number of deals contributing to the *merger event*. A horizontal merger is defined as a merger between two firms within the same primary four-digit SIC code. An industry is classified as having experienced a *merger event* in a given quarter if the total transaction value (TV) of all horizontal acquisitions announced in that quarter exceeds 10% percent of industry total assets (TA). TV is the total value of consideration paid by the acquirer excluding fees and expenses (in millions). TA is the book value of total assets (in millions)

Panel B provides the distribution of f_{mj}, the percentage of supplier industry j's output sold to the merging industry m for a sample of 1,155 merger industry–supplier industry pairs. Higher values of f_{mj} indicate that the supplier industry j is more dependent on the consolidating industry for buying its output. Dependent suppliers are defined as those with f_{mj} in the top quintile. Remaining suppliers are classified as non-dependent suppliers.

Panel A: SIC code of merging industries, merger year, and size of merger event

SIC	Year	Quarter	TV/TA	No. of deals	SIC	Year	Quarter	TV/TA	No. of deals
2047	1984	2	0.114	1	7261	1991	2	0.109	2
3944	1984	2	0.116	1	1446	1991	2	0.266	1
4953	1984	2	0.160	1	7371	1992	1	0.207	1
2035	1984	2	0.492	1	2656	1992	1	0.261	1
7331	1984	3	0.163	1	4222	1992	3	0.105	1
8743	1984	3	0.172	1	7322	1992	3	0.181	2
2086	1984	4	0.159	2	2842	1992	4	0.339	1
2721	1985	1	0.192	3	3482	1993	2	0.220	1
3429	1985	2	0.131	1	3533	1993	3	0.139	1
2434	1985	3	0.750	1	8072	1993	3	0.173	1
2599	1985	4	0.246	1	3463	1993	3	0.298	1
3635	1985	4	0.465	1	2393	1993	3	0.323	1
3549	1986	1	1.462	1	3944	1993	3	0.336	2
3084	1986	3	0.252	1	3592	1993	4	2.242	1
3823	1986	4	0.166	2	2299	1994	1	0.182	1
3691	1987	1	0.127	1	2041	1994	3	0.150	1
1479	1987	1	0.904	1	3851	1994	3	0.168	1
2992	1987	2	0.100	1	2063	1994	3	0.277	1
4131	1987	2	0.156	1	2064	1994	3	0.280	1
2822	1987	3	0.144	1	2677	1994	4	0.225	1
7331	1988	1	0.102	1	2297	1995	1	0.240	1
2611	1988	2	0.146	1	3792	1995	2	0.123	1
3911	1988	3	0.125	2	3931	1995	2	0.220	1
2099	1988	3	0.145	1	7374	1995	2	0.296	3
2064	1988	3	0.281	1	2676	1995	3	0.766	1
2062	1988	3	0.318	1	2813	1995	4	0.153	3
3851	1988	4	0.404	1	3556	1995	4	1.739	1
2241	1989	1	0.206	1	2092	1996	1	0.143	1
3537	1989	2	0.218	2	3431	1996	1	0.179	1
3353	1989	3	0.127	1	7521	1996	1	0.189	1
3524	1989	3	0.136	1	2499	1996	2	0.477	1
3556	1989	3	1.651	1	2652	1996	2	0.815	1
3612	1989	4	0.204	1	3433	1996	3	0.245	1
3823	1990	2	0.104	1	3944	1996	4	0.146	2
7323	1990	2	0.437	1	7221	1996	4	0.252	1
7215	1996	4	0.266	1	2893	2000	4	0.104	1
8733	1997	1	0.464	1	3812	2000	4	0.147	1
2448	1997	1	0.582	1	3441	2001	1	0.144	1
2514	1997	1	1.681	2	4922	2001	1	0.149	1
3641	1997	1	41.906	1	7841	2001	1	0.349	2
4724	1997	2	0.106	2	8712	2001	1	0.373	1
4222	1997	2	0.351	1	7311	2001	1	1.223	2
3631	1997	3	0.101	1	3911	2001	2	0.134	1
2037	1997	3	0.109	2	2671	2001	2	0.178	2
3826	1997	3	0.123	2	2911	2001	2	0.201	2
6361	1997	3	0.138	1	3995	2001	2	0.323	2
2062	1997	3	0.680	1	7382	2001	2	0.333	1
2091	1997	4	0.135	1	3825	2001	3	0.102	1
2251	1998	1	0.123	1	3821	2001	3	0.102	1
3634	1998	1	0.261	2	3949	2001	3	0.138	1
2992	1998	1	0.361	1	3571	2001	3	2.699	2
2273	1998	3	0.194	1	3444	2002	1	0.451	1
3534	1998	3	1.277	1	7323	2002	1	6.354	2
2833	1998	4	0.164	2	3999	2002	2	0.343	2
3357	1998	4	0.328	4	6282	2002	2	1.204	4
3452	1998	4	0.439	4	2452	2002	2	1.932	1
3691	1998	4	0.529	2	3491	2002	2	2.737	1
7322	1999	2	0.153	6	7322	2002	3	0.136	1
2252	1999	2	0.206	1	8711	2002	3	1.417	1

Table 1 (*continued*)

Panel A: SIC code of merging industries, merger year, and size of merger event

SIC	Year	Quarter	TV/TA	No. of deals	SIC	Year	Quarter	TV/TA	No. of deals
7374	1999	2	0.325	7	2844	2002	3	1.976	1
2035	1999	2	0.543	1	2999	2002	3	243.384	1
7291	1999	3	0.147	1	3826	2002	4	0.130	2
3663	1999	3	0.204	4	3714	2002	4	0.174	2
3334	1999	3	0.265	1	3651	2002	4	2.411	1
1446	1999	4	0.106	1	3562	2002	4	3.696	1
3315	1999	4	0.109	1	3443	2003	1	0.107	1
2834	1999	4	0.422	7	3842	2003	1	0.178	1
3669	1999	4	0.869	2	3577	2003	3	0.205	3
3594	2000	1	0.158	1	8111	2003	3	28.791	3
3851	2000	2	0.119	1	3823	2003	4	1.268	2
3931	2000	3	0.114	1					

Panel B: Fraction of supplier output sold to merging industry

f_{mj}	*N*	Min (%)	Max (%)	Mean	Median (%)
Dependent suppliers	231	5.48	93.27	15.70	9.66
Non-dependent suppliers	924	0.04	5.42	1.68	1.35
All	1,155	0.04	93.27	4.48	1.76

competitive industries, in industries with greater barriers to entry, and in industries with greater product differentiation. We use the Herfindahl index, calculated as the sum of squared market shares of the firms in an industry, as a measure of competition within an industry. Since a high capital requirement is likely to function as a barrier to entry, we use capital intensity and capital expenditures as control variables when estimating industry profitability. For each four-digit SIC, we calculate Capital intensity as industry total assets (Compustat item 6) divided by industry total sales (Compustat item 12). Capital expenditures are calculated as an industry's total capital expenditure (Compustat item 128) divided by industry total assets. While Capital intensity provides a scaled measure of the total capital stock in an industry at a point in time, Capital expenditures provide a scaled measure of the annual capital investment required in an industry. Finally, we use Advertising intensity to proxy for product differentiation, where this is calculated as industry total advertising expense (Compustat item 45) divided by industry total sales. Table 2 presents estimates using ordinary least squares, with robust standard errors clustered at the two-digit SIC level.[18]

In the first column of Table 2, the dependent variable is the three-year average of supplier industry abnormal operating performance preceding the downstream merger. The coefficient on the dependence dummy is statistically insignificant. This indicates that, controlling for general factors affecting industry profit margins, the profitability of dependent suppliers is statistically indistinguishable from that of non-dependent suppliers prior to the downstream *merger event*. The dependent variable in the second column is supplier industry abnormal operating performance averaged over the three years following the downstream *merger event*. The coefficient on the dependence dummy is now negative and significant at the 95% confidence level. The magnitude of the coefficient indicates that the abnormal cash-flow margin of dependent supplier industries is 3% lower than that of non-dependent supplier industries. We note that cash-flow margins are higher in industries with greater barriers to entry and in industries with greater product differentiation.

4.3. Supplier industry selling prices

The results in the previous subsection, while establishing deterioration in the performance of dependent suppliers after downstream consolidation, say nothing about why the deterioration occurs. Deterioration in operating margins can occur due to a rise in costs or a fall in selling prices. If consolidation downstream creates buying power, we should observe a decline in supplier selling prices. Therefore, we now test whether selling prices of dependent suppliers decline more after downstream consolidation. An auxiliary advantage of examining selling prices is that supplier cash-flow margins are available only for a subset of four-digit supplier SIC codes (see footnote [17]). Since product price data compiled by the Bureau of Labor Statistics (henceforth BLS) are available for a larger sample of supplier industries, we can both enlarge our sample of supplier industries and answer the question of buying power creation more directly.

Prior product market studies have examined the effects of horizontal mergers on the selling prices of the consolidating industry itself using a control-group

[18] The 318 observations used in the analysis of supplier industry profit margins comprise 98 unique industries at the four-digit SIC level. The sample is small because Compustat SIC codes are often aggregated at the two- or three- digit SIC level and, therefore, we are unable to obtain profit margin data for a number of four-digit SIC codes.

Table 2
Supplier operating performance.

This table presents a multivariate analysis of abnormal cash flow margins (ACFM) of supplier industries. We identify the 10 most dependent suppliers of each of the 141 industries that experienced a merger event between 1984 and 2003. ACFM of an industry is defined as that industry's median cash flow-to-sales ratio minus the cash flow-to-sales ratio of the median industry in the economy. The cash flow-to-sales ratio of a firm is the ratio of operating income (Compustat item 13) to sales (Compustat item 12). In column 1, the dependent variable is the average ACFM in supplier industries over the three years preceding the downstream merger event. In column 2, the dependent variable is the average ACFM in supplier industries over the three years following downstream consolidation. The dependence dummy equals one if the supplier industry belongs to the top quintile of f_{mj}, the fraction of industry j's output sold to the downstream merging industry, and zero otherwise. *Herfindahl index* is the sum of the squared sales market shares of firms in the supplier industry. *Capital intensity* is industry total assets (Compustat item 6) divided by industry sales (Compustat item 12). *Capital expenditure* is the supplier industry's total capital expenditure (Compustat item 128) divided by the industry's total assets. *Advertising expense* is the supplier industry's total advertising expense (Compustat item 45) divided by the industry's total sales. *t*-Statistics based on robust standard errors clustered at the two-digit SIC level are in parentheses. Bold font indicates significance at least at the 10% level. The superscripts a, b, and c indicate significance at the 1%, 5%, and 10% levels, respectively.

	1 Dependent variable ACFM before downstream consolidation	2 Dependent variable ACFM after downstream consolidation
Dependence dummy	−0.022	**−0.030**
	(1.49)	(2.07)[b]
Herfindahl index	0.017	−0.038
	(0.90)	(1.10)
Capital intensity	**0.060**	**0.057**
	(6.75)[a]	(6.14)[a]
Capital expenditure	**0.535**	**0.812**
	(1.87)[c]	(2.02)[c]
Advertising expense	0.111	**0.455**
	(0.43)	(1.90)[c]
R-squared	0.27	0.31
F-statistic	15.33[a]	8.40[a]
Observations	318	317

approach. These studies compare changes in prices charged by the merging firms to those charged by a control group of firms in the same industry. The control group is assumed to be similarly impacted by other factors that affect price changes in an industry like demand conditions, changes in input prices, and the like. For example, Kim and Singal (1993) compare airfare changes on routes affected by airline mergers with airfare changes on unaffected routes. For our study, a control-group approach would require us to identify, for each supplier industry, another industry experiencing identical changes in demand conditions and factor prices but that is not itself affected by downstream consolidation, and is not an upstream or downstream industry to the supplier industry. This is, clearly, a tall order. As a result, we abandon this approach and, instead, explicitly account for changes in input prices and demand shocks that a supplier industry may face.

For each supplier of a consolidating industry, we obtain the Producer Price Index (PPI) from the BLS.[19] The PPI series allows us to measure the change over time in the selling prices received by domestic producers of goods and services. We adjust the PPI series for inflation using the Gross Domestic Product (GDP) price deflator, and call it the *Real Producer Price Index* (RPPI). Table 3 presents summary statistics of supplier industry RPPI. The table shows the average value of RPPI for suppliers as a whole over the three years before the downstream merger, the average value three years after the downstream merger, as well as the difference between the two values. The difference is negative and significant at the 99% confidence level, suggesting that supplier industries, on average, experience a decline in selling prices after downstream consolidation. Next, we split the sample into two groups: dependent suppliers and non-dependent suppliers. Table 3 shows that dependent suppliers had significantly lower prices than the non-dependent suppliers, both before and after the downstream consolidation. Although both groups experience a decline in prices after the downstream merger, the difference-in-differences test in the last row shows that the fall in prices is significantly larger for dependent suppliers.

These univariate results support the hypothesis that downstream consolidation has greater adverse effects on dependent suppliers. However, the finding that dependent suppliers have lower prices than non-dependent suppliers both before and after the downstream *merger event* requires that we account for the possibility that more dependent suppliers are fundamentally different from less dependent ones in terms of average price levels over time. Moreover, since univariate tests show that both groups of suppliers experience significant price drops after the downstream merger, we need to control for the possibility that, due to exogenous factors, price levels after downstream consolidation are lower for all industries.

Our multivariate analysis begins with the following regression model estimated using pooled OLS with Newey-West standard errors.

$$\Delta rppi_{jt} = \alpha_0 + \alpha_1 D_j + \alpha_2 \Delta rppi\_inp^1_{jt} + \alpha_3 \Delta rppi\_inp^2_{jt} + \alpha_4 \Delta wage_{jt} + \alpha_5 \Delta tp_t + \varepsilon_{jt} \quad (1)$$

where *rppi* is the natural logarithm of the RPPI of supplier industry *j*. The dummy variable, *D*, identifies dependent

[19] 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 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. In concept, the PPI is calculated using the modified Laspeyres formula: $I_t = \sum_{Q_0 P_0}^{Q_0 P_t} \times 100$, where I_t is the price index in the current period; P_0 is the price of a commodity in the comparison period; P_t is the current price of the commodity; and Q_a represents the quantity shipped during the weight-base period. More details can be found in Chapter 14, Producer Prices, BLS Handbook of Methods http://www.bls.gov/opub/hom/pdf/homch14.pdf.

Table 3
Supplier selling prices: univariate analysis.

This table compares prices in supplier industries during the three years before and three years following consolidation in a downstream industry. We identify the 10 most dependent suppliers of each of the 141 industries that experienced a merger event between 1984 and 2003. Producer Price Index (PPI) data for supplier industries are obtained from the Bureau of Labor Statistics (BLS). The PPI for each supplier is deflated using the GDP price deflator to obtain the Real PPI (RPPI). The table includes all merger industry–supplier industry pairs for which RPPI data are available. Dependent suppliers are supplier industries with the top 1/5th of values for f_{mj}, the fraction of industry j's output sold to the downstream merging industry. Non-dependent suppliers include all remaining supplier industries. U.S. Census Bureau's 1992 and 1997 benchmark input–output tables are used to calculate supplier dependence. t-Statistics are provided in parentheses. Bold font indicates significance at least at the 10% level. The superscripts a, b, and c indicate significance at the 1%, 5%, and 10% levels, respectively.

	1 Before downstream merger		2 After downstream merger		3 Change	
	N	RPPI	*N*	RPPI	*N*	ΔRPPI
All supplier industries	895	1.416	929	1.391	889	**−0.025** (5.63)[a]
Dependent suppliers	174	1.371	184	1.326	173	**−0.044** (5.28)[a]
Non-dependent suppliers	721	1.427	745	1.407	716	**−0.019** (4.13)[a]
Difference		**−0.056** (2.29)[b]		**−0.080** (3.06)[a]		**−0.024** (2.22)[b]

suppliers. The control variables $rppi\_inp^1_{ij}$ and $rppi\_inp^2_{ij}$ represent the RPPI of supplier industry j's two primary inputs, again in logs, which we identify using benchmark I–O tables.[20] To this end, we first calculate the weights, w_{ji}, that represent the fraction of supplier industry j's input provided by industry i. We take the two industries, i, with the highest values of w_{ji} as the main contributors to input prices for the supplier industry j. Price data for these inputs are obtained from the BLS. The control variable *wage* is the log of average hourly earnings of production workers compiled by the BLS. Hourly earnings are available only for production workers in the mining and manufacturing industries and are often provided only at the three-digit SIC level. When wage data are available only at the three-digit level, we apply them to all four-digit industries within the three-digit SIC. The industrial production index, *tp*, obtained from the Federal Reserve Board, measures log of the real output of the manufacturing, mining, and electric and gas utilities industries and is used to control for the demand conditions in the economy. The regression includes a time trend, industry dummies at the two-digit SIC level, and year dummies.

We first estimate Eq. (1) for all supplier industries over the 36 months preceding downstream consolidation and then separately over the 36 months following downstream consolidation, ignoring the *merger-event* quarter. Results from these two regressions are in columns 1 and 2 of Table 4. Column 1 shows that the coefficient on the dependence dummy, D, is statistically insignificant in the period prior to the downstream *merger event*. Thus, once factor prices and demand conditions are controlled for, price changes in dependent supplier industries prior to downstream consolidation are not significantly different from those in other supplier industries. However, in the post-merger sample presented in column 2, the dependence dummy is significantly negative at the 99% confidence level. Therefore, after the downstream consolidation, dependent suppliers do experience adverse price changes relative to non-dependent suppliers. The magnitude of the regression coefficient in column 2 suggests that the decline in prices for dependent supplier industries is greater by about 0.1% per month relative to non-dependent supplier industries.

While the analysis indicates diminished price performance post-downstream consolidation, it does not prove conclusively that the coefficient on the dependence dummy is different between the two periods. To do that, we estimate the following regression using the full 72-month panel:

$$\Delta rppi_{jt} = \alpha_0 + \alpha_1 D_j + \alpha_2 PM_{jt} + \alpha_3 D_j PM_{jt} + \alpha_4 \Delta rppi\_inp^1_{jt} + \alpha_5 \Delta rppi\_inp^2_{jt} + \alpha_6 \Delta wage_{jt} + \alpha_7 \Delta tp_t + \varepsilon_{jt}. \quad (2)$$

The dummy variable, D, again captures supplier dependence and the coefficient α_1 captures differentials in average price levels of dependent suppliers over time. For any supplier industry–merger industry pair, the post-consolidation dummy variable, *PM*, equals one after the downstream *merger event* and zero before. Its coefficient, α_2, captures the change in average price levels after consolidation for all suppliers. It also controls for exogenous shocks that might affect prices in supplier industries as well as trigger mergers in the downstream industry. The coefficient of primary interest is, however, α_3: if dependent suppliers suffer larger declines in selling prices due to downstream consolidation, the coefficient on the interaction of D and *PM* should be negative. All other variables are as described earlier for Eq. (1).

[20] It is important that the input prices used as control variables in this regression are unaffected by events occurring in the merging industry. To reduce the possibility of endogenous input prices, we ensure that the industries that provide the main inputs of the supplier industry have no product market relation with the downstream merging industry.

Table 4
Supplier selling prices: multivariate analysis.

This table presents a multivariate analysis of selling prices in the supplier industry during the six years surrounding downstream consolidation. We identify the 10 most dependent suppliers of each of the 141 industries that experienced a merger event between 1984 and 2003. For each supplier of a consolidating industry, we obtain the Producer Price Index (PPI) from the Bureau of Labor Statistics (BLS) starting from three years before the downstream *merger event* to three years after the downstream *merger event*. The PPI series are adjusted for inflation using the GDP price deflator to obtain *RPPI*. Columns 1–3 contain estimates of panel regressions. In column 1 (column 2) the data are restricted to the 36 months preceding (following) the downstream *merger event*. Column 3 contains estimates of the full panel of the 72-month period. The dependent variable in columns 1–3 is the monthly RPPI in log-differences. The dummy variable, *D*, identifies suppliers who are highly dependent on the downstream consolidating industry: *D* equals one if the fraction of supplier output, f_{mj}, sold to the downstream industry lies in the top quintile, and zero otherwise. For a given supplier, the Post-merger dummy (*PM*) equals one in the months following the downstream event, and zero for the months preceding. The control variables *rppi_inp*^{1} and *rppi_inp*^{2} represent the real PPI of the supplier industry's two primary inputs, again in log-differences. The variable *wage* represents log-differences of average hourly earnings of production workers compiled by the BLS. *tp*, obtained from the Federal Reserve Board, measures log-differences of the real output of the manufacturing, mining, and electric and gas utilities industries. The panel regression includes a time trend, industry dummies at the two-digit SIC level, and year dummies. *t*-Statistics are based on Newey-West standard errors. Column 4 presents estimates of a cross-sectional regression in which the dependent variable is a supplier industry's average log *RPPI* over the three years after the downstream merger minus the average log *RPPI* over the three years prior to the downstream merger. For control variables, we calculate the change in average input prices, wages, and total production in the same manner. The explanatory variable of interest is the dependence dummy *D*. Column 5 presents a similar cross-sectional regression but with randomly generated event quarters between 1984 and 2003. Changes in control variables are similarly calculated around the random-event quarter. In columns 4 and 5, *t*-Statistics (in parentheses) are based on robust standard errors clustered at the two-digit SIC level. In all regressions, bold font indicates significance at least at the 10% level. The superscripts a, b, and c indicate significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable: change in supplier RPPI	1 Panel: before downstream merger	2 Panel: after downstream merger	3 Full panel (difference-in-differences)	4 Cross-sectional	5 Cross-sectional: Random
Dependence dummy (*D*)	−0.0003	**−0.001**	−0.0002	**−0.0134**	0.00
	(−1.58)	(−2.69)[a]	(−1.08)	(−2.44)[b]	(0.03)
Input price 1 (*rppi_inp*^{1})	**0.245**	**0.165**	**0.209**	**0.391**	**0.451**
	(10.97)[a]	(12.63)[a]	(15.08)[a]	(4.13)[a]	(6.21)[a]
Input price 2 (*rppi_inp*^{2})	**0.152**	**0.150**	**0.153**	**0.108**	**0.072**
	(10.98)[a]	(11.23)[a]	(15.70)[a]	(2.21)[a]	(2.08)[b]
Wages (*wage*)	**0.0240**	0.00492	**0.0151**	**−0.356**	−0.085
	(3.13)[a]	(0.53)	(2.54)[b]	(2.04)[b]	(0.51)
Total production (*tp*)	0.007	**0.0496**	**0.0266**	**0.130**	**0.127**
	(0.42)	(2.39)[b]	(2.04)[b]	(2.10)[b]	(2.57)[a]
Post-merger dummy (*PM*)			0.00		
			(0.52)		
$D \times PM$			**−0.001**		
			(−1.99)[b]		
R-squared	0.20	0.12	0.16	0.32	0.35
Observations	16,325	13,494	29,819	586	418

Column 3 of Table 4 presents the estimation results for Eq. (2). The coefficient on the interaction of the dependence dummy and the post-merger dummy, α_3, is negative and significant at the 95% confidence level indicating that dependent suppliers experience larger price declines post-downstream consolidation compared to non-dependent suppliers. Since level effects are controlled for, the interaction term isolates the differential impact of downstream consolidation on upstream prices for dependent suppliers. The coefficients on the post-merger dummy and the dependence dummy are both statistically indistinguishable from zero indicating an absence of evidence in favor of the hypotheses that (i) prices for all suppliers are lower post-downstream consolidation and (ii) dependent suppliers always face lower prices. As expected, the results on input prices, wages, and total production confirm that higher input prices do pass through to output prices and that demand shocks also impact output prices.

To demonstrate that the differential impact of downstream consolidation on prices faced by dependent suppliers is not sensitive to the regression methodology used, we also employ an alternative to the difference-in-differences method described above. We run the following cross-sectional regression using OLS with robust standard errors clustered at the two-digit SIC level:

$$\Delta \ln RPPI_j = \alpha_0 + \alpha_1 D_j + \alpha_2 \Delta \ln RPPI\_INP_j^1 + \alpha_3 \Delta \ln RPPI\_INP_j^2 + \alpha_4 \Delta \ln WAGE_j + \alpha_5 \Delta \ln TP + \varepsilon_j. \quad (3)$$

where $\Delta \ln RPPI_j$ is the supplier *j*'s average log RPPI over the three years after the downstream merger minus the average log RPPI over the three years prior to the downstream merger. As control variables, we use the changes in average input prices, wages, and total production. Again the explanatory variable of interest is the dependence dummy *D*. Results are presented in column 4 of Table 4. As expected, the coefficient on the dummy variable *D* is negative and statistically significant: dependent suppliers experience larger declines in prices in the wake of downstream consolidation.

A remaining concern is that prices faced by dependent suppliers may trend downwards with time even in the absence of downstream consolidation. To address this concern, we conduct an experiment where, for each

supplier in our sample, we generate a random 'event-quarter' between 1984 and 2003 drawn from a uniform distribution. Then we repeat a cross-sectional regression similar to that in Eq. (3) with one key difference—we use the randomly generated date as the break point. That is, the change in supplier prices is calculated as the average price three years after the randomly selected quarter minus the average price three years before. Changes in control variables are calculated in a similar manner. If prices in dependent supplier industries were to naturally trend downwards, the dependence dummy would be significantly negative in this randomized sample as well. Column 5 of Table 4 shows that this coefficient is no longer statistically significant. This finding reinforces the significance of the downstream *merger event* as the structural break in prices faced by dependent suppliers.

4.4. Disentangling efficiency and buyer power hypotheses

While the tests in Section 4.3 clearly establish a decline in the prices of dependent supplier industries after downstream consolidation, attributing such a decline to increased buyer power is not straightforward. As discussed earlier, an increase in selling power downstream, perhaps due to greater collusion or concentration, could also result in lower demand for inputs and, consequently, lower input prices. In unreported tests, we find no evidence of higher selling prices in the downstream industry after consolidation activity. Therefore, enhanced selling power does not appear to be the cause of the decline in supplier prices. However, consolidation-induced productive efficiencies could also result in similarly reduced demand for inputs and consequent price declines. To disentangle the buying power effects of downstream consolidation from efficiency-generated effects, we take recourse to the theory of countervailing power.

Countervailing power theory suggests that suppliers with prior pricing power would be the natural targets of buying power generated by consolidation downstream. Efficiency-increasing consolidation, in contrast, does not clearly predict a differential impact among suppliers, as discussed in Section 3. To test Hypothesis 3, we use two different proxies for pricing power of supplier industries: the Census Bureau's estimates[21] of the four-firm concentration ratio (*sup_con*) and the Herfindahl index (*sup_herf*) obtained from the 1982, 1987, and 1992 census conducted at the four-digit SIC level.[22] For downstream consolidation that occurred between 1993 and 1997 (inclusive), we use the 1992 census to obtain *sup_con* and *sup_herf*. For consolidation that occurred between 1988 and 1992 (inclusive), we use the 1987 census and for consolidation activity between 1983 and 1987 (inclusive), we use the 1982 census. Thus, for a subsample, we are able to obtain reliable measures of supplier industry concentration prior to downstream consolidation. We re-estimate Eq. (3) above with *sup_con* and *sup_herf* as the explanatory variables in place of the dependence dummy, *D*. The results presented in columns 1 and 2 of Table 5 show that suppliers with higher values of *sup_con* and *sup_herf* experienced larger price declines after downstream consolidation. That is, suppliers that were more concentrated prior to downstream consolidation experienced greater price declines, indicating support for the buying power hypothesis.

These results are further reinforced when we abandon reliance on summary measures of concentration and focus directly on the structural attributes of market power. Since barriers to entry are a structural source of pricing power, Hypothesis 4 states that suppliers with high entry barriers should experience larger price declines after downstream consolidation. Consistent with this, we saw in Table 2 that supplier industries with higher capital intensity and higher capital expenditures, both of which are common proxies for barriers to entry, on average have higher abnormal profits. Moreover, advertising expenses, a proxy for barriers to entry as well as product differentiation, is positively related to profits in one of the two regressions presented in Table 2. Therefore, we test Hypothesis 4 using capital intensity, capital expenditures, and advertising expenses as proxies for barriers to entry. We calculate supplier capital intensity (*sup_ks*), supplier capital expenditure (*sup_capex*), and supplier advertising expenses (*sup_advert*) for the year prior to downstream consolidation using Compustat data as already described in Section 4.2. Although these variables are available on an annual basis, they suffer from two disadvantages. First, matching price data with Compustat data results in smaller sample size. Second, the three Compustat variables are measured for public firms only. Nonetheless, we run regression Eq. (3) again with sup_*ks*, *sup_capex,* or *sup_advert* as the primary explanatory variable. Results are provided in columns 3–5 of Table 5. We see that capital expenditures and capital intensity both have negative and statistically significant coefficients. Overall, Table 5 shows that four out of our five proxies for non-competitive pricing in supplier industries are associated with larger supplier price declines after downstream consolidation.

In the final test of this section, we use two measures of the *change* in concentration of the supplier industry prior to downstream consolidation. Since horizontal mergers reduce the number of firms operating in an industry and increase concentration, we use a measure of horizontal merger activity in the supplier industry as a proxy for possible changes in concentration. The variable *sup_horiz* is calculated for each supplier industry as the number of horizontal acquisitions announced in the three years preceding downstream consolidation divided by the average number of firms in that industry during the same

[21] Ali, Klasa, and Yeung (2008) show that industry concentration measures calculated with Compustat data, which cover only public firms, are poor proxies for actual industry concentration. These measures have correlations of only 13% with the corresponding U.S. Census measures that are based on all public and private firms in an industry. Their results indicate that product market research using Compustat-based industry concentration measures may lead to incorrect conclusions.

[22] From 1997 onwards, U.S. Census Bureau data are provided on the NAICS basis instead of SIC. Since there is not necessarily an one-to-one correspondence between NAICS and SIC, we avoid creating more noise in the concentration measures and do not attempt to match subsequent NAICS-based industry concentration data to our SIC-based sample.

Table 5
Changes in supplier selling prices and supplier pricing power prior to consolidation downstream.

This table examines the relation between the change in supplier selling prices post-downstream consolidation and various measures of prior supplier pricing power. We identify the 10 most dependent suppliers of each of the 141 industries that experienced a merger event between 1984 and 2003. For each supplier to a consolidating industry, we obtain the Producer Price Index (PPI) from the Bureau of Labor Statistics (BLS) starting from three years before the downstream *merger event* to three years after the downstream *merger event*. The PPI series are adjusted for inflation using the GDP price deflator to obtain *RPPI*. All six columns present estimates of cross-sectional regression in which the dependent variable is a supplier industry's average log *RPPI* over the three years' post-downstream consolidation minus the average log *RPPI* over the three years prior. The change in average input prices ($rppi\_inp^1$ and $rppi\_inp^2$), wages (*wage*), and total production (*tp*) are calculated in the same manner. *sup_con* is the four-firm concentration ratio of the supplier industry prior to the downstream merger and *sup_herf* its Herfindahl index. Both *sup_con* and *sup_herf* are obtained from the Census Bureau. The following variables are obtained from Compustat as of the year prior to downstream consolidation: *sup_ks* is supplier industry total assets divided by supplier industry total sales, *sup_capex* is equal to supplier industry capital expenditures divided by supplier industry assets, *sup_advert* is supplier advertising expenses divided by supplier industry total sales. *t*-Statistics (in parentheses) are based on robust standard errors clustered at the two-digit SIC level. In all regressions, bold font indicates significance at least at the 10% level. The superscripts a, b, and c indicate significance at the 1%, 5%, and 10% levels, respectively.

	1	2	3	4	5
4-Firm concentration ratio (*sup_con*)	**−0.079** (3.85)[a]				
Herfindahl index (*sup_herf*)		**−0.002** (2.29)[b]			
Capital intensity (*sup_ks*)			**−0.041** (1.91)[c]		
Capital expenditures (*sup_capex*)				**−0.567** (2.21)[b]	
Advertising expenses (*sup_advert*)					0.127 (0.48)
Change in input price 1 ($rppi\_inp^1$)	**0.332** (3.14)[a]	**0.332** (3.03)[a]	**0.283** (3.27)[a]	**0.484** (3.18)[a]	**0.505** (3.35)[a]
Change in input price 2 ($rppi\_inp^2$)	**0.198** (2.88)[b]	**0.192** (2.63)[b]	0.051 (1.16)	0.111 (1.53)	0.109 (1.51)
Change in wages (*wage*)	−0.021 (0.18)	−0.004 (0.04)	**−0.314** (3.09)[b]	**−0.809** (3.07)[a]	**−0.863** (3.27)[a]
Change in total production (*tp*)	0.095 (1.42)	0.074 (1.09)	0.021 (0.35)	**0.186** (2.02)[c]	0.145 (1.66)
Observations	314	314	180	192	192
R-squared	0.36	0.33	0.35	0.47	0.45

period. We also calculate the change in supplier industry concentration (*Dsup_con*) more directly using the four-firm concentration ratio.[23] Although this direct measure of supplier industry concentration is available for only a small subsample, it serves as a useful robustness test of the countervailing power hypothesis. We regress the change in supplier industry price after downstream consolidation on *sup_horiz* and *Dsup_con*. The results are presented in Table 6. We see that suppliers experiencing greater horizontal merger activity prior to downstream consolidation experienced greater declines in price after downstream consolidation. Likewise, supplier industries that experienced an increase in the four-firm concentration ratio prior to downstream consolidation suffer more adverse price changes after. For comparison purposes, we also regress the change in supplier industry price after downstream consolidation on measures of non-horizontal merger activity (*sup_nonhoriz*) and unrelated merger activity (*sup_unrelated*) in the supplier industry prior to downstream consolidation.[24] Table 6 shows that these other measures of merger activity in the supplier industry prior to downstream consolidation bear no significant relation with subsequent declines in selling prices.[25]

The relation between supplier horizontal acquisitions and subsequent price changes could be explained away with the argument that perhaps periods of high horizontal merger activity in an industry usually precede price declines in the industry, perhaps due to increase in efficiencies being passed on through lower prices and that such a decline in prices would have happened regardless of a downstream merger. To address this concern, we conduct an experiment similar in spirit to the random-event exercise in Table 4. We begin with a

[23] Since Census data are not annual, it is not possible to get accurate measures of changes in supplier industry concentration during the few years preceding a downstream merger. Nonetheless, we conduct an approximate test with a subsample. If a downstream merger is announced between 1986 and 1989 (inclusive), we calculate the change in supplier industry concentration as the 1987 census measure minus the 1982 Census measure. If a downstream merger is announced between 1991 and 1994 (inclusive), we calculate the change in supplier industry concentration as the 1992 Census measure minus the 1987 census measure.

[24] Non-horizontal acquisitions are defined as deals where an acquirer in the supplier industry buys a target firm that does not share the same four-digit SIC code. However, the acquirer and target could share the same primary three-digit, two-digit, or one-digit SIC code. Unrelated acquisitions are defined as deals where an acquirer in the supplier industry buys a target firm that does not even share the same one-digit SIC code.

[25] We note that it is not an error or a coincidence that the number of observations in columns 1, 3, and 4 of Table 6 is the same: In these three regressions, we use the same set of supplier industries. However, the dependent variables capture different types of merger activity in the supplier industries.

Table 6
Relating the change in supplier selling prices to prior supplier merger activity and change in supplier concentration.

This table examines the relation between the change in supplier selling price after downstream consolidation and (i) merger activity in a supplier industry prior to downstream consolidation and (ii) change in supplier industry concentration prior to downstream consolidation. We identify the 10 most dependent suppliers of each of the 141 industries that experienced a merger event between 1984 and 2003. For each supplier of a consolidating industry, we obtain the Producer Price Index (PPI) from the Bureau of Labor Statistics (BLS) starting from three years before the downstream *merger event* to three years after. We adjust the PPI series for inflation using the GDP price deflator and use the deflated series as the dependent variable (called *RPPI*). Columns 1–4 present estimates of cross-sectional regressions where the dependent variable is a supplier industry's average log *RPPI* over the three years after downstream consolidation minus the average log *RPPI* over the three years prior. The sample includes all supplier industry–merger industry pairs for which supplier RPPI data are available. Supplier horizontal mergers (*sup_horiz*) are defined as the number of horizontal mergers announced in supplier industries during the three years preceding downstream consolidation divided by the number of firms in the industry. A horizontal merger is defined as a merger where both the acquirer and target operate in the same primary four-digit SIC code. *Dsup_con* is the change in the four-firm concentration ratio of the supplier industry prior to downstream consolidation. The variables *sup_nonhoriz* and *sup_unrelated* also capture merger activity in supplier industries during the three years preceding downstream consolidation. *sup_nonhoriz* is calculated as the number of deals announced in which the acquirer in the supplier industry buys a target firm that does not share the same four-digit SIC code divided by the number of firms in the supplier industry. The variable *unrelated mergers* is calculated as the number of announced deals in which an acquirer in the supplier industry buys a firm that does not share even the same one-digit SIC code divided by the number of firms in the supplier industry. For control variables, we calculate the change in input prices, wages, and total production as the three-year average after downstream consolidation minus the three-year average prior to it. Column 5 presents a similar cross-sectional regression for all unique four-digit SIC industries for which RPPI data are available. In column 5, randomly generated quarters between 1984 and 2003 serve as the event dates. Changes in prices are calculated as the average price three years after the randomly selected quarter minus the average price three years prior. Changes in control variables are similarly calculated around the random-event quarter. *t*-Statistics (in parentheses) are based on robust standard errors clustered at the two-digit SIC level. In all regressions, bold font indicates significance at least at the 10% level. The superscripts a, b, and c indicate significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable: change in supplier RPPI	1	2	3	4	5 Random-event sample
Horizontal mergers (*sup_horiz*)	**−0.435** (2.07)[b]				−0.590 (0.93)
Change in four-firm concentration ratio (*Dsup_con*)		**−0.001** (2.21)[b]			
Non-horizontal mergers (*sup_nonhoriz*)			−0.192 (0.66)		
Unrelated mergers (*sup_unrelated*)				−0.326 (0.54)	
Change in input price 1 ($rppi\_inp^1$)	**0.407** (4.46)[a]	**0.317** (3.12)	**0.399** (4.66)[a]	**0.396** (4.87)[a]	**0.307** (2.54)[b]
Change in input price 2 ($rppi\_inp^2$)	0.092 (1.65)	0.303 (2.21)	0.092 (1.61)	**0.095** (1.72)	0.075 (1.98)[c]
Change in wages (*wage*)	**−0.379** (1.97)[c]	−0.019 (0.14)	**−0.387** (2.09)[b]	**−0.392** (2.20)[b]	−0.306 (1.21)
Change in total production (*tp*)	**0.144** (2.71)[a]	−0.158 (1.06)	**0.150** (2.74)[a]	**0.152** (2.83)[a]	**0.182** (1.98)[c]
Observations	674	107	674	674	180
R-squared	0.36	0.43	0.35	0.35	0.19

sample of all four-digit SIC industries for which producer price data are available. For each industry, we create a random-event quarter between 1984 and 2003. We then calculate $\Delta \ln RPPI_j$ as industry *j*'s average log *RPPI* over the three years after the random-event quarter minus the average log *RPPI* over the three years prior to the random-event quarter. Changes in input prices, wages, and total industrial production are calculated in the same way as earlier. For each industry, we calculate the number of horizontal acquisitions announced in the three years preceding the random-event quarter divided by the total number of firms in the industry. We then estimate Eq. (3) for this random-event sample. Results are presented in Column 5 of Table 6. We see that the coefficient on prior horizontal merger activity is insignificant: industries engaging in higher horizontal merger activity prior to the random-event quarter did not experience larger price declines after the random-event quarter. Thus, we do not find evidence that any given period of high horizontal merger activity is followed by price declines in that industry.

4.5. Merger activity patterns in customer and supplier industries

The previous section provides robust evidence that dependent suppliers and those with some degree of market power are adversely affected by downstream consolidation. These results establish that horizontal mergers create buying power. However, our finding that supplier industries engaging in prior horizontal merger activity of their own experience larger price declines introduces the intriguing possibility that downstream mergers are themselves countervailing responses to upstream consolidation. The logic of the countervailing power hypothesis would, however, argue that buying power created by such downstream consolidation would, in turn, create incentives for further consolidation upstream. A time-series pattern of sequential merger activity amongst connected industries could then offer some insights about the propagation patterns of merger waves across industries. In addition, the existence of any such patterns of propagation would go toward

distinguishing our story from the alternate hypothesis that exogenous changes trigger contemporaneous consolidation all along the supply chain. In this section, therefore, we examine whether there exist any sequential patterns in consolidation activity across supplier-customer industry pairs.

To investigate such patterns, we need a sufficiently long time-series of horizontal merger activity for all industries. Therefore, we work with the full sample of horizontal acquisitions initially identified from SDC and described in Section 4.1. Using the full set of four-digit SIC codes in the 1992 benchmark I–O tables, we create two separate samples. In the first sample, for each four-digit industry, i, we identify ten customer industries that buy the largest fraction f_{ij} of industry i's output: the larger the value of f_{ij}, the more dependent is that supplier industry i on customer industry j. We call this the *supplier-main customer* sample. Since some values of f_{ij} are quite small, we are able to exploit the variation in f_{ij} to our advantage. For each supplier industry and customer industry, we also create an annual panel data of horizontal merger activity over the 1984–2003 period, defined as the number of horizontal mergers announced as a proportion of the number of firms in the industry.

In an analogous fashion, we also create a *customer-main supplier* sample. In this, we match each four-digit industry, i, to ten supplier industries from which industry i buys the largest fraction, w_{ji} of its inputs: the larger the value of w_{ji}, the more dependent is the customer industry i on purchasing inputs from supplier industry j. As before, we create an annual panel data of supplier and customer industry horizontal mergers from 1984–2003.

To examine whether dependent suppliers consolidate in response to prior consolidation in customer industries, we use *the supplier-main customer* sample to run panel regressions in which horizontal merger activity (MA) at time t in the supplier industry i is regressed on various measures of past horizontal merger activity in customer industries. The general set-up of the panel regression is:

$$MA_{it} = \alpha_0 + \alpha_1 Past\_CMA_{it} + \alpha_2 D_i + \alpha_3 Past\_CMA_{it} \times D_i + \alpha_4 Curr\_CMA_{it} + \alpha_5 MA_{it-1} + \alpha_6 Energy_i + \alpha_7 RnD_{it} + \alpha_8 Shock_i + \alpha_9 MktPE_t + \varepsilon_{it}. \quad (4)$$

The variable *Past_CMA* captures prior horizontal merger activity in customer industries. In the primary regressions, we use three different measures of *Past_CMA*: (i) horizontal merger activity in customer industries in year $t-1$, or (ii) cumulative horizontal merger activity in customer industries in years $t-1$ and $t-2$, or (iii) cumulative horizontal merger activity in customer industries in years $t-1$, $t-2$, and $t-3$. As before, we capture supplier dependence with the dummy variable D, which is equal to one when the value of f_{ij} is in the top quintile and zero otherwise. The coefficient of primary interest, α_3, measures the impact of the interaction of *Past_CMA* and D. A positive α_3 supports the hypothesis that consolidation in dependent supplier industries is a response to consolidation in their main customer industries. To account for common shocks that may affect both customers and suppliers concurrently, we control for contemporaneous merger activity in the customer industry (*Curr_CMA*). Since mergers may occur in waves that persist for more than a year, we control for lagged values of merger activity in supplier industry i itself (MA_{it-1}). We also include variables identified by Mitchell and Mulherin's (1996) study of the inter-industry patterns in the rate of takeovers and restructurings. These include supplier industry sales shocks, employment shocks, energy dependence, and research and development (R&D) expenditures.[26] Energy dependence, *Energy*, is calculated as the fraction of the supplier industry's input that is obtained from SIC codes 12, 13, and 29 using the 1992 benchmark input–output tables. R&D over sales ratio, *RnD*, is calculated for each supplier industry as of the prior fiscal year. As in Mitchell and Mulherin (1996), the sales shock variable is the absolute value of abnormal industry sales growth. Abnormal industry sales growth for the supplier industry in year t is calculated as the industry's sales growth during the five preceding years minus the average sales growth of all industries over the same time period. Similarly, the employment shock variable is the absolute value of abnormal employment growth. Abnormal employment growth in the supplier industry in year t is calculated as employment growth during the five preceding years minus the average employment growth of all industries over the same period. These industry shock variables are calculated with employment data and value-of-sales data obtained from the National Bureau of Economic Research (NBER) and the U.S. Census Bureau. We find that the sales shock and employment shock variables are highly positively correlated. Therefore, we use factor analysis to extract the principal factor and use this factor, labeled *Shock*, as the economic shock variable. Finally, since merger waves are highly correlated with stock market valuations, we include the price-to-earnings ratio of the market (*MktPE*) as a control variable.[27]

In Panel A of Table 7, we present estimates of Eq. (4) using the three different measures of *Past_CMA*. In column 1, *Past_CMA* is horizontal merger activity in the customer industry in year $t-1$. In column 2, *Past_CMA* is horizontal merger activity in the customer industry in years $t-1$ and $t-2$. In column 3, *Past_CMA* is horizontal merger activity in the customer industry in years $t-1$, $t-2$, and $t-3$. We see that the coefficient on the interaction of *Past_CMA* and the dummy variable D is positive and statistically significant in all three regressions. Thus, horizontal merger activity in supplier industries is significantly higher when their main customers (i.e. customers on which they are dependent) engaged in consolidation activity in the previous three years. We also note that the contemporaneous relation between customer and

[26] Deregulation is also considered an important determinant of merger activity (see, for example, Mitchell and Mulherin, 1996; and Andrade, Mitchell, and Stafford, 2001). Andrade, Mitchell, and Stafford (2001) classify the following industries as having experienced deregulation during the sample period we cover: broadcasting (1996), banks and thrifts (1994), utilities (1992), and telecommunications (1996). Since our sample is restricted to mining and manufacturing sectors, none of these industries is present in our sample.

[27] We use the price-to-earnings ratio of the Standard and Poor's (S&P) 500 index as calculated by Robert Shiller and provided on his Web site http://www.econ.yale.edu/~shiller/data.htm.

Table 7
Merger patterns: merger activity in supplier industries and their main customer industries.

This table presents the time-series relation between horizontal merger activity in supplier industries and their top customers. For each of 324 four-digit SIC codes, we use the BEA input–output tables to identify ten customer industries that purchase the largest fraction of the supplier industry's output. A panel data of annual horizontal merger activity from 1984 to 2003 is constructed for each supplier industry and its ten customer industries. Horizontal merger activity in an industry is defined as the number of acquisitions announced in that industry in year t where both acquirer and target operate in the same four-digit SIC code divided by the number of firms operating in that industry in year t. The dependent variable is merger activity in a supplier industry in year t. The dummy variable, D, captures dependence of the supplier industry on the customer industry: D equals one if the fraction of supplier output, f_{mj}, sold to customer industry lies in the top quintile, and zero otherwise. In Panel A, the explanatory variable *Past_CMA* represents three different measures of merger activity in the customer industry. In column 1, *Past_CMA* equals customer merger activity in year $t-1$. In column 2, *Past_CMA* equals customer merger activity in years $t-1$ and $t-2$. In column 3, *Past_CMA* equals customer merger activity in years $t-1$, $t-2$ and $t-3$. In each column, the key variable of interest is the interaction of *Past_CMA* and D. Control variables are as follows: R&D expense in year $t-1$; energy dependence as of 1992 benchmark I–O tables; economic shock is the principal factor of the sales growth and employment growth over the years $t-5$ to $t-1$; Market PE ratio is the price-earnings ratio in year t. In Panel B, we provide only the coefficient on the interaction term $CMA \times D$ (along with the t-statistic) for six separate panel regressions. Column 1 of Panel B presents the same regression as in Column 1 of Panel A. In columns 2–6 of Panel B, the *Past_CMA* variable captures customer merger activity in the year $(t-k)$ where k ranges from 2–6. t-Statistics based on robust standard errors clustered at the two-digit SIC level are in parentheses. Bold font indicates significance at least at the 10% level. The superscripts a, b, c and indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A

	Past_CMA=Customer merger activity in		
	Year $(t-1)$	*Years* $(t-1)$ and $(t-2)$	*Years* $(t-1)$, $(t-2)$, and $(t-3)$
Past_CMA	0.008	**0.016**	**0.011**
	(0.79)	(2.38)[b]	(2.21)[b]
Dependence dummy (D)	−0.000	−0.000	−0.000
	(0.93)	(0.93)	(0.71)
Past_CMA × D	**0.061**	**0.037**	**0.023**
	(4.02)[a]	(2.53)[b]	(2.33)[b]
Customer mergers (t)	**0.015**	0.004	0.007
	(1.77)[c]	(0.34)	(0.56)
Supplier mergers ($t-1$)	**0.249**	**0.251**	**0.262**
	(5.78)[a]	(5.03)[a]	(5.09)[a]
Research and development expense	**0.023**	**0.023**	**0.024**
	(2.30)[b]	(2.14)[b]	(2.11)[c]
Energy dependence	0.008	0.009	0.007
	(1.08)	(1.07)	(1.03)
Economic shock	0.000	0.000	−0.000
	(0.09)	(0.04)	(0.34)
Market price-earnings	**0.003**	**0.003**	0.003
	(2.32)[b]	(1.85)[b]	(1.73)
Observations	18,090	16,925	15,756
R-squared	0.10	0.10	0.11

Panel B

	Past_CMA=Customer merger activity in					
	Year $(t-1)$	Year $(t-2)$	Year $(t-3)$	Year $(t-4)$	Year $(t-5)$	Year $(t-6)$
Coefficient on Past_CMA × D	**0.061**	**0.029**	**0.065**	**0.063**	0.019	0.004
t-Stat	(4.02)[a]	(1.69)[c]	(2.04)[c]	(2.60)[b]	(0.30)	(0.08)

supplier industry mergers is weak. Moreover, supplier merger activity in year t is significantly positively correlated with supplier merger activity in year $t-1$, and supplier merger activity is positively correlated with the market price-to-earnings ratio and research and development expenses.

To get an estimate of the length of the effect of customer merger activity on subsequent supplier merger activity, we run the same regression several times *without* cumulating customer merger activity in recent years. That is, we define *Past_CMA* as customer merger activity in a given year t-k, where k ranges from 2 to 6. Panel B of Table 7 presents α_3 and its t-statistics for all of these regressions in columns 2–6. For comparison, column 1 of Panel B presents again the coefficient from the first regression shown in Table 7 Panel A (where k=1). We see that horizontal merger activity in dependent suppliers is positively correlated with horizontal merger activity in top customers for up to four years in the past.

We then turn to examining the impact of supplier industry consolidation on customer industries. For this analysis, we use the *customer-main supplier* sample to run the following panel regression:

$$MA_{it} = \alpha_0 + \alpha_1 Past\_SMA_{it} + \alpha_2 D_i + \alpha_3 Past\_SMA_{it} \times D_i + \alpha_4 Curr\_SMA_{it} + \alpha_5 MA_{it-1} + \alpha_6 Energy_i + \alpha_7 RnD_{it} + \alpha_8 Shock_i + \alpha_9 MktPE_t + \varepsilon_{it}. \quad (5)$$

In this sample, the dependent variable *MA* now denotes horizontal merger activity in the customer industry. The variable *Past_SMA* is used to capture past horizontal merger activity in supplier industries. We control for contemporaneous mergers in the supplier industry, *Curr_SMA*, as well as for lagged mergers in the customer industry itself ($MA_{i,t-1}$). The dummy variable, D,

Table 8
Merger patterns: merger activity in customer industries and their main supplier industries.

This table presents the time-series relation between horizontal merger activity in customer industries and their top suppliers. For each of 324 four-digit SIC codes, we use the BEA input–output tables to identify ten supplier industries that provide the largest fraction of the customer industry's input. A panel data of annual merger activity from 1984 to 2003 is constructed for each customer industry and its ten supplier industries. Horizontal merger activity in an industry is defined as the number of acquisitions announced in that industry in year t where both acquirer and target operate in the same four-digit SIC code divided by the number of firms operating in that industry in year t. The dependent variable is merger activity in a customer industry in year t. The dummy variable, D, captures dependence of the customer industry on the supplier industry: D equals one if the fraction of customer industry input provided by the supplier industry lies in the top quintile, and zero otherwise. In Panel A, the explanatory variable *Past_SMA* represents three different measures of merger activity in the supplier industry. In column 1, *Past_SMA* equals supplier merger activity in year $t-1$. In column 2, *Past_SMA* equals supplier merger activity in years $t-1$ and $t-2$. In column 3, *Past_SMA* equals supplier merger activity in years $t-1$, $t-2$, and $t-3$. In each column, the key variable of interest is the interaction of *Past_SMA* times D. Control variables are as follows—R&D expense in year $t-1$; energy dependence as of 1992 benchmark I–O tables; economic shock is the principal factor of the sales growth and employment growth over the years $t-5$ to $t-1$; market PE ratio is the price-earnings ratio in year t. In Panel B, we provide only the coefficient on the interaction term *Past_SMA* × D (along with the t-statistic) for six separate panel regressions. Column 1 of Panel B presents the same regression as in column 1 of Panel A. In columns 2–6 of Panel B, the *Past_SMA* variable captures supplier merger activity in the year (t–k) where k ranges from 2 to 6. t-Statistics based on robust standard errors clustered at the two-digit SIC level are in parentheses. Bold font indicates significance at least at the 10% level. The superscripts a, b, c and indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A

	Past_SMA=Supplier merger activity in		
	Year ($t-1$)	*Years* ($t-1$) and ($t-2$)	*Years* ($t-1$), ($t-2$), and ($t-3$)
Past_SMA	−0.002	0.002	0.002
	(0.15)	(0.20)	(0.35)
Dependence dummy (D)	0.000	0.000	0.000
	(0.95)	(0.71)	(0.74)
Past_SMA × D	0.009	0.001	−0.000
	(0.68)	(0.12)	(0.01)
Supplier mergers (t)	0.003	0.004	0.004
	(0.30)	(0.30)	(0.26)
Customer mergers ($t-1$)	**0.225**	**0.230**	**0.238**
	(7.97)[a]	(6.80)[a]	(7.62)[a]
Research and development expense	**0.031**	**0.032**	**0.034**
	(3.84)[a]	(3.44)[a]	(3.61)[a]
Energy dependence	0.013	0.013	0.011
	(1.43)	(1.39)	(1.40)
Economic shock	−0.000	−0.000	−0.000
	(0.69)	(0.59)	(0.81)
Market price-earnings	**0.003**	0.003	**0.003**
	(2.30)[b]	(1.68)	(1.82)[c]
Observations	15,445	14,439	13,431
R-squared	0.098	0.102	0.104

Panel B

	Past_SMA=Supplier merger activity in					
	Year ($t-1$)	Year ($t-2$)	Year ($t-3$)	Year ($t-4$)	Year ($t-5$)	Year ($t-6$)
Coefficient on Past_SMA × D	0.000	−0.009	−0.014	0.011	0.001	0.003
t-Stat	(0.01)	(0.69)	(0.93)	(0.63)	(0.07)	(0.22)

captures the dependence of the customer industry on the supplier industry: it equals one for the top quintile of values of the fraction w_{ji}. Control variables are analogous to the ones employed in the last set of regressions. The first three columns of Table 8, Panel A present estimates of this equation using measures of *Past_SMA* for years $t-1$, $t-1$ and $t-2$ cumulated, and $t-1$ through $t-3$ cumulated, respectively. The coefficient α_3 is not statistically significant in any of the three regressions. In Panel B of Table 8, we repeat the same panel regression several times *without* cumulating past supplier merger activity. Here, *Past_SMA* is supplier merger activity in a given year $t-k$, with k ranging from 2 to 6. For comparison purposes, column 1 of Panel B also presents the coefficient from the first regression shown in Table 8 Panel A (where $k=1$). We see that the coefficient α_3 is never significant, indicating the absence of a relationship between consolidation activity in customer industries and past consolidation in their top supplier industries.

In summary, the results of this section support the hypothesis that supplier industries undertake consolidation activity in response to consolidation in their main customer industries. We do not find corresponding evidence that customer industry consolidation follows supplier industry consolidation.[28] Thus, our results

[28] Our inability to find any significant impact on the merger decisions of customer industries subsequent to upstream consolidation is consistent with our (unreported) finding that downstream prices do not exhibit increases after consolidation activity. Although studies such as Kim and Singal (1993) have shown changes in output prices after consolidation in particular industries, other cross-industry studies have

indicate strong support for the notion that consolidation activity tends to travel up the supply chain in line with the Becker and Thomas (2009) finding that changes in the concentration of main customer industries are followed by similar changes in concentration of supplier industries but not vice-versa.

5. Robustness issues

Our results are robust with respect to alternate methods of sample construction. Our measure of a *merger event* in the main analysis uses the ratio of merger transaction value to industry total assets to identify significant consolidation activity. Since the transaction value data use market values obtained from SDC, they should ideally be scaled by the market value of industry assets. Unfortunately, such scaling produces significant data loss as the Compustat main files often provide data aggregated to the three-digit SIC level. As a result, we have had to scale by the book value of industry assets available from the Compustat business segment files at the four-digit SIC level. An unfortunate side effect is that we have 20 industries where the market value of the targets purchased exceeds the book value of industry total assets. Indeed, for three industries, the ratio exceeds 20. An alternative standardization can be obtained by utilizing industry total sales (also available from Compustat's business segment files). As a robustness check, we classified an industry as having experienced a *merger event* in a given quarter if the following conditions hold: (i) the total transaction value of deals announced is greater than 10% of industry total sales and (ii) the total transaction value of deals announced in any of the previous 12 quarters did not exceed 2.5% of industry total sales. This method gives us 130 'merging' industries with identifiable suppliers. Although this alternative sample of merger events is slightly smaller, 105 of the 130 merger events (80%) are identical to our main sample. Our main results continue to hold in this alternative sample.

Some industries in our initial sample of consolidating industries also experienced multiple *merger events* between 1984 and 2003: 14 industries experienced two, and four industries experienced three *merger events* during this period. By design, any two *merger events* within the same industry are more than three years apart, thus enabling us to study the price impacts of these distinct *merger events* separately. However, for robustness, we have also dropped all industries that experienced more than one horizontal *merger event* from our initial sample and found that our results continue to hold in this setting.

Finally, it is possible that some suppliers classified as less dependent on one downstream merging industry are classified as dependent on another downstream industry that happened to experience a *merger event* around the same time. If this were a common occurrence, the power of our tests would be low. In the initial sample of supplier industry-merging industry pairs, there are 63 cases (out of 1,155) where suppliers classified as 'not dependent' on one downstream merging industry are classified as dependent suppliers for other downstream industries that underwent significant consolidation within a three-year period. Excluding these observations makes no qualitative difference to our results.

6. Conclusion

This paper conducts the first comprehensive, cross-industry tests of the product market impact of horizontal acquisitions on supplier industries through their effects on profits and prices. We find strong evidence that horizontal mergers do, in fact, create buying power and impact the performance of dependent suppliers. Dependent suppliers suffer significant declines in both their profits and their selling prices in the three years following major downstream consolidation activity, consistent with the creation of buying power through consolidation downstream.

To ensure that our results are not a mere artifact of merger-induced improvements in production efficiency, we explore the implications of the exercise of market power upstream via the channels hypothesized in the theory of countervailing power. This leads to the prediction of differential impact of such newly created buying power on supplier industries with different degrees of market power of their own. We show that supplier industries with higher Herfindahl index values and with higher four-firm concentration ratios prior to downstream consolidation experience larger price declines after downstream consolidation. We also show that supplier industries enjoying higher barriers to entry prior to downstream consolidation experience larger price declines after. This evidence suggests that downstream consolidations create countervailing buying power that is exercised in their wake.

To our knowledge, we are the first to establish that dependent supplier industries experience adverse selling price changes consequent to downstream consolidation. We are also the first to provide direct evidence that horizontal mergers countervail upstream market power. Our results point to one possible transmission mechanism for merger waves: consolidation in one industry triggering countervailing consolidations in industries that share product market relationships. We provide suggestive evidence of horizontal mergers in supplier industries following horizontal mergers in their main customer industries.

(*footnote continued*)
also failed to detect higher output prices subsequent to horizontal mergers. This lack of impact on prices could be due to the sample selection bias we refer to in the introduction: anti-competitive mergers likely to affect selling prices are anticipated to get blocked by antitrust authorities and are never embarked upon. Given such a bias, and given that horizontal mergers may also be driven by efficiency and strategic concerns, it could be that cross-industry studies inherently have weak power in the detection of selling power.

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