Vertical Integration and Foreclosure: Evidence from Production Network Data

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Abstract

This paper studies the prevalence of potential anticompetitive effects of vertical mergers using a novel dataset on U.S. and international buyer-seller relationships, and across a large range of industries. We find that relationships are more likely to break when suppliers vertically integrate with one of the buyers' competitors than when they vertically integrate with an unrelated firm. This relationship holds for both domestic and cross-border mergers, and for domestic and international relationships. It also holds when instrumenting mergers using exogenous downward pressure on the supplier's stock prices, suggesting that reverse causality is unlikely to explain the result. In contrast, the relationship vanishes when using rumored or announced but not completed integration events. Firms experience a substantial drop in sales when one of their suppliers integrates with one of their competitors. This sales drop is mitigated if the firm has alternative suppliers in place. These findings are consistent with anticompetitive effects of vertical mergers, such as vertical foreclosure, rising input costs for rivals, or self-foreclosure.

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1 Introduction

Vertical integration of two firms has the potential to increase their economic efficiency by exploiting synergies in the design, production, and distribution of their goods and services. At the same time, firms may pursue integration as a strategy not only to create competitive advantage, but also to engage in anti-competitive behavior. One such case arises when one of the integrating firms controls access to a bottleneck input, such as access to vital infrastructure or technology. The integrated firm might use its access to the bottleneck to extend or preserve its market power in the upstream markets by refusing to provide rival firms in downstream markets with access to the bottleneck. These firms are said to be foreclosed.[1] While a large theoretical literature investigates the motives for vertical foreclosure[2], empirical evidence of firms using foreclosure as a business strategy is restricted to a few very particular cases[3], not least because vertical relationships are rarely observed. This not only restricts our ability to test the theory, but also limits our understanding of the prevalence of foreclosure and related anticompetitive practices in reality. Even less is known about potential strategies to mitigate the effects of being foreclosed.

The empirical prevalence of vertical foreclosure is, of course, at least partly determined by competition law and its enforcement. Most of its forms are regarded as violating competition laws in a large range of jurisdictions. In the United States the Sherman and Clayton Antitrust Acts set out limitations to merger activity, and starting with *Terminal Railroad Association v. U.S.* (1912) U.S. courts have established a doctrine on foreclosure. Competition authorities typically issue guidelines on their assessment of vertical mergers to avoid unforeseen restrictions on mergers. At the same time – or perhaps as a consequence – enforcement of these vertical merger laws is relatively rare.[4] With recent work arguing that concentration and market power among US firms increased over the course of the last decades[5], and the finger being pointed at regulatory authorities[6], one is led to ask: is enforcement lax, or is actual foreclosure just very rare? What are the factors determining the prevalence of vertical foreclosure and related anticompetitive practices, and how severe are the consequences? How can firms threatened by foreclosure mitigate its impact?

This paper examines the occurrence of vertical foreclosure across a range of industries and countries. We exploit a novel panel dataset on vertical relationships — the network structure of production — between large firms, both in the U.S. and abroad. These data allow us to study whether buyer-seller relationships break following vertical mergers and acquisitions. We show

[1] By foreclosure, we mean a buyer excluding a competitor from the market by means of acquiring its supplier. This could be by refusing to supply or by (directly or indirectly) raising the rival buyer's costs.

[2] See Rey and Tirole (2007) for an overview. The classic references are Hart and Tirole (1990) and Ordover et al. (1990).

[3] Recent examples include Asker (2016) for the Chicago beer market and Crawford et al. (2018) for the US cable TV industry. Lafontaine and Slade (2007) and Slade (2019) survey this literature.

[4] Salop and Culley (2015) find only 46 vertical enforcement actions in the US over the period 1994–2013.

[5] De Loecker et al. (2020) estimate a rise in average US markups using Compustat and US Census data; Gutiérrez and Philippon (2017) document rising Herfindahl concentration indices in US industries, and Barkai (2016) documents a rise in the profit share of US non-financial corporations.

[6] See Gutierrez and Philippon (2018) and The Economist (2018)

that the breaking of a buyer-seller relationship in response to the supplier vertically integrating downstream is more likely when the downstream merging firm is a competitor of the buyer — but not when the downstream merging firm is not a competitor of the buyer. Consistent with theories of vertical foreclosure, the former break probability is even higher when there is little competition in the upstream industry. The increased probability of links breaking cannot be explained by common industry-level (or industry-pair-level) shocks to merger activity or the break probability. We find this increased break probability in response to both domestic and cross-border mergers. Similarly, domestic and cross-border relationships are equally likely to break in response to such vertical mergers.

The correlation we find does not immediately imply that vertical market foreclosure is taking place in the population of firms and relationships that we study. Causality could run in the opposite direction: vertical integration could be the *response* to relationships breaking, or to the threat thereof. Alternatively, both integration and links breaking could be caused by unobserved shocks. Finally, the links breaking might not be the the consequence of foreclosure, but might be the consequence of the integrating parties being able to produce the final good at such a low cost that the buyer decides to exit the market (and hence stops purchasing the input).

A series of additional regressions indicates that these alternative explanations are unlikely to account for the findings. To see whether our results stem from reverse causality, we follow Edmans et al. (2012) to construct an instrumental variable for vertical mergers and acquisitions. The variable captures events where investor capital outflows of mutual funds put large downward pressure on firms' stock prices, thereby making the firm more likely to be acquired. The correlation between vertical integration and links breaking prevails for vertical acquisitions that follow situations where such fund outflow events put downward pressure on the bottleneck supplier's stock price. If the investor capital outflows are unrelated to the performance of the supplier, these cases are integration events that are unlikely to happen for supply assurance reasons (as, for example, in Bolton and Whinston (1993)). The relationship also prevails when using these events to construct instrumental variables. Furthermore, we find similar results when conditioning on situations where the suppliers are "healthy" in the sense that they have seen sales increases prior to integrating.

Moreover, we study events where firms are rumored to vertically integrate or announce an integration, but end up not integrating. To the extent that these rumored integration events might be caused by the same unobserved shocks as actual integration events, they make for a good comparison group. For relationships where suppliers are rumored to vertically integrate, we do not find a higher hazard rate of links breaking than for the average relationship. We also do not find the large difference in hazard rates between rumored integration with a competitor of the buyer versus firms unrelated to the buyer.

To investigate whether strong synergies (i.e. improved efficiency) among merging firms force the downstream competitor out of the market and therefore break the link itself, we study the sales response of firms whose *competitor* is vertically integrating but who did not have a prior relationship with the integrating supplier. We find no statistically significant drop in sales for these firms, suggesting that strong synergies are unlikely to explain the breaking of vertical relationships in our main result. This is consistent with the results of Blonigen and Pierce (2016), who find no significant increases in physical productivity among US plants that undergo a merger or acquisition, but an increase in market power as measured by markups.

Finally, we study the performance of firms in the wake of their supplier's integration. Firms which have a supplier that vertically integrates with one of its competitors experience a temporary decrease in sales. The sales drop is larger for firms that do not have another supplier from the same industry as the one that is integrating. Diversification of the supplier base is hence a possible way to mitigate the impact of being foreclosed.

We interpret our results as supporting the view that vertical mergers have, on average in the population of firms and relationships that we study, anticompetitive effects. These anticompetitive effects can take the form of integrated firms excluding competitors from accessing an upstream input. They could also take the form of integrated firms "raising rivals' cost", potentially leading to the severance of the relationship, or self-foreclosure on the side of the competitor, such as to prevent the competitor from accessing strategically valuable information. While the relationships we study are not representative of the overall population of buyer-seller relationships in the United States, or among industrialized countries (the set of firms reporting relationships in our data consists mostly of firms that are either listed on exchanges or issue traded securities, and those firms are also more likely to report relationships with important suppliers and customers), the relationships in our sample will be more likely to be in the spotlight of antitrust authorities, it is likely that anticompetitive effects from vertical integration are also prevalent outside of the sample that we study.[7]

Our paper relates to three different literatures. The first is the literature that studies the determinants and effects of mergers and acquisitions, both domestic (Malmendier et al., 2018, Maksimovic et al., 2013, Rhodes-Kropf and Viswanathan, 2004, Gugler et al., 2003, Shenoy, 2012, Blonigen and Pierce, 2016, Cunningham et al., 2021, Harford et al., 2019) and international (Blonigen, 1997, Nocke and Yeaple, 2007, Ekholm et al., 2007, Breinlich, 2008, Guadalupe et al., 2012, Stiebale, 2016). In contrast to most of this literature, we study the impact not on integrating firms themselves, but on the vertically related ones.[8] We also show that foreclosure considerations — as determined by the structure of the production network — predict vertical mergers.

The second is the empirical literature on detecting vertical market foreclosure. Waterman and Weiss (1996), Chipty (2001), and Crawford et al. (2018) (in the cable TV industry), Hastings and Gilbert (2005) (in the gasoline retailing industry), and Lee (2013) (in the video game industry) find evidence for vertical foreclosure; Hortaçsu and Syverson (2007) (in cement and ready-mixed concrete markets) and Asker (2016) (in the beer industry) find no vertical

[7] Wollmann (2019, 2020) finds that exemptions on premerger notifications severely limit antitrust enforcement.

[8] Recent exceptions are Gugler and Szücs (2016) and Stiebale and Szücs (2019), who study the impact of mergers on horizontally related firms.

foreclosure in their respective industries.[9] In contrast to this literature, we study a range of industries, which not only broadens the scope of statements that we can make, but also allows for comparisons across industries by their degree of competitiveness. We draw from data on vertical and competitor relationships, which ties our hands on the definition of markets and vertical integration. The drawback is that our data prevents us from studying prices or markups, and therefore consumer welfare. Instead, we look at the supplier network of potentially foreclosed firms, and how the relationship between integration and links breaking varies with market structure in the upstream market.

Finally, our paper also relates to the growing literature on the importance of firm's position in the production network for its performance and exposure to shocks (Barrot and Sauvagnat, 2016, Giroud and Mueller, 2017, Bernard et al., 2017, Carvalho et al., 2016, Boehm et al., 2019, Tintelnot et al., 2018, Kikkawa et al., 2018, Miyauchi, 2018). Atalay et al. (2019) study the transaction cost imposed by trading across the firm border using buyer-seller transaction data. Alfaro et al. (2016) study the relationship between prices and vertical integration across many industries. Related to our work, Bernard and Dhingra (2015) find increased integration and foreclosure following the 2012 Free Trade Agreement between Colombia and the United States. Our paper shows how the network matters through the strategic incentives of horizontally related firms, and for how the production network itself is shaped by those incentives. We also introduce a new dataset on buyer-seller connections in the U.S. and abroad and document its properties.

The next section describes the data; Sections 3 and 4 present the econometric evidence.

2 Data

We combine three different datasets for our empirical analysis: a dataset describing supply chain and competitor networks, a dataset of mergers and acquisitions, and data on firm sales and employment. The first dataset is FactSet Revere, a panel of almost 900,000 vertical and horizontal relationships of large US and foreign firms. It describes the supplier, customer, and competitor relationships as well as partnerships of a set of large (mostly publicly listed or security-issuing) firms from the US and abroad (we call these companies the "covered" companies). Each relationship is coded with a relationship type, the identity of the firms, and a start and end date. The data vendor collects this information annually through the covered companies' public filings, investor presentations, websites and corporate actions, and through press releases and news reports. Since the relationship data is the main content of the dataset, its coverage is much broader than supplier data in Compustat or Bloomberg. While the data

[9] A substantial empirical literature has emerged that study vertical relationships and foreclosure in the healthcare industry. Vertically integrated primary care providers tend to steer patients to in-network specialist doctors (Chernew et al., 2018, Brot-Goldberg and de Vaan, 2018). Ho and Lee (2017) and Cuesta et al. (2018) estimate quantitative models of bargaining in vertical relationships in the healthcare industry. In the empirical model of Ho and Lee (2019), firms have an incentive to exclude some suppliers in order to threaten their trading partners to replace them with the excluded ones and thereby keep prices low. The network of vertical relations emerges as an equilibrium object.

coverage is specifically geared towards large firms, many small and non-listed firms nevertheless show up in relationships with large firms, hence our overall network is much larger than the set of listed firms. Coverage varies by country; data for covered North American companies is available from 2003 to present; Revere starts to cover publicly listed and security-issuing companies from industrialized and major emerging economies (including Europe and China) from around 2007.[10] To the extent of our knowledge, our paper is the first one in the economics literature to use this dataset, so we show summary statistics in more detail than we otherwise would.

FactSet Revere contains thirteen different types of relationships (see Appendix A.1 for more details). We aggregate these relationship types into two networks: a directed network of buyer-supplier relationships (from supplier and customer relationships, as well as distribution, production, marketing, and licensing relationships) and an undirected network of competitors. Moreover, we annualize the relationship data: A relation of any kind is counted as active in a given calendar year if there is at least one day between start date and end date of the relation that falls into that calendar year. The result is a panel of relations that is identified by source company, target company and year.[11]

Table I—: Descriptive statistics for the firm network

	Full Sample			Sample of buyers		
	Mean	SD	Max	Mean	SD	Max
# Customers	2.13	8.28	533	3.37	10.72	533
# Suppliers	2.13	10.20	980	3.85	13.48	980
# Competitors	2.16	7.73	381	3.48	10.13	381
Share of domestic customers	0.49	0.45	1	0.48	0.42	1
Share of domestic suppliers	0.50	0.45	1	0.50	0.45	1
Share of domestic competitors	0.46	0.45	1	0.46	0.43	1
Obs. per firm (years)	3.97	4.30	14	6.24	4.28	14
Log Sales	12.00	2.81	20	12.70	2.62	20
Log Employment	6.27	2.56	15	6.90	2.46	15
Firms	180,192			80,287		

Note: Summary statistics for the number of links in the firm network (2003-2016). The left columns summarize the full set of firms in the database, the right columns only those firms that have at least one supplier in the database. We count relations as domestic when both firms are headquartered in the same country. "Observations per firms" summarizes the coverage length of firms. Sales and employment data come from Compustat, Orbis and FactSet Fundamentals. Note that coverage for sales (employment) is lower: 74,511 (73,613) firms in the full sample and 40,576 (40,389) among buyers.

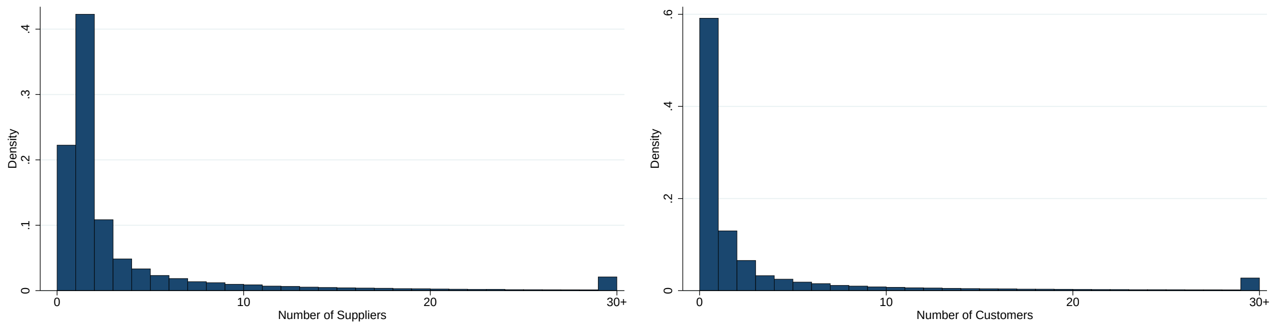
Table I summarizes the resulting links in the network of firms, which is much more dense than suggested by data exclusively relying on SEC filings (as reported, for instance, by Barrot and Sauvagnat (2016)). Among the more than 180,000 firms in our dataset, 80,000 have at least

[10]See Appendix A for details on coverage by country and year.

[11]Firms sometimes undergo organizational changes where a firm identifier ceases to exist and one or more new ones may be created (e.g. in cases of mergers and splits). In such cases, FactSet records the successor identifiers, and we say that a buyer-seller relationship breaks only if there is no buyer-seller relationship with one of the successor firms.

one supplier link recorded. On average, our buyers have 3.85 suppliers, but many firms have substantially more. The average numbers of customers and competitors is just slightly lower, allowing to construct a dense network. The average length of buyer-supplier relationships in our data is 4.46 years; the unconditional probability of buyer-supplier links breaking in any given year is 22%. Only 6.3% of links that break over the observation period are reformed at a later point in time, and almost never more than once. For buyer-supplier links the share of links that are reestablished later on is higher, at 12.9%.[12]

Figure 1: Distribution of the number of suppliers and customers



Note: The sample consists of firms that have at least one supplier.

Figure 1 shows the distribution of the number of suppliers and customers among firms. The distributions are very skewed, with most firms having few suppliers and customers, and some having many. Whenever we use the number of links in our regressions below, we will hence use the log of one plus the number of links instead of the raw count in order to avoid our results being driven by outliers. The fact that the number of relationships is heavily skewed is well-known from the literatures on firm heterogeneity and superstar firms.[13] Table II confirms that the firms with most connections account for a disproportionately large fraction of sales.

Table II—: Total sales by percentile of the # suppliers distribution

	Fraction of Sales, %
All	100.0
Top 25%	78.1
Top 10%	58.6
Top 5%	46.8
Top 1%	25.8

Note: The table shows the average fraction of sales (over years) accounted for by firms in the top percentiles of the distribution of the number of suppliers (firms with at least one supplier only).

Finally, one word of caution about these data. While the coverage of relationships is better

[12] In appendix B.5 we show that our main results are robust to not counting relationships as breaking if they are subsequently reestablished.

[13] The literature is vast; see, in particular, the recent empirical work by Bernard et al. (2017). Most similar to us, Carballo et al. (2018) document the skewness of the customer distribution and sales for international buyers of Latin American firms. In theoretical work, Oberfield (2018) explains how superstar firms emerge in a setting where firms search for suppliers.

than in other large panels that span many industries and countries, it is probably still incomplete: relationships with small firms, and relationships that account for a small fraction of sales or costs are presumably less likely to be recorded. Our data show about 500 listed suppliers for Walmart in 2016, and Walmart is — together with Apple, Samsung, and the large auto manufacturers — one of the firms with the highest number of recorded suppliers. In reality though, Walmart probably has tens of thousands of suppliers, suggesting that many relationships are missing. The relationships recorded in our data are probably the larger or more important ones.[14]

The second dataset we use is the set of mergers and acquisitions in Bureau Van Dijk's Zephyr database. Zephyr records deals and rumors about deals for mergers and acquisitions in which at least a 2% stake in the target company changes owners and the deal's value exceeds GBP 1M (Bollaert and Delanghe (2015)). For each merger or acquisition, Zephyr reports the nature of the transaction, the identity of the target company, the acquiring company and the seller, as well as the date of announcement, the date when the transaction was finished, and the stake of the acquirer in the target before and after the acquisition. Zephyr also contains a large number of rumored deals that never materialized, which we will use as a comparison group in some of our regressions.

Analogously to the relationship data, we annualize the Zephyr data and construct a panel of mergers and acquisitions between acquiring and acquired company. We focus on transactions where one company fully acquires another or the entities merged. We infer the vertical or horizontal nature of an integration by combining the M&A data with the input-output network: a vertical integration is a merger or acquisition between two firms that have an ongoing buyer-seller relationship in the year of integration.

Table III reports the number of mergers and acquisitions between firms for which supply chain information is available. The majority of mergers and acquisitions in our sample is between firms that are not vertically related. 6.7% of full acquisitions in our sample are vertical in the sense that they are between firms that have an active buyer-supplier relationship. The share is almost the same for partial acquisitions, which we do not use in our analysis but report here for completeness. The non-vertical mergers and acquisitions can be either purely horizontal or between unrelated firms that neither compete directly nor supply each other with inputs. For the sake of brevity, we will refer to both mergers and acquisitions as "mergers" for the remainder of the paper.

There is a small but non-negligible number of cases with risk of vertical foreclosure. Table IV summarizes key statistics about the buyer-supplier relations in our sample. While the unconditional probability that a relation ends in a given year is only 22.4%, this probability is more than 50% in cases where the supplier integrates vertically with a competitor of the buyer. In our data, this happens in 105 out of the 6865 cases in which a supplier vertically integrates

[14] Alternatively, one could use administrative VAT transaction records, as are available for countries like Belgium (Bernard et al., 2017) and Chile (Huneeus, 2018). However, in that case our study would be limited to relatively small samples and few vertical merger cases (as well as additional constraints imposed by the confidential nature of these data).

Table III—: Types of mergers and acquisitions

	Non-vertical		Vertical		Total	
	Count	%	Count	%	Count	%
Partial acquisitions	745	93.2	54	6.8	799	100.0
Full acquisitions & mergers	2,799	93.3	201	6.7	3,000	100.0
Total	3,544	93.3	255	6.7	3,799	100.0

Note: Number of partial and full mergers and acquisitions by presence of a vertical relation between the merging parties (2003-2016). Partial acquisitions exclude minority stakes. For a breakdown including horizontal mergers see Appendix A.

with another buyer.

Table IV—: Buyer-supplier links: hazard rates of links breaking and risk of foreclosure

	Value
P(link breaks)	0.225
Avg. relatation duration	4.45
Number of cases where supplier vertically integrates	6865
Number of cases where supplier integrates w. competitor	206
... and buyer-supplier link breaks	105

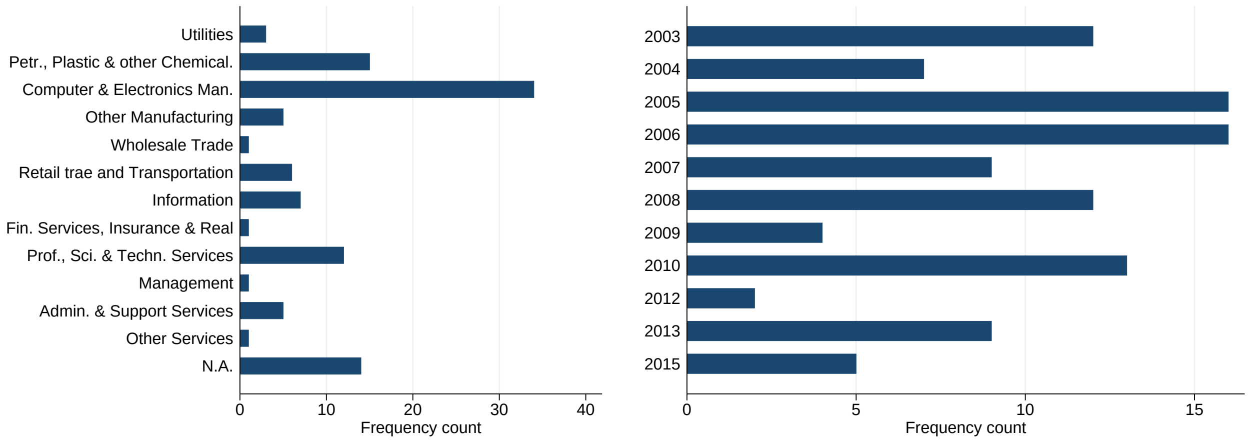
Note: The first row reports the unconditional probability that a buyer-supplier relationship ends in a given year. The second row reports the average length of these relations. The third row counts the number of cases in which a supplier vertically integrates. The fourth row restricts this number to cases where the vertical integration involves a competitor of the buyer. The fifth row counts the instances in which the buyer-supplier link breaks following vertical integration of the supplier with a competitor of the buyer. In all but one of the 206 foreclosure risk cases, the downstream firm is acquiring the upstream supplier.

Figure 2 shows the industry-wise and year-wise distribution of cases where the relationship breaks following vertical integration of the supplier with a competitor of the buyer. These situations are not confined to a narrow set of industries, but occur broadly across the economy. A particularly large number of such cases falls into computer and electronics manufacturing, in which there are many large firms that are frequently undertaking mergers and acquisitions. In the short panel that is available to us, there is no clear trend over time in the number of these potential foreclosure cases. Whereas recent research has documented a rise market power since the early eighties (De Loecker et al., 2020), this does not translate into an increase in the number of potential foreclosure cases over time in our sample.

We complement the relationship and M&A data by sales and employment figures and industry codes from Compustat, Bureau Van Dijk's Orbis database and FactSet Fundamentals (2003–2014). Since these data have been widely used in the literature, we will not describe them here.[15] The last rows of Table I show summary statistics for sales and employment.

[15]See Kalemli-Ozcan et al. (2015) for detailed information on Orbis. We use a current and past vintage of Orbis to have a better coverage.

Figure 2: Potential foreclosure cases by sector and year



Note: A potential foreclosure case is a situation where a buyer-seller relationship breaks following integration of the supplier with a competitor of the buyer. The left panel describes the sector of the buyer ("N.A." denotes missing sector information, and we exclude these firms from all regressions with industry fixed effects). About three quarters of potentially foreclosed firms are US firms.

3 Extensive-margin Foreclosure

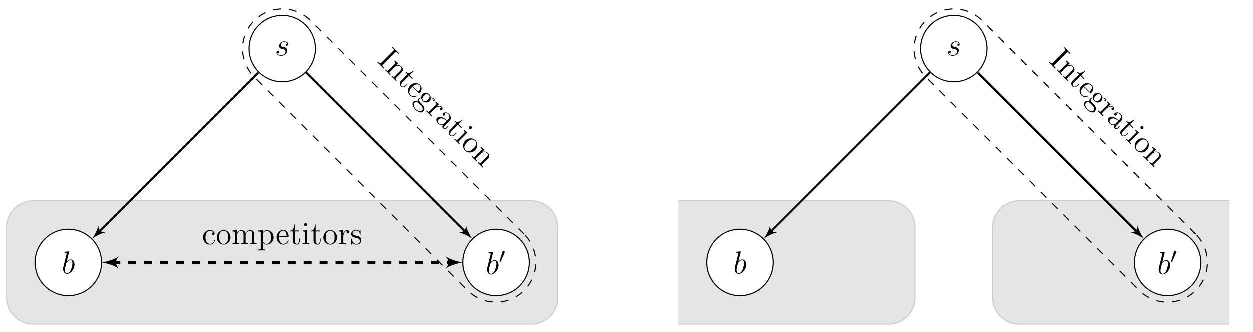
3.1 Empirical Strategy

Our empirical strategy is to study whether vertical relationships are more likely to break after the supplier integrated with a competitor of a buyer, than when it integrated with an unrelated firm. Consider a vertical relationship between seller s and buyer b. If b is a competitor of the firm b' that s is integrating with, then the integrating parties may have an incentive to foreclose b. If, on the other hand, b and b' are in different markets, then b would not be threatened by foreclosure (see Figure 3). Our strategy is therefore to compare the probability of the (b, s) relationship breaking between these two scenarios.

We define markets through the competitor relationships that we observe in FactSet Revere. FactSet constructs these competitor relationships based on firm's product portfolios and self-disclosed competitor relationships from SEC filings. We prefer this definition over industry code-based definitions for two reasons. Firstly, even 6-digit NAICS categories are often broad and encompass many different product markets (e.g. NAICS 334310: "Audio and Video Equipment Manufacturing"). Secondly, many of the firms in our sample are large firms that operate in different product markets, which are not always reflected in the SIC or NAICS codes. For those firms, competitor relationships are usually not transitive. As a result, the FactSet competitor relationships are very different from co-memberships in industry cells: among competitor pairs according to FactSet, only 43.5% are among firms that share a 4-digit NAICS code. Conversely, among all pairs of firms that share a 4-digit NAICS code, only 0.03% coincide with a FactSet competitor link.[16]

[16]The corporate finance literature is well aware that industry co-membership is a poor way to measure competitor relationships. Rauh and Sufi (2011) use competitor definitions from CapitalIQ and argue that this method captures competitor relationships much more accurately than using industry codes. Hoberg and Phillips

Figure 3: Empirical strategy: compare situations where buyers b and b' are in same vs. different markets



(a) Buyers b and b' in same market: foreclosure potential

(b) Buyers b, b' in different markets: no foreclosure potential

Note: This figure illustrates the main empirical strategy. We compare two situations in which a seller s integrates with a buyer b': one in which b and b' compete in the same product markets (a) and one in which they do not (b).

We estimate the following linear probability model[17] on the set of all triples (b, s, t) where s is listed as one of b's suppliers (or b is listed as one of s's customers) for at least one day in year t:

$$\begin{aligned} \mathbb{1}\{\text{LinkBreaks}\}_{bst} = \; & \alpha \mathbb{1}\{s \text{ vertically integrates}\}_{st} \\ & + \beta \mathbb{1}\{s \text{ integrates vertically w. competitor of } b\}_{bst} \\ & + \eta_{bs} + \eta_{bt} + \eta_{i(b)i(s)t} + \varepsilon_{bst} \end{aligned} \tag{1}$$

where $\mathbb{1}\{\text{LinkBreaks}\}_{bst}$ is a dummy variable that is one if and only if the vertical relationship between b and s is active during year t, but not during year $t+1$ (and also not between entities that are successors to b or s in case of a split or change in organizational form). The right-hand side variables are a dummy for whether s vertically integrates during year t, and a dummy for whether s vertically integrates with a competitor of b during year t. We include (i) fixed effects for buyer $\times$ year, η_{bt}, to control for time-varying characteristics of the buyer that could make all its supplier relationships more likely to break during a given year (such as exit), (ii) buyer $\times$ supplier fixed effects, η_{bs}, thereby identifying the coefficients of interest, α and β, from within-relationship variation in the hazard rate of the relationships breaking, and in the firms' characteristics, and (iii) industry-pair $\times$ year fixed effects, $\eta_{i(b)i(s)t}$, which takes out industry-specific (or industry-pair-specific) shocks that may lead to a higher break probability (where industries are defined at the 3-digit NAICS level). We exclude relations from the regression where the buyer and supplier themselves are the vertically integrating parties.

Table V shows the result from estimating equation 1 using ordinary least squares. The first column shows that when suppliers are vertically integrating, the probability of a given vertical relationship breaking is higher by about 2.7 percentage points (though this is not statistically

(2010) develop measures of product market competition from text analysis of firm filings.

[17] We use a linear model as a benchmark specification because it allows us to include high-dimensional fixed effects. We estimate hazard models in Appendix B.3, and find similar results.

Table V—: Correlation of buyer-supplier link breaking with vertical integration of supplier

	Dependent variable: $\mathbb{1}\{\text{LinkBreaks}\}_{bst}$			
	(1)	(2)	(3)	(4)
Supplier v. integrates	0.027	0.017	0.009	0.024
	(0.019)	(0.019)	(0.020)	(0.018)
Supplier v. integrates w. competitor		0.176**	0.176**	0.148**
		(0.059)	(0.062)	(0.052)
Controls				Yes
Relation FE	Yes	Yes	Yes	Yes
Buyer × Year FE	Yes	Yes	Yes	Yes
Industry Pair × Year FE			Yes	Yes
R^2	0.578	0.578	0.619	0.671
Observations	640753	640709	472832	472832

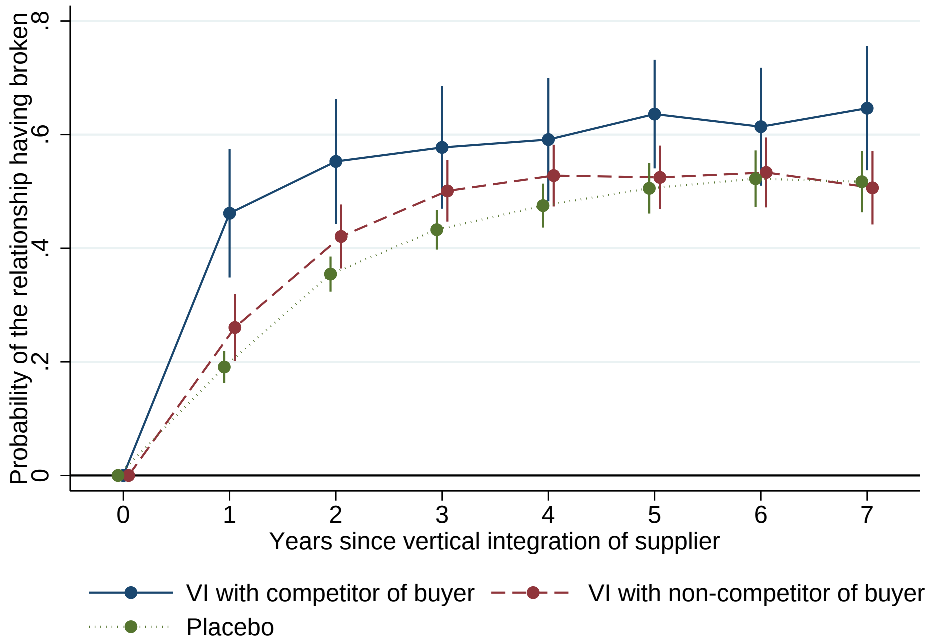
Note: Controls: number of upstream customers and competitors, age of the link, dummy indicating other links of the supplier breaking. Robust standard errors clustered at the supplier-year level. The number of reported observations is the number of non-singleton observations. The drop in the number of observations in columns (3) and (4) is explained by firms with missing industry codes. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

significant). Given that the unconditional probability of a relationship breaking in our data is about 22%, this would constitute an increase of about 12%. Column (2) shows that the likelihood of the vertical relationship breaking is indeed much higher (18 percentage points difference, or a 80% higher probability) when the buyer is a competitor to the downstream merging firm. This difference remains large and statistically significant when including industry pair × year fixed effects to control for sector- or sector-pair-specific shocks (column 3), and when controlling for a range of supplier and relationship characteristics (column 4).

It is worth pointing out that the results above are unlikely to be driven by the possibility that a relationship may not be observed by FactSet following a merger, because the firm entity has ceased to exist, or because it may not be tracked anymore: if that was the case, we should be seeing a substantially increased hazard also following vertical mergers with firms that are not competitors of the downstream merging firm.

Figure 4 shows graphically how break probabilities differ across these two types of vertical integration events. The horizontal axis shows the time after a vertical integration event of the supplier; the vertical axis shows the probability of the relationship having broken (i.e. one minus the probability of the relationship being active). By definition of the sample, in the year of integration of the supplier the buyer-seller relationship must be active. We see that relationships where the supplier integrates with a competitor of the buyer (solid blue line) are much less likely to survive the post-integration years, in particular the year following integration, than relationships where the supplier integrates with a non-competitor of the buyer (dashed red line). The dotted green line shows relationship survival rates for simulated placebo events that are generated to occur with 0.6% probability in any given year where a relationship is active. This corresponds to the average probability that a supplier in a given relation vertically integrates. The regression that generates these marginal effects include relationship, buyer-year, and industry-pair year fixed effects; the corresponding plot of a regression without fixed effects looks very similar.

Figure 4: Probability of relationships having broken after supplier's vertical integration



Note: The figure shows coefficients on dummies capturing the years since a supplier's vertical integration, in a regression of the probability of a buyer-seller relationship being inactive on time-since-integration dummies, as well as relationship, buyer × year, and industry-pair × year fixed effects. Standard errors are clustered at the supplier-year level. The solid blue line denotes relationships where the supplier integrates with a competitor of the buyer; the dashed red line denotes relationships where the supplier integrates with a non-competitor of the buyer; the dotted green line represents relationships where a placebo integration event has been drawn to occur. That placebo event is randomly drawn to occur with 0.6% probability in any given year where a relationship is active (and independently across relationship-years).

Next, we study variation across industries in the relationship between vertical integration and links breaking. Most theories of vertical foreclosure, in particular the raising rivals' cost theories and extending monopoly power theories of vertical foreclosure predict that market power in the bottleneck market increases the incentives to foreclose. We want to empirically assess this prediction. In order to do so, we study whether the correlation between integration with a competitor and relationships breaking is lower when the supplier has less market power. We measure the supplier's market power by the number of his competitors.[18] More specifically, we run the regression

[18] Alternatively, one could measure the supplier's market power with market shares. Our sales coverage among suppliers and in upstream markets generally, however, is very limited, so we prefer measuring supplier market power through the number of competitors.

$$
\begin{aligned}
\mathbb{1}\{\text{LinkBreaks}\}_{bst} = \; & \alpha \mathbb{1}\{s \text{ vertically integrates}\}_{st} \\
& + \beta \mathbb{1}\{s \text{ integrates vertically w. competitor of } b\}_{bst} \\
& + \gamma \mathbb{1}\{s \text{ integrates vertically w. competitor of } b\}_{bst} \times C_{st} \\
& + \delta C_{st} \\
& + \eta_{bs} + \mu_{bt} + \varepsilon_{bst} \qquad (2)
\end{aligned}
$$

where C_{st} is a variable capturing the number of competitors of the supplier s at time t. Just like the number of buyers and suppliers is heavily skewed, so is the number of competitors, therefore we use the log of one plus the number of competitors for C_{st}.

Table VI shows the results. We find that the correlation between buyer-supplier-links breaking and vertical integration of a supplier with a competitor is lower when the supplier has more competitors (columns (1) and (2)). This result is in line with theories of foreclosure: the existence of more alternative suppliers to the buyer reduces the incentives of the acquirer to foreclose competitors. In columns (3) and (4) we also include interactions with the number of competitors of the buyer. The point estimates of the coefficients on these interaction terms are slightly positive (though not statistically significant). While not entirely conclusive, it is possible that more competition in the downstream market increases the probability of links breaking after integration with a competitor.

Tables V and VI show a correlation that by itself is not evidence for vertical foreclosure. We see that relationships are relatively much more likely to break when the supplier is undergoing a vertical merger with a competitor of the buyer, than when it is merging with a firm that is not a competitor of the buyer. The fact that this correlation is stronger when the supplier has few competitors lends support to the view that vertical foreclosure, or another anticompetitive effect from vertical integration, could be occurring in the population of firms that we study. Yet, the regressions are not necessarily evidence for a causal link between mergers and the breaking of relationships, simply because mergers do not happen randomly. In particular, there are three main confounding explanations:

Firstly, it could be that the integration between the supplier and the competitor is a consequence of the relationship between buyer and supplier breaking; for instance because the supplier's acquirer might be concerned that the supplier would otherwise exit.[19] In that case our regression would suffer from reverse causality: integration with a competitor of the buyer would be relatively more likely because the competitor could be purchasing exactly those goods that the supplier is discontinuing.

Secondly, it could be that both the breaking of the relationship and the vertical integration are the result of an unobserved shock hitting one of the firms. Such a shock would need to make the supplier more likely to integrate with competitors of its buyers than with a non-competitor

[19] Bolton and Whinston (1993) study firms' incentives to vertically integrate for supply assurance reasons. In this situation, "exit" does not have to be a complete exit of the supplier, but could be just an exit from a particular market.

Table VI—: Interaction with the number of upstream competitors

	Dependent variable: $\mathbb{1}\{\text{LinkBreaks}\}_{bst}$			
	(1)	(2)	(3)	(4)
Supplier v. integrates w. competitor	0.557**	0.449**	0.323	0.241
	(0.171)	(0.159)	(0.340)	(0.309)
Supp. v. int. w. comp. × # upstream comp.	-0.125*	-0.106*	-0.125	-0.106
	(0.057)	(0.053)	(0.093)	(0.085)
Supplier v. integrates	0.012	0.029**	0.012	0.029
	(0.008)	(0.007)	(0.019)	(0.021)
# upstream competitors	-0.017**	-0.023**	-0.017**	-0.023**
	(0.002)	(0.002)	(0.003)	(0.003)
Supp. v. int. w. competitor × # downstream competitors			0.063	0.056
			(0.046)	(0.040)
Controls		Yes		Yes
Relation FE	Yes	Yes	Yes	Yes
Buyer × Year FE	Yes	Yes	Yes	Yes
Industry Pair × Year FE	Yes	Yes	Yes	Yes
R^2	0.619	0.667	0.619	0.667
Observations	472832	472832	472832	472832

Note: Controls: number of upstream customers, age of the link, dummy indicating other links of the supplier breaking. "Upstream competitors" is the number of competitors of the supplier; "downstream competitors" is the number of competitors of the buyer. Table reports robust standard errors, clustered at the supplier-year level. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

in order to explain the different magnitude of the coefficient estimates in Table V. We discuss these alternative explanations in turn.

Thirdly, if synergies between the vertically integrating firms are very strong, the resulting cost savings in the production of the downstream good could drive their competitors in the downstream market out of the product market, and lead them to stop buying from the upstream integrating firm.

We proceed to discuss the first two alternative explanations, and turn to the third one after showing the impact of separations on sales in Section 4.

3.2 Reverse causality: vertical integration for supply assurance?

Our relationship between links breaking and vertical integration may be driven by suppliers' motivation to exit certain product markets and cut ties with some of their customers, which in turn may cause them to be acquired by one of their customers. We therefore apply an instrumental variable strategy that exploits shocks that are outside of the control of the firm and that make integration more likely. Our instrument builds on Edmans et al. (2012), who show that when large mututal funds experience an outflow of capital, they are forced to sell off assets, which puts downward pressure on the share prices of firms in their portfolio. In turn, these firms become more likely to be acquired.

We follow Edmans et al. (2012) and Dessaint et al. (2019) and construct a variable capturing the *hypothetical* (not actual) share sales of large U.S. mutual funds in response to an outflow of investor capital. We first calculate the net inflow of capital to the fund based on its total net asset holdings and returns reported in the CRSP mututal funds database. For funds j that see a net outflow of more than five percent of its total net assets in a given quarter q, we calculate the hypothetical sales of a stock i if holdings of all assets were reduced proportionally to the outflow.[20] More precisely, these total hypothetical sales of a stock i by large mutual funds are

$$MFHS^{\$}_{i,q} = \sum_{j:\ \text{Flow}_{j,q} < -0.05} (\text{Flow}_{j,q} \cdot \text{Shares}_{ji,q-1} \cdot \text{Price}_{i,q-1})$$

where $\text{Flow}_{j,q}$ is the net inflow of fund j's investor capital, as a fraction of total beginning-of-period net assets, and $(\text{Shares}_{ji,q-1} \cdot \text{Price}_{i,q-1})$ is the dollar value of the fund's holdings of stock i at the end of the previous quarter. We sum this variable over the four quarters in the year and normalize the sum by the total trading volume in that year to obtain a normalized measure $MFHS_{j,t}$.

The normalized MFHS variable is meant to capture the downward pressure on prices that is exerted by the capital outflows of mutual funds. Figure 5a shows the average response of cumulative stock returns following a large mututal fund outflow event (defined as normalized MFHS below the tenth percentile). Stock prices drop significantly as the shock hits and then recover to the pre-shock level. Figure 5b shows the response of the probability to be involved in the completion of a vertical merger or acquisition before and after such an event. In the year after the outflow event, the probability of integration is significantly higher. The one year lag between outflow event and completion of the acquisition may reflect the time to negotiate the acquisition and the antitrust authority's clearance.

This variable is useful to us because it effects an increase in the probability that a firm is being acquired, yet it is unlikely that the shock has a direct immediate impact on the operations of the firm or its buyers (Dessaint et al. (2019) call them "nonfundamental").[21] While lower stock prices may be associated with worsened access to financing and lower medium-term investment, it seems reasonable to assume that this shock will not lead firms to sever their ties with customers (or vice versa) other than through changes in the ownership status. Hence, these shocks make for a possible instrumental variable.

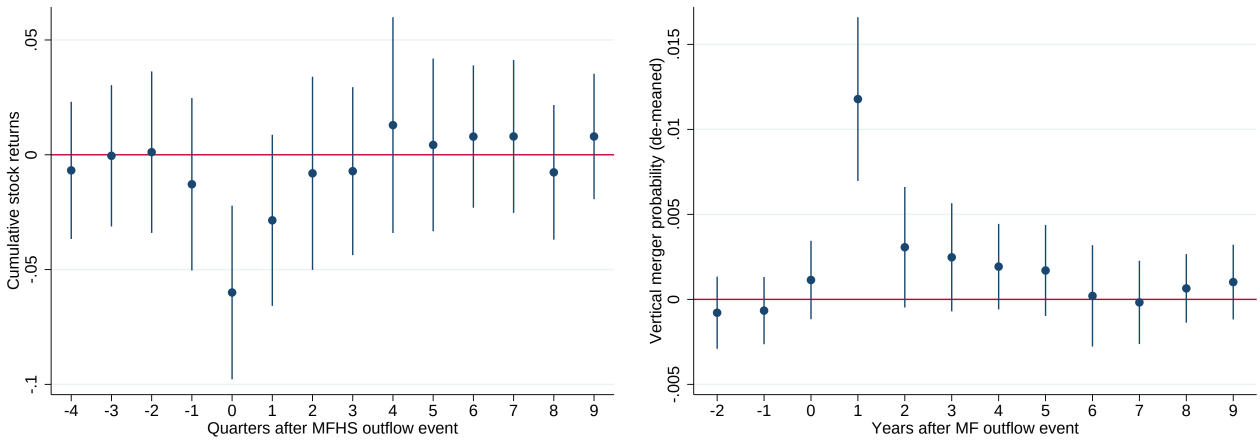
We first employ this variable in the form of an interaction. We estimate the linear model

$$\begin{aligned}\mathbb{1}\{\text{LinkBreaks}\}_{bst} = \ & \alpha \mathbb{1}\{s \text{ vertically integrates}\}_{st} \times \text{MFHSEvent}_{st} \\ & + \beta \mathbb{1}\{s \text{ integrates vertically w. competitor of } b\}_{bst} \times \text{MFHSEvent}_{st} \\ & + \eta_{bs} + \mu_{bt} + \varepsilon_{bst}\end{aligned}$$

where MFHSEvent_{st} is a dummy that is one if the supplier experiences an outflow event (nor-

[20]Data on mututal fund stock holdings come from the Thomson Spectrum CDA database, and stock prices from Thomson Worldscope. See Appendix A for data sources and definitions.

[21]In Appendix B.9 we show that firms do not have lower sales during these events.



(a) Cumulative stock returns

(b) Vertical merger probability

Figure 5: Response to a mutual fund outflow event

Note: The figures show the average response of cumulative stock returns (vertical axis, left panel), and the average response of the probability to engage in a vertical merger or acquisition (vertical axis, right panel) following a mutual fund capital outflow (defined as normalized MFHS being below the tenth percentile) at quarter 0. The left panel is a regression of cumulative stock returns on time-since-event dummies; the right panel is a regression of vertical integration dummies on time-since event dummies. Both regressions contain firm and industry-time fixed effects; standard errors are clustered at the firm level.

malized MFHS variable below the tenth percentile) in periods $t-2$, $t-1$, or t. The coefficients α and β capture the average difference in the probability of links breaking following supplier's vertical integration events that happens after outflow events, compared to the baseline as explained by fixed effects. Table VII show that these differences are similar to those of the population of *all* supplier vertical integration events. Hence the vertical integration events that follow MFHS outflows (i.e. events that are less likely to be affected by reverse causality) have similar correlations with links breaking, suggesting that reverse causality is unlikely to explain the increased probability of links breaking in the baseline specifications.

We now turn to an instrumental variable strategy. We have two challenges. First, the MFHS outflows may shift the likelihood of vertical integration of the supplier, but we may also need an instrument for the second part of the expression, namely whether the suppliers' integration is with a competitor of the buyer. For this we use the share of the supplier's customers in period $t-1$ that are competitors of the buyer. A higher share of competitors among the supplier's customers will generally increase the likelihood that the acquiring customer is a competitor. [22]

The second challenge is that the MFHS events are quite rare, potentially leading to a weak instrument problem. To alleviate this problem we construct generated instruments from the exogenous variables through a generating regression (see Wooldridge (2010) Ch. 6.1, and in particular Xu (2021) for an application to the weak instrument problem). Importantly, the estimates will be consistent even if the functional form of the generating regression is mis-

[22]Like any statistic that describes market structure, this statistic may be determined by a host of characteristics, such as entry costs, technology, and demand-side characteristics. For our application it would be sufficient that its determinants are independent of the particular shock that causes the link to break (other than through the suppliers' vertical integration). Even though we cannot directly test this, it may be reassuring to know that the share itself does not predict links breaking conditional on the fixed effects.

Table VII—: Relationships breaking following Vertical Integration after MFHS events

	Dependent variable: $\mathbb{1}\{\text{LinkBreaks}\}_{bst}$		
	(1)	(2)	(3)
Supplier v. integrates (after MF outflow)	0.003	-0.005	0.009
	(0.021)	(0.021)	(0.020)
Supplier v. integrates w. competitor (after MF outflow)		0.276^{***}	0.223^{**}
		(0.080)	(0.084)
Controls			Yes
Method	OLS	OLS	OLS
Relation FE	Yes	Yes	Yes
Buyer × Year FE	Yes	Yes	Yes
Industry Pair × Year FE			Yes
R^2	0.578	0.578	0.671
Observations	640753	640709	472832

Note:

Controls: number of upstream customers, age of the link, dummy indicating other links of the supplier breaking. Table reports robust standard errors, clustered at the supplier-year level. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

specified. Our baseline generating regression is a Poisson model,[23]

$$E\left(\mathbb{1}\{s \text{ vertically integrates}\}_{st}|Z\right) = g(Z,\lambda) \tag{3}$$
$$:= \exp(\lambda_1 \text{MFHSEvent}_{st} + \lambda_2 \text{MFHSEvent}_{st} \times \text{ShareCustomersBCompetitors}_{bst-1} + \lambda_{bs} + \lambda_{bt})$$

where Z denotes the exogenous variables and λ the vector of parameters. We then use the fitted values of this regression, $g(Z,\hat{\lambda})$, as well as $g(Z,\hat{\lambda}) \times \text{ShareCustomersBCompetitors}_{bst-1}$ as instruments to estimate the coefficients in (4) using 2SLS:

$$\mathbb{1}\{\text{LinkBreaks}\}_{bst} = \alpha \mathbb{1}\{s \text{ vertically integrates}\}_{st} \tag{4}$$
$$+ \beta \mathbb{1}\{s \text{ integrates vertically w. competitor of } b\}_{bst} + \eta_{bs} + \mu_{bt} + \varepsilon_{bst}$$

If $E(\varepsilon|Z) = 0$, this produces consistent estimates of α and β.

Table VIII shows the results. While the standard errors are considerably larger than in the baseline linear regressions, the difference in the point estimates for the two coefficients remains large and possibly even increases. Estimates are similar for alternative ways of specifying the generating regression (3) (see Appendix B.16).

As an alternative to the IV strategy, we show results where we restrict attention to a subsample of firms that are "healthy", and are therefore less likely than the average firm to cut substantial parts of their product mix. Table IX shows results of estimating equation (1) on the sample of firms that have positive sales growth between years $t-2$ and $t-1$ (columns (1) to (3)), or sales growth above the median of three percent (columns (4) to (6)). The point

[23]The Poisson model has the advantage that the estimates are asymptotically unbiased as the number of relationships and time periods grows large. Appendix B.16 shows robustness to other specifications.

Table VIII—: Relationships breaking following Vertical Integration: Generated IV (Poisson)

	Dependent variable: $\mathbb{1}\{\text{LinkBreaks}\}_{bst}$		
	(1)	(2)	(3)
Supplier v. integrates	0.031	0.016	0.022
	(0.020)	(0.020)	(0.019)
Supplier v. integrates w. competitor		0.319	0.297
		(0.201)	(0.190)
Controls			Yes
Method	IV	IV	IV
Relation FE	Yes	Yes	Yes
Buyer × Year FE	Yes	Yes	Yes
R^2	0.000	0.000	0.131
First stage F-stat	2460.292	17.504	17.495
Observations	506373	506335	506335

Note:

Controls: number of upstream customers, age of the link, dummy indicating other links of the supplier breaking. Table reports robust standard errors, clustered at the supplier-year level. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

estimates of the coefficient on the integration with a competitor variable are larger than in our baseline specifications (even though the smaller sample makes the estimate less precise). Firms that are growing are much less likely to exit product markets (Goldberg et al., 2010). For the firms in this subsample, the causality is hence much less likely to run from the breaking of the relationship to vertical integration.

Table IX—: Regressions on relationships with "healthy" suppliers

	Dependent variable: $\mathbb{1}\{\text{LinkBreaks}\}_{bst}$					
	Sample: $\Delta \log \text{Sales}^s_{t-1} > 0$			Sample: $\Delta \log \text{Sales}^s_{t-1} >$ median		
	(1)	(2)	(3)	(4)	(5)	(6)
Supplier v. integrates	0.034	0.023	0.034	0.049	0.024	0.037
	(0.026)	(0.028)	(0.025)	(0.031)	(0.035)	(0.030)
Supplier v. integrates w. competitor	0.375^{**}	0.312^{*}	0.212^{+}	0.372^{**}	0.359^{*}	0.236
	(0.117)	(0.129)	(0.122)	(0.144)	(0.155)	(0.146)
Controls			Yes			Yes
Relation FE	Yes	Yes	Yes	Yes	Yes	Yes
Buyer × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry Pair × Year FE		Yes	Yes		Yes	Yes
R^2	0.607	0.675	0.709	0.616	0.686	0.720
Observations	252057	191741	191741	197811	148193	148193

Note: Columns (1) to (3) restrict the sample to buyer-supplier pairs where $\Delta \log \text{Sales}^s_{t-1}$ is above zero, columns (4) to (6) where it is above the median. Controls: number of upstream customers and competitors, age of the link, dummy indicating other links of the supplier breaking. Number of observations exclude singleton observations. Robust standard errors, clustered at the supplier-year level, in parentheses. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

3.3 Unobserved shocks: omitted variables

3.3.1 Comparison with rumors of mergers and acquisitions

Our next exercise speaks to the possibility that both vertical integration and the discontinuation of buyer-supplier relationships are the response to unobserved shocks. As discussed above, such shocks must be directed to make integration with a competitor of the buyer more likely in order to explain the correlation in the baseline tables. One could think of a market-level change in technology which increases the need for customization of the supplied input, while also driving some firms out of the market, causing links to break. The adopters of the new technology and their suppliers choose to vertically integrate to reduce the inefficiency associated with the hold-up problem (Klein et al., 1978).

We try to find a group of firms that is most comparable in terms of the shocks that they may have been facing, but for an *exogenous* reason do not manage to vertically integrate. The closest we can get to such a comparison group is by considering rumors of mergers.[24] Zephyr collects rumors from "unconfirmed reports", which "may be in the press, in a company press release, or elsewhere" (Bureau Van Dijk, 2017). Our approach is hence similar to the comparison of a placebo with the actual treatment in the sense that our rumor does not actually result in vertical integration (but potentially with the difference that even an attempted merger may lead to buyers switching suppliers). Rumors are dated at the time when they are first mentioned. While buyers in rumored and actual treatments are quite comparable, the suppliers in rumored mergers are somewhat larger than the suppliers that actually integrate (see Table XVIII in the appendix). Note that we can control for these differences in our regressions and also do not find differential effects for larger or smaller suppliers.

We first study the benchmark specification, equation (1), with actual vertical integration events replaced by the rumors. This specification compares the average probability of links breaking outside of such events with the average break probability under a rumored vertical integration, and one with a competitor of the buyer. Table X reports the results of these regressions. Links break slightly less often during rumored vertical integration with non-competitors of the buyer, and slightly more often (though not statistically significantly so) during rumored vertical integration with competitors. The point estimate of the coefficient on the "rumored vertical integration with competitor" dummy is certainly much lower that the corresponding point estimate in the benchmark regression with actual mergers (though note that the comparison is not straightforward: the dummy here is one at the rumor date, whereas it is one in Table V on the *completion* date). Table XXI in Appendix B.2 shows results with both rumors and actual integration events in the same regression.

To investigate more closely the timing aspect and to have the tightest possible comparison between actual and rumored mergers, we compare the break probability before and after actual mergers with buyers' competitors to the break probability before and after rumored mergers with buyers' competitors. In both cases we use the date of the announcement. More precisely,

[24] Another possible comparison group would be mergers that have been announced but never completed. However, such events are very rare in our data.

Table X—: Links are not more likely to break following rumors of M&A

	Dependent variable: $\mathbb{1}\{\text{LinkBreaks}\}_{bst}$	
	(1)	(2)
Supplier v. integrates (rumor w/o unfinished)	-0.020	-0.022
	(0.020)	(0.017)
Supplier v. integrates w. competitor (rumor w/o unfinished)	0.004	-0.003
	(0.040)	(0.035)
Controls		Yes
Relation FE	Yes	Yes
Buyer × Year FE	Yes	Yes
Industry Pair × Year FE	Yes	Yes
R^2	0.586	0.639
Observations	596746	596747

Note: Controls: number of upstream customers and competitors, age of the link, dummy indicating other links of the supplier breaking. Number of observations exclude singleton observations. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

we run a regression of a binary variable that is one if the relationship is not active anymore on a set of dummies for the number of years since announcement, separately for actual and rumored mergers (and separately by whether the merger is with a competitor of the buyer), and including relationship, buyer × year, and sector-pair × year fixed effects.

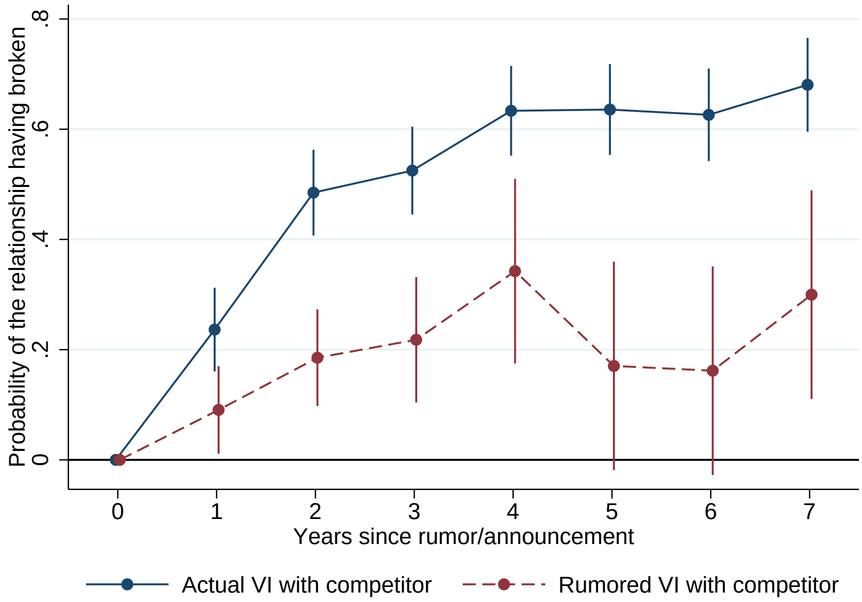
Figure 6 shows the results. Following the announcement, break probabilities are substantially higher for actual than for rumored vertical mergers with competitors. Not only are relationships where there is a rumor about the supplier integrating with a competitor not more likely to break in the first period, but these relationships seem to be fairly long-lasting. To the extent that rumors are a good comparison group to actual merger events, vertical integration and links breaking are unlikely to be driven by the same underlying unobserved shocks.

3.4 International relationships and cross-border mergers

We now turn to studying the international dimension in our regressions. Buyers with foreign suppliers may be at higher risk of foreclosure if competition authorities do not take foreign markets into account in their merger evaluation. Similarly, cross-border mergers, which account for about 20% of full vertical mergers (Table XI), may receive a different degree of scrutiny than purely domestic mergers. We therefore look at whether the extensive margin of (cross-border or domestic) relationships correlates differently with integration.

Table XII shows the results. The first two columns are the same as in Table V with the difference that we add country-pair × year fixed effects. Columns (3) and (4) include interactions with a dummy that is one if b and s are registered in different countries. Whereas the coefficient on the interaction with any kind of vertical integration by a supplier is negative and weakly statistically significant, we do not find evidence suggesting that international relations are more likely to become targets of foreclosure. Columns (5) and (6) include interactions with

Figure 6: Probability of relationships breaking: actual vs rumored integration with competitor



Note: The figure shows coefficients on dummies capturing the years since a supplier's rumored (dashed red line) or actual (solid blue line) vertical integration, in a regression of the probability of a buyer-seller relationship being inactive on time-since-integration dummies (separately for rumored mergers with competitors, with non-competitors, and actual mergers with competitors, and with non-competitors) as well as relationship, buyer × year, and industry-pair × year fixed effects. Here, time zero is the time of the rumor or the announcement of the merger. We exclude rumors that are realized within three years.

Table XI—: Domestic and cross-border mergers and acquisitions

	Non-vertical		Vertical		Total	
	Count	%	Count	%	Count	%
Domestic	2,038	92.7	161	7.3	2,199	100.0
Cross-border	761	95.0	40	5.0	801	100.0
Total	2,799	93.3	201	6.7	3,000	100.0

Note: Number of full mergers and acquisitions by presence of a vertical relation between the merging parties (2003-2016). M&As are counted as domestic if both merging parties are headquartered in the same country, otherwise they are considered cross-border M&A.

a dummy that is one if the buyer that s is integrating with is located in a different country. Their coefficients, too, are small and insignificant. International mergers seem to be no different than domestic mergers when it comes to their likelihood of foreclosing the competition.

4 Impact on Downstream Firms

4.1 Impact on Sales

The results from the previous section show that buyer-seller relationships are more likely to break when the downstream merging firm is a competitor of the buyer. The obvious next question is: does it matter? If the input market is frictionless and perfectly competitive, the

Table XII—: International Relationships, International M&A's

	Dependent variable: $\mathbb{1}\{\text{LinkBreaks}\}_{bst}$					
	(1)	(2)	(3)	(4)	(5)	(6)
Supplier v. integrates	0.007 (0.020)	0.022 (0.019)	0.017 (0.021)	0.031 (0.019)	0.003 (0.021)	0.019 (0.019)
Supplier v. integrates w. competitor	0.185** (0.063)	0.157** (0.052)	0.161* (0.065)	0.148** (0.055)	0.180** (0.066)	0.155** (0.055)
S integrates × Intl. Rel.			-0.044^{+} (0.023)	-0.042^{+} (0.023)		
S integrates w. comp. × Intl. Rel.			0.101 (0.112)	0.039 (0.106)		
S integrates × Intl. M&A.					0.072 (0.088)	0.050 (0.084)
S integrates w. comp. × Intl. M&A.					0.008 (0.231)	-0.001 (0.198)
Controls		Yes		Yes		Yes
Relation FE	Yes	Yes	Yes	Yes	Yes	Yes
Buyer × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry Pair × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country Pair × Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.636	0.683	0.636	0.683	0.636	0.683
Observations	464705	464705	464705	464705	464705	464705

Note: Controls: number of upstream customers and competitors, age of the link, dummy indicating other links of the supplier breaking. Robust standard errors clustered at the supplier-year level. The number of reported observations is the number of non-singleton observations. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

cost to losing a supplier is zero (of course, in such a situation there is no foreclosure motive at all). If, on the other hand, the use of outside suppliers is associated with a higher variable cost, then the loss of the supplier will push the buyer along the demand curve to a point where the firm operates at a lower scale.

We now study the response of firm sales to events where (1) a supplier of the firm vertically integrates; (2) a supplier of the firm vertically integrates with a competitor of the firm. Specifically, we estimate the equation

$$\begin{aligned}\log Sales_{bt} = \; & \alpha \mathbb{1}\{\text{A supplier vertically integrates}\}_{bt} \\ & + \beta \mathbb{1}\{\text{A supplier integrates vertically w. competitor of } b\}_{bt} \\ & + \eta_b + \mu_{i(b)t} + \varepsilon_{bt} \qquad (5)\end{aligned}$$

where η_b is a buyer fixed effect, and $\mu_{i(b)t}$ is an industry × year fixed effect. While our sales variable is constructed from accounting data and is probably measured with error, this should not bias our estimates as long as the measurement error is classical.

The first two columns of Table XIII show the results. In a year where a supplier of the firm is integrating with a non-competitor, the firm's sales are slightly higher; if the integration happens with a competitor, the sales are slightly lower than average. But this small coefficient is masking a lot of heterogeneity. Columns (3) and (4) interact the dummy for vertical integration with a competitor with a variable capturing the number of other suppliers from the same 3-digit sector as the supplier that the firm is being cut off from (at the time of the integration). This means that the coefficient on the "integration with competitor" variable now captures the average sales response for a firm that does not already have any "alternative" suppliers already in place in the sector where its supplier vertically integrates.

Columns (3) and (4) of Table XIII show that the point estimates of this coefficient are large and negative: firms that are cut off from a supplier that they do not already have an existing alternative to are suffering a large drop in sales. On the other hand, the presence of alternative suppliers mitigates the sales impact. Note that the sales loss may capture both a movement along the demand curve due to higher variable costs, as well as a potential loss of market share due to the competitor experiencing cost reductions after the vertical integration. At the same time, we see the sales drop only when a supplier vertically integrates with a competitor – so unless the cost reductions are particularly taking place in vertical integration episodes with the buyer's competitors, it is unlikely that this channel plays a major role in driving the buyer's sales response. There is also a small positive effect on sales when a supplier vertically integrates with a non-competitor, which may point to efficiency gains from the integration. Columns (5) and (6) apply an IV strategy analogous to the one used in Table VIII. We first construct dummies whether the firm has a supplier that faces an MFHS outflow event up to two periods before time t, and likewise take the maximum (across suppliers) of the interaction of MFHS event dummies with the suppliers' share of customers that are competitors of the firm. We then regress the endogenous variables on these two variables and fixed effects using a Poisson regression, and use the fitted values as generated instruments in a standard 2SLS regression. The resulting coefficient estimates are similar to the OLS estimates, although somewhat less precise. In all specifications the model fit is very good – but that is due to the fixed effects absorbing most of the variation in sales. In Appendix B.1 we show results with employment on the left-hand side. We do not find a significant drop in firm employment when a supplier integrates with a competitor.

Figure 7 shows an event study graph around the time of vertical integration of a supplier with a non-competitor (dashed red line) and with a competitor, for firms that have no existing alternative suppliers (solid blue line). We see that in cases where the supplier is vertically integrating with a competitor, firms' sales are substantially lower if they do not have existing alternative suppliers.

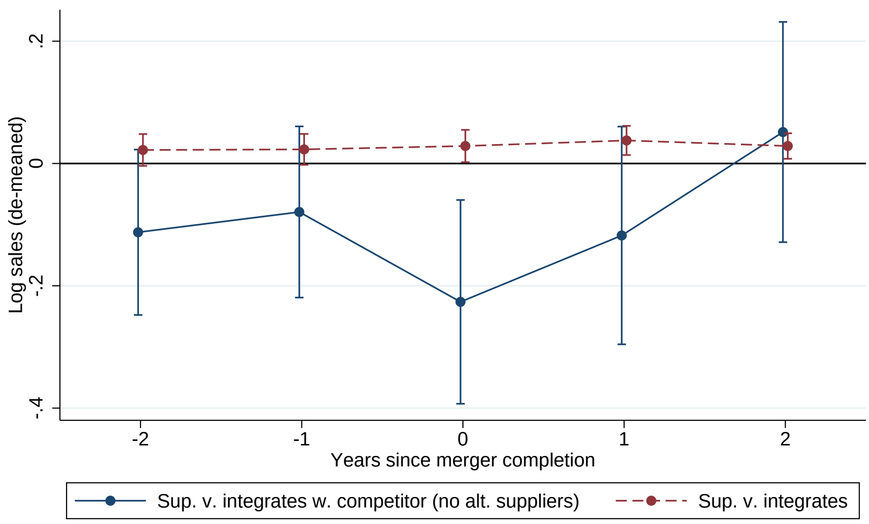
Finally, we look at the sales impact of suppliers' vertical integration events in international mergers. Table XIV shows results when we restrict attention to cross-border mergers. The point estimates of the "integration with competitor" dummy are very similar to those in Table XIII.

Table XIII—: Impact on buyer's sales

	Dependent variable: Log sales					
	(1)	(2)	(3)	(4)	(5)	(6)
Supplier v.integrates	0.042**	0.018+	0.042**	0.019+	0.036	-0.003
	(0.010)	(0.010)	(0.010)	(0.010)	(0.025)	(0.024)
Supplier v. integrates w. competitor	-0.037	-0.052+	-0.137*	-0.144*	-0.115	-0.115
	(0.031)	(0.030)	(0.061)	(0.058)	(0.105)	(0.102)
$\times$ $log(1 + \#$ alt. suppliers)			0.043*	0.040*	0.054+	0.045
			(0.017)	(0.017)	(0.031)	(0.030)
Buyer FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry $\times$ Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls		Yes		Yes		Yes
Method	OLS	OLS	OLS	OLS	IV	IV
Observations	77202	77202	77202	77202	77202	77202
First stage F-stat					641	629
R^2	0.98	0.98	0.98	0.98	0.00	0.02

Note: Controls: number of customers, competitors and suppliers. In columns (5) and (6), the right-hand side variables are all instrumented by the fitted values of a Poisson regression of endogenous variables (vertical integration; vertical integration with competitor) on the maximum (over suppliers) of the MFHS outflow event dummies and interactions with the share of suppliers' customers that are competitors of the firm during period $t-1$. First stage F-statistics are Kleibergen-Paap. Robust standard errors, clustered at the firm level, are in parentheses. $^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$.

Figure 7: Timing of the correlation of buyers' log sales with vertical integration of a supplier



Note: The figure presents the results of estimating equation 5 with two leads and lags for both $\mathbb{1}\{\text{A supplier integrates vertically w. competitor of } b\}_{bt}$ and $\mathbb{1}\{\text{A supplier integrates vertically}\}_{bt}$. Confidence intervals are calculated using robust standard errors clustered at the firm level.

4.2 Can synergies account for breaking supplier links?

One potential alternative explanation of our finding that vertical relations are more likely to end when the supplier vertically integrates with the buyer's competitor is that there are very strong synergies from the merger. If synergies give the integrated downstream firm a large cost

Table XIV—: Sales impact: International Mergers

	Dependent variable: Log sales			
	(1)	(2)	(3)	(4)
Supplier v. integrates (intl. M&A)	0.040**	0.022*	0.041**	0.023*
	(0.012)	(0.011)	(0.012)	(0.011)
Supplier v. integrates w. comp. (intl. M&A)	-0.034	-0.050	-0.097+	-0.108+
	(0.032)	(0.031)	(0.057)	(0.057)
× $log(1 + \#$ alt. suppliers)			0.027+	0.025
			(0.016)	(0.016)
Buyer FE	Yes	Yes	Yes	Yes
Industry × Year FE	Yes	Yes	Yes	Yes
Controls		Yes		Yes
Observations	77,202	77,202	77,202	77,202
R^2	0.98	0.98	0.98	0.98

Note: Controls: number of upstream customers and competitors, age of the link, dummy indicating other links of the supplier breaking. Robust standard errors clustered at the firm level. The number of reported observations is the number of non-singleton observations. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

advantage, the unintegrated downstream competitor may be forced to exit the product market, which may lead it to cut its ties to the upstream firm.

If this explanation was driving our results, however, we would expect that vertical integration would adversely affect the market shares of all downstream firms in the industry, including competitors that did not have a supplier relationship with the integrating upstream unit. Table XV shows results from a regression of log firm sales on a dummy that is one if the firm has a competitor in that year that vertically integrates (and firm and industry × year fixed effects, as well as the set of controls from above). We find no statistically significant correlation between a competitor vertically integrating and a change in firm sales. This stands in contrast to the situation that we looked at above, where a competitor is vertically integrating with the buyer's supplier, and where we observed a drop in firm sales.

These results are in line with the findings of Blonigen and Pierce (2016), who study the effect of mergers and acquisitions on physical productivity and markups of U.S. manufacturing establishment. They use a similar dataset of public and private mergers and acquisitions, and find no effect of physical productivity of integrating plants, but a significant increase in markups. While their data allows for a much more direct investigation of the productivity effects of mergers and acquisition than our indirect results on competitor's sales, the results support the view that much of the impact of M&A is to reduce competition, and little to increase economic efficiency.

Table XV—: Impact of vertical integration on competitors' sales

	Dependent variable: Log sales						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A competitor v.integrates	0.011 (0.039)	-0.024 (0.038)			-0.039 (0.060)		
$max(t, t-1)$			0.021 (0.035)			0.013 (0.049)	
$max(t, t-1, t-2)$				0.054 (0.036)			0.031 (0.045)
Buyer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls		Yes	Yes	Yes	Yes	Yes	Yes
Method	OLS	OLS	OLS	OLS	IV	IV	IV
Observations	120,689	120,689	120,689	120,689	120,689	120,689	120,689
R^2	0.94	0.95	0.95	0.95	0.01	0.01	0.01

Note: The variable in the second (third) row is a dummy that is one if a competitor has undergone a vertical integration in the current or last year (current or last two years). Columns (5) to (7) use an instrumentation strategy analogously to the buyer sales regressions where the instruments are the fitted values of a Poisson regression of the vertical integration dummies on dummies for the MFHS events over the corresponding periods (and fixed effects). Controls: number of customers, competitors and suppliers. Robust standard errors, clustered at the firm level, are in parentheses. The number of observations is larger here than in Table XIII because we have more firms with sales data that have competitor relationships than firms with supplier relationships. $^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$.

4.3 Discussion

Interpretation

Our results suggest that existing antitrust measures have not managed to fully prevent anti-competitive effects from vertical mergers in the sample that we study. Since we find similar results on domestic and international mergers, it does not seem to be the case that international mergers are exposed to more scrutiny from competition authorities. Overall, we get the impression that vertical merger enforcement is lax throughout, possibly because of the intellectual history of the question (Salop, 2017).

Our econometric exercises show the average effect of *realized* mergers and acquisitions in our sample. These mergers are *selected* in the sense that they have not been blocked by antitrust authorities. This could be because efficiency gains were thought to be large, because concerns for anticompetitive effects were small, because sufficient remedies could be imposed on integrating firms, or because mergers were "below the radar" of competition authorities. This sample is hence not necessarily representative for the population of proposed mergers, and the expected average treatment effects may therefore differ.

At the same time, it is likely that there are many other cases of anticompetitive effects of vertical mergers than the ones we highlight. Our events are those where a buyer-supplier relationship fully breaks. A situation that is perhaps more prevalent is where the buyer is facing higher prices offered by the bottleneck supplier. Evaluating such situations would require data on prices.

Even if anticompetitive effects are taking place among the cases we studied, the overall welfare consequences are not necessarily negative, in particular because consumer prices might fall due to increases in productivity or changes in competition. Frictions in firm-to-firm markets are likely to impose additional transaction costs, which will be reflected in the prices paid by final consumers. A full structural analysis of the welfare cost of vertical foreclosure across a broad range of industries is beyond the scope of this paper, but we view our reduced-form evidence as a first step in this direction.

Mechanisms

Our empirical results point to anticompetitive effects from vertical mergers that lead to the breaking of vertical relationships. There are several mechanisms that could give rise to such effects, and we find patterns in the data that are consistent with their predictions.

One obvious explanation is that the integrated firm forecloses the competing downstream firm. Such behaviour for foreclosure may be motivated from the supplier's incentive to preserve its market power (Hart and Tirole, 1990, O'Brien and Shaffer, 1992, McAfee and Schwartz, 1994). If an unintegrated monopolist supplier cannot commit to sell only to one downstream firm, downstream firms will foresee the supplier's temptation to also sell to the competitors and reject contracts that would implement the monopolist's outcome. The supplier hence vertically integrates to solve the commitment problem and restore monopoly profits. Higher upstream (downstream) competition makes the commitment problem less (more) severe, which is broadly in line with our results by upstream/downstream market competition shown in Table VI.

A second mechanism where anticompetitive effects from vertical integration arise is the "raising rivals' cost" mechanism of Ordover et al. (1990). By cutting off the competitors' access to the bottleneck input, the integrated downstream firm can raise the market power of unintegrated alternative suppliers and thereby harm the competitors. Allain et al. (2016) describe a related mechanism where vertical integration leads to increased hold-up problems (and therefore increased cost) for competitors. Results in Appendix B.11 show that buyer sales decrease after vertical integration of the supplier with a competitor, even when the vertical relationship with the supplier does not break.

Another possibility is that firms self-foreclosure to prevent information leakage when a supplier integrates with a competitor. Allain et al. (2011)[25] formalize this mechanism in a model where firms, in order to innovate, must share information with their suppliers, which cannot be fully protected by intellectual property rights. This information, if shared with a vertically integrated competitor, increases the risk of any innovation becoming available to the competitor. As a result, the effective cost of sourcing from an integrated supplier is higher, and downstream firms may find themselves wanting to break a pre-existing supplier relationship. Anticompetitive effects may exist if that cost increase is associated with higher effective cost

[25] See also related work by Hughes and Kao (2001) and Chen (2001).

of production (e.g. because unintegrated alternative suppliers have higher market power); this will then lead to lower innovation by the downstream firm.

Examples from newspaper coverage and SEC filings associated with integration events in our data corroborate the existence of such self-foreclosure considerations, where customers of the integrating supplier want to break the relationships because continuing the relationship would be associated with a strategic disadvantage on the output market. As an example, consider the acquisition of hard drive disk platter producer Komag by its customer Western Digital (WF) in 2007. Komag had also been supplying WD's rivals Seagate, Maxtor, and Hitachi, and these relationships ceased after integration. In a conference call with market analysts, a senior executive from WD said about Komag's future relationships with their existing customers: "[...] we are prepared to provide all customers with the committed volumes outlined in their existing volume purchase arrangement. However, customers will determine their [input] requirement. Therefore, there could be a significant reduction in volume from those customers [...]." (Securities and Exchange Commission, 2007).

5 Conclusion

This paper presents results that suggest that anticompetitive effects from vertical mergers are occurring among large firms, across a range of sectors in the economy, and both for domestic and international mergers. These anticompetitive effects operate at least to some extent on the extensive margin of buyer-supplier connections: vertical relationships are much more likely to break when the supplier is integrating with a competitor of the buyer, than when the supplier is integrating with an unrelated party. We find that this higher hazard rate for links breaking remains statistically significant when considering integration events that occur following exogenous downward pressure on the suppliers' stock price. Rumored integration that never takes place is not associated with higher hazard rate. We find that on average firms whose supplier vertically integrated with one of their competitors experience a temporary drop in sales. This sales drop is lower for firms that have relationships with other suppliers from the same industry in place.

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Appendix

A Data Sources and Definitions

We combine three components to construct the database used in this paper:

- A production and competitor network between large firms from FactSet Revere
- A comprehensive M&A database, Bureau van Dijk's Zephyr, with information on deals and rumors about deals
- Company financials and industry classifications from Bureau van Dijk's Orbis, Compustat and FactSet Fundamentals

This appendix describes each of the data sources as well as the key variables we derive from them.

A.1 FactSet Revere supply chain data

Content and data sources

FactSet is a commercial data provider that mainly sells to companies in the financial services sector. Its supply chain data (called "Revere") provides information on the nature and duration of vertical and horizontal relationships between firms. FactSet collects this information on relations from primary public sources such as SEC filings, investor presentations, corporate actions, company websites and press releases. For each firm, FactSet conducts an annual review to update the database. In addition, press releases and corporate actions are monitored daily for US firms.

Each relation between two companies is dated with a start date at which the relation was first recorded by FactSet and with an end date at which it was noticed that the relation no longer existed. In addition, each relation is categorized into buyer links, supplier links, competitor links or partnerships. These broad categories are detailed into 13 subcategories (see Table XVI). We use these categories to define two types of networks:

- Buyer-supplier network: a directed graph on which an edge is created when the target company is a supplier of the source company, i.e. at least one of the following is true:
  - the source company discloses the target company as a supplier of products or services
  - the target company discloses the source company as a customer of products or services
  - the target company provides paid manufacturing, distribution or marketing services to the source company
  - the target company licenses products, patents, technology or IP to the source company

Table XVI—: Number of relationships in raw FactSet Revere data

	Frequency	Percentage
Supplier	114,136	12.71
Competitor	197,423	21.98
Customer	290,893	32.38
Partner: Distribution	24,725	2.75
Partner: Equity investment	53,602	5.97
Partner: Production	12,737	1.42
Partner: Investor	48,244	5.37
Partner: Joint-Venture	29,845	3.32
Partner: Licensing	37,083	4.13
Partner: Marketing	16,296	1.81
Partner: Other	876	0.10
Partner: Research Collaboration	46,273	5.15
Partner: Technology	26,189	2.92
Total	898,322	

Note: Frequency table of the raw number of relations in the relationship dataset from which we construct the firm network. In line with the description in the documentation of the data, we count companies providing paid distribution, production, marketing and licenses as suppliers.

- Competitor network: an undirected graph on which an edge is created if at least one of the two company discloses the other one as a competitor

We do not include the partnership links provided by fact set for our analyses (Joint ventures, Equity stakes, research collaborations and integrated product offerings).

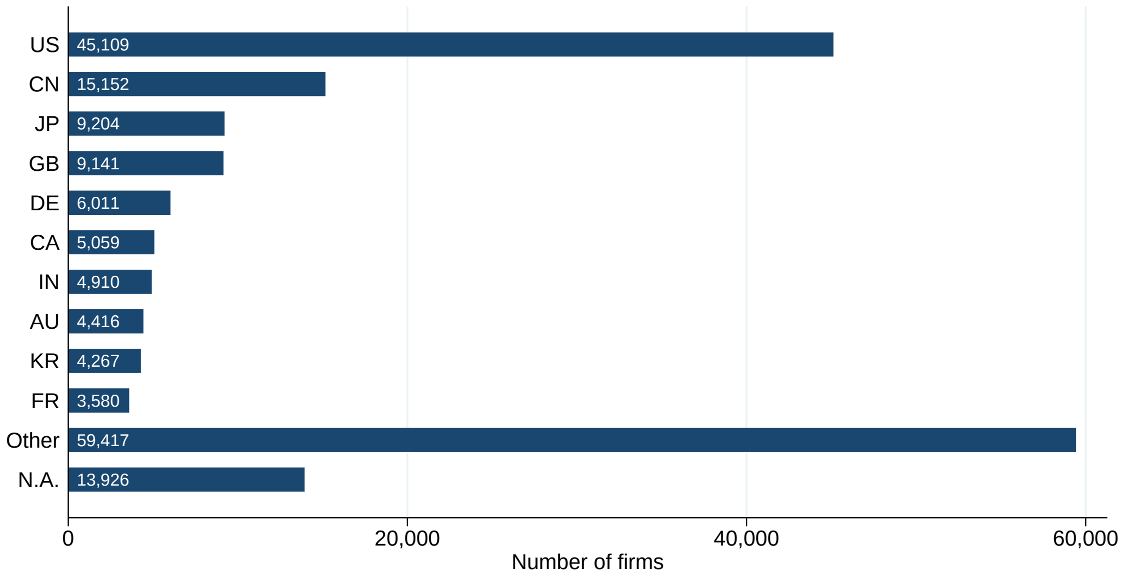
Finally, many relations are also provided with a few keywords explaining the links, though not in a fully systematic fashion. Companies can have multiple links, for instance in order to document that a supplier is also in competition with a given customer.

Coverage

The data contain observations on 180,192 firms, some of which are "covered" companies (in the sense that the data provider actively searches for information on these firms); the others show up as suppliers, buyers, or competitors of covered companies. FactSet determines coverage mainly based on membership of firms in major stock indexes. The provider aims to cover all companies listed in a set of global indexes, such as the FTSE Global All Cap, Russel Global, Stoxx Global and a range of global MSCI indexes. In addition, all US-based publicly traded firms are covered, as well as companies that are part of multiple local and regional stock market indexes, i.e. large non-US multinationals. FactSet achieves high but not complete coverge of the indexes. For example, 90.3% of the firms in MSCI ACWI All Cap have relationship information, 95.4% of the S&P 500 and 94.5% of the Russell 3000. While these coverage rules favor large listed firms, there are many smaller and non-listed firms in our sample because they have relationships with large firms.

Coverage varies by country. Figure 8 reports the number of firms in the database by the country of their headquarters. Consistent with the fact that FactSet originally only covered US

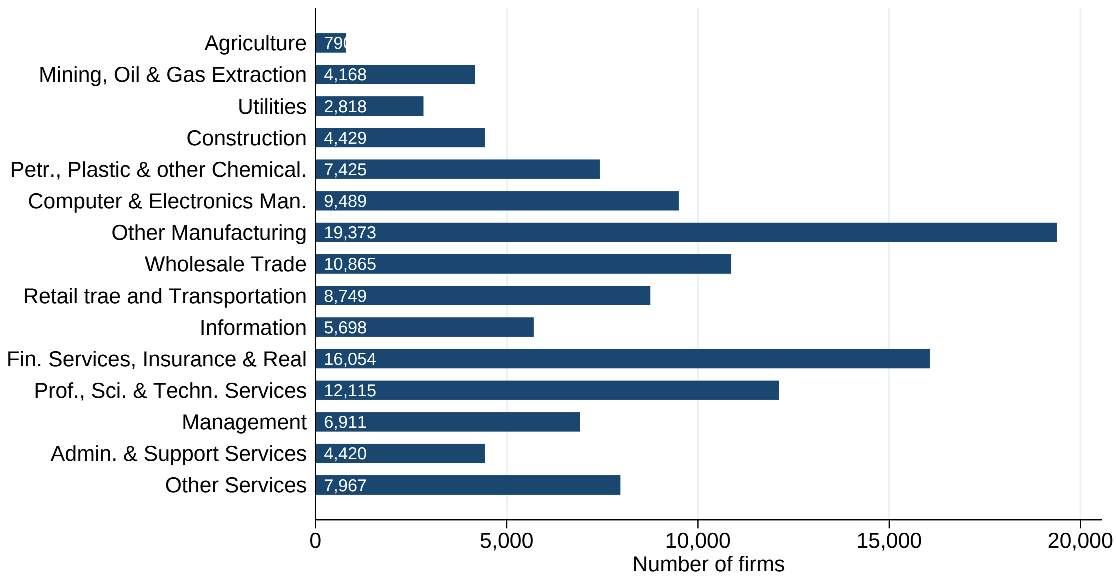
Figure 8: Number of firms by country



Note: The figure reports the number of firms in the FactSet database by country of headquarter.

firms, about a quarter of the firms is based in the US. Due to efforts to expand the database internationally starting in 2007, and because of foreign firms trading with US firms, international coverage goes well beyond large multinationals.

Figure 9: Number of firms by industry

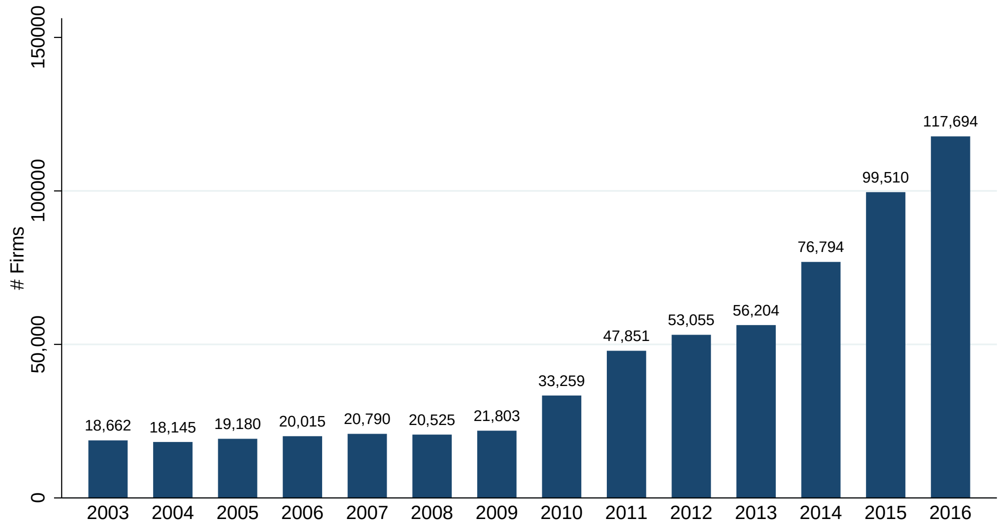


Note: The figure reports the number of firms in the FactSet database by primary industry classification.

While the database is not representative even of the universe of US firms, it does contain a wide range of industries. Figure 9 reports the number of firms in the sample by a high-level aggregation of NAICS industry codes. The manufacturing sector contains the largest share of firms in our data, followed by financial services and insurances, and then by professional services.

When a company entity in the data ceases to exist, FactSet documents the reasons for it, along with a successor company where it exists. This fact allows us, in particular, to identify the successor company in the case of a complete merger or acquisition so that links are not mechanically breaking at acquisition.

Figure 10: Number of firms over time



Note: The figure presents the number of firms in the FactSet database by year.

The data start in 2003 and have been gradually expanded over time (Figure 10). Non-US firms were included from 2007 onwards.

Key variables

We annualize the relationship data in order to facilitate the matching with the company financials. A relation of any kind is counted as active in a given year if there is at least one day between start date and end date of the relation that falls into that year. The result is a panel of relations that is identified by source company, target company and year.

Buyer-supplier link breaks: The variable is one if and only if (i) the relation was active in the previous year but is no longer active and (ii), in case buyer and/or supplier were involved in a merger or acquisition, there is no active link between the successor company or acquiror and the buyer or supplier. The second condition rules out purely mechanically breaks in the supply chain that could result from mergers and acquisitions. This variable is the main left-hand side variable in the regressions in Section 3.

We set this variable to missing in a few cases to avoid other possible mechanical breaks. If a buyer has dropped out of coverage and, in case of a merger or acquisition, the successor company or acquiror is not covered by FactSet in the current year, then its relations are not counted as breaking. This is to rule out that we erroneously count a link as broken purely because a firm is no longer covered. We also count the variable as missing when the buyer and the supplier in the given relation are integrating.

A.2 Zephyr M&A data

We use Bureau van Dijk's Zephyr database for information on mergers and acquisitions. Zephyr records deals and rumors about deals for mergers and acquisitions in which at least a 2% stake in the target company changes owners and the value of the deal exceeds GBP 1M. For an overview of Zehphyr's content, coverage, and how it compares to other M&A databases, see Bollaert and Delanghe (2015). For the sake of brevity, we refer to any merger or acquisition simply as merger in the following.

Matching and merging with other data sources

Zephyr reports the exact dates of rumors, announcements and (expected) completions or withdrawals of mergers. Analogously to the FactSet data, we convert these data to a panel of merger events, where each observation is identified by the target firm, the acquiring firm and the calendar year of the completion date for completed mergers or the year of the rumor for mergers that were rumored but never completed.

We match firms in the FactSet and Zephyr databases using security identifiers such as CUSIP or ISIN, as well as ticker names wherever possible. For the remaining firms we use a string matching tool provided by Bureau van Dijk that takes into account company names and, where available, addresses.

Table XVII—: Types of mergers and acquisitions

	Vertical		Horizontal		Both		Unrelated		Total	
	Count	%	Count	%	Count	%	Count	%	Count	%
Partial acquisitions	46	5.8	51	6.4	8	1.0	694	86.9	799	100.0
Full acquisitions & mergers	132	4.4	568	18.9	69	2.3	2,231	74.4	3,000	100.0
Total	178	4.7	619	16.3	77	2.0	2,925	77.0	3,799	100.0

Note: Number of partial and full mergers and acquisitions by presence of a vertical and horizontal relation between the merging parties (2003-2016). Partial acquisitions exclude minority stakes.

Table XVII breaks down the mergers and acquisitions between firms in the matched sample by the type of their relation in the FactSet Revere data. In addition to vertical mergers, the data allow us to identify horizontal mergers (through competitor relationships) and mergers that are both horizontal and vertical in nature. In our analyses, however, we focus on integrations that have a vertical dimension to them.

Table XVIII reports summary statistics about buyer-supplier relations where the supplier was vertically integrating or rumored to be vertically integrating with a competitor of the buyer. While the buyers in both groups are quite comparable, it seems that rumors involve suppliers that are on average somewhat larger than those suppliers which actually undergo integration. Note that we control for these differences in our regressions and also do not find a differential effect for larger or smaller suppliers.

Table XVIII—: Treated buyer-supplier relations and placebo counterparts

	Vertical M&A with Comp.		
	Actual M&A	Rumored M&A	Difference
New relationships	0.10	0.14	0.04
Ending relationships	0.52	0.16	-0.36***
Buyer's suppliers	69.40	78.18	8.78
Supplier's buyers	27.67	48.44	20.76***
Buyer's competitors	66.74	68.13	1.39
Supplier's competitors	19.49	36.32	16.82***
Age of relationship	3.49	3.97	0.48
Sales (log m$): Buyer	8.26	8.96	0.70**
Sales (log m$): Supplier	6.92	8.78	1.87**
Sales (log m$): Competitor	9.33	9.78	0.45**
Log Employment: Buyer	9.23	9.84	0.61*
Log Employment: Supplier	6.96	9.47	2.51**
Log Employment: Competitor	10.33	9.87	-0.46*
N	214	222	436

Note: Summary statistics for the buyer-supplier-years for which suppliers are involved in a vertical M&A-transaction with a competitor of the buyer.

Key variables

With the firm network and the merger information in place, we construct our main explanatory variables. For ease of exposition, for a given buyer-supplier-year observation, we refer to the buyer as firm b, to the supplier as firm s and to a firm that merges with the supplier as firm c.

Supplier vertically integrates: We construct a dummy variable that is equal to one at the buyer-supplier-year level if firm s is involved in a merger with firm c which is also a customer of s. We restrict attention here to full mergers and acquisitions in the sense that the stake of the acquirer after the acquisition is 100% but was either zero or unknown before. Firm s can be either the acquirer or the target in the M&A with firm c. Note that we only count mergers as vertical if there was an active buyer-supplier relationship between s and c in the year of integration.

Supplier vertically integrates with buyer's competitor: This dummy variable is equal to one at the buyer-supplier-year level if firm s and c are merging, s is an active supplier of c in that year and b and c have an active competitor relationship in that year.

For the placebo analyses we construct the same variables again using rumored mergers instead of actual mergers. These rumors come from "unconfirmed reports", which "may be in the press, in a company press release, or elsewhere" (Bureau Van Dijk, 2017). They may indeed come from announcements by one of the involved firm as long as the other firms have not yet confirmed the announcements. In the Zephyr database, this corresponds to deals for which the variable *deal status* is "Rumour". The timing of these events differs slightly: instead of the completion date (which is unavailable), we use the rumor date. In general however, there is little time elapsing between a rumor and the completion of a deal: 145 days on average and about 92% of rumors which turn out to be true are realized within a year. For our placebo analyses, we exclude all rumors that materialize within three years.

A.3 Company financials and industry classifications

To achieve best possible coverage of company financials and industry classifications for the firms in our supply chain network, we combine data from Orbis, Compustat (through WRDS) and FactSet Fundamentals. The combination of the various data sources is necessary in particular because of varying coverage over time. While we have supply chain and merger information available from 2003 to present, Orbis data is only available to us from 2007 onwards. In contrast, Compustat and FactSet Fundamentals are available for earlier years as well.

Matching and merging with other data sources

As with the Zephyr database, we first match all firms for which securities identifiers are available. As Zephyr and Orbis share the same identifier, matching these data sources is straightforward. For the remaining firms and data sources we use the company names for string matching.

For firms where financials are available from multiple data sources, we only retain the information from the data source that provides the longest coverage of the sales variable of that firm. Hence, all of a given firm's financial information always come from the same data source in order to ensure consistency over time and across items. Wherever ties occur, preference is given first to FactSet Fundamentals, then to Orbis. Note that the variables from several datasets are almost perfectly correlated for the observations where we do have overlaps in coverage.

Key variables

Sales: The sales data are contained in the variables "ff_sales" in FactSet Fundamentals, "sales" in Orbis and "sale" in Compustat. Orbis reports all financials directly in USD, the sales data from the other data sources are converted to USD where necessary using exchange rate information included in those datasets. A few firms in the data exhibit unusual sales trajectories that seem to suggest reporting or data entry issues. In order to rule out that our results are driven by such observations, we exclude firms whose sales growth falls into the first or 99th percentile in one or more years.

Employment: The number of employees is contained in the variables "ff_emp" in FactSet Fundamentals, and "emp" in Orbis and Compustat. We use these variables without further processing.

NAICS codes: From Orbis and Compustat we can also retrieve NAICS industry codes ("naics_primary" and "naics_secondary" in Orbis, "naics" in Compustat). When several NAICS codes are available, we restrict attention to the primary one for clustering or aggregation.

A.3.1 Mutual fund capital outflow instrument

To construct the MFHS instrument, we follow Appendix C of Dessaint et al. (2019) (which in turn is based on the construction in Edmans et al. (2012)). We construct quarterly capital net outflows of US mutual funds using the CRSP mutual funds data, and the hypothethical stock sales following large outflows using the funds' portfolio data in CDA Spectrum/Thomson. We match funds using the crosswalk provided by WRDS.

The CRSP mutual funds data reports monthly return and total net assets by asset class k. We first compute the return of fund j in month m of year t as the weighted average return across asset classes:

$$Return_{j,m,t} = \frac{\sum_k (TNA_{k,j,m,t} \times Return_{k,j,m,t})}{\sum_k TNA_{k,j,m,t}}$$

We compound these returns to arrive at quarterly returns. The net inflow into fund j in quarter q of year t, as a fraction of its beginning-of-quarter net assets, is then

$$Flow_{j,q,t} = \frac{TNA_{j,q,t} - TNA_{j,q-1,t} \times (1 + Return_{j,q,t})}{TNA_{j,q-1,t}}.$$

From CDA Spectrum/Thomson we have share holdings $Shares_{j,i,q,t}$ of each fund j in firm i at the end of quarter q of year t, as well as share prices. We calculate the hypothetical sales of j's assets in i for funds j that experience large outflows ($Flows_{j,q,t} < -0.05$):

$$MFHS^{\$}_{i,q,t} = \sum_{j:\text{Flows}_{j,q,t} < -0.05} \left(\text{Flow}_{j,q} \cdot \text{Shares}_{ji,q-1} \cdot \text{Price}_{i,q-1} \right).$$

Finally, we sum this up over quarters and normalize by trading volume

$$MFHS_{i,q,t} = \sum_{q=1}^{4} \frac{MFHS^{\$}_{i,q,t}}{Volume_{i,q,t}}.$$

A.4 Summary statistics for vertically integrating firms

Table XIX shows summary statistics for firms that vertically integrate with one of their buyers. The left column contains firms that integrate with non-competitors of one of their buyers, the right column contains firms that integrate with a firm that is not in a competitor relationship with any other buyer.

B Further results

B.1 Impact of foreclosure on employment

Table XX shows the impact of a supplier integrating with a competitor on firm employment. The OLS results are similar to sales, though somewhat smaller (about half of the percentage-wise effect on sales) and not statistically significant. IV estimates are not significantly different from zero either. Overall, there does not seem to be an impact of foreclosure on employment.

Table XIX—: Summary statistics for vertically integrating firms

	No foreclosure potential		Foreclosure potential	
	Mean	SD	Mean	SD
# Buyers	45.03	69.12	18.51	15.29
# Suppliers	45.34	66.11	15.38	16.81
# Competitors	45.45	65.84	17.57	12.50
Log sales	15.50	2.04	13.31	2.29
Log employment	9.37	2.23	6.79	2.23
Observations	150		53	

Note: The table presents summary statistics on suppliers that vertically integrate with a non-competitor of the buyer (first column) or a competitor of the buyer (second column). Coverage of sales and employment is very poor (<10%) for suppliers in vertical integrations with foreclosure potential.

Table XX—: Impact on buyer's employment

	Dependent variable: Log employment					
	(1)	(2)	(3)	(4)	(5)	(6)
Supplier v.integrates	0.029^{**}	0.010	0.029^{**}	0.010	-0.010	-0.042^{+}
	(0.010)	(0.010)	(0.010)	(0.009)	(0.025)	(0.025)
Supplier v. integrates w. competitor	-0.015	-0.029	-0.078	-0.087	-0.104	-0.107
	(0.053)	(0.052)	(0.101)	(0.099)	(0.126)	(0.123)
$\times$ $log(1 + \#$ alt. suppliers)			0.027	0.025	0.040	0.033
			(0.024)	(0.024)	(0.035)	(0.034)
Buyer FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry $\times$ Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls		Yes		Yes		Yes
Method	OLS	OLS	OLS	OLS	IV	IV
Observations	70983	70983	70983	70983	70983	70983
R^2	0.98	0.98	0.98	0.98	-0.00	0.01

Note: Controls: number of customers, competitors and suppliers. Robust standard errors, clustered at the firm level, are in parentheses. In columns (5) and (6), the right-hand side variables are all instrumented by the fitted values of a Poisson regression of endogenous variables (vertical integration; vertical integration with competitor) on the maximum (over suppliers) of the MFHS outflow event dummies and interactions with the share of suppliers' customers that are competitors of the firm during period $t-1$. $^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$.

B.2 Direct comparison of the rumored vs actual mergers

Table XXI shows regressions with both rumored and actual integration events included. This allows for a direct comparison of the two types of events in the same specification. While the main coefficient of interest – the impact of an actual vertical merger of the supplier with the buyer's competitor – remains large and significant, the rumored counterparts of these events have slightly negative and statistically not significant coefficients.

Table XXI—: Comparison of rumored and actual vertical mergers with competitor of the buyer

	Dependent variable: $\mathbb{1}\{\text{LinkBreaks}\}_{bst}$		
	(1)	(2)	(3)
Supplier v. integrates	0.018	0.010	0.025
	(0.020)	(0.020)	(0.019)
Sup. v. integrates, rumor about competitor	-0.031	-0.025	-0.042
	(0.043)	(0.074)	(0.067)
Supplier v. integrates w. competitor	0.206**	0.201*	0.189*
	(0.071)	(0.095)	(0.083)
Controls			Yes
Relation FE	Yes	Yes	Yes
Buyer × Year FE	Yes	Yes	Yes
Industry Pair × Year FE		Yes	Yes
R^2	0.578	0.619	0.671
Observations	640709	472832	472832

Note: Controls: number of upstream customers and competitors, age of the link, dummy indicating other links of the supplier breaking. Robust standard errors clustered at the supplier-year level. The number of reported observations is the number of non-singleton observations. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

B.3 Hazard models

An alternative way to model the impact of a supplier's vertical integration on the probability of a buyer-supplier link breaking is in terms of a hazard model. In this framework, we can compare the survival times of links where the supplier integrated with a competitor of the buyer to the survival times of links where there was a vertical integration with a non-competitor. When a link does not break during the observation period, the survival time is treated as censored.

Table XXII presents the result of a Cox proportional hazard model estimated on all buyer-supplier links in which the supplier vertically integrated with one of its customers:

$$h_{bs}(t) = h_{0bs}(t) \exp\left(\beta \mathbb{1}\{s \text{ integrates vertically w. competitor of } b\}_{bs} + \eta_b + \eta_t + \eta_{i(b)} + \eta_{i(s)}\right)$$

where $h_{bs}(t)$ is the hazard of a buyer-supplier link breaking and η_b , η_t, $\eta_{i(b)}$ and $\eta_{i(s)}$ are indicator variables for buyers, integration years, the buyer's industry and the supplier's industry respectively. We use a partial likelihood framework that does not require to specify the baseline hazard $h_{0bs}(t)$.[26] The survival time is measured from the beginning of the year of integration to the end of the year in which the relationship broke. Columns (1) to (3) retain all integration events, even when a given buyer-supplier link undergoes multiple vertical mergers of the supplier. Columns (4) to (6) only keep the first of these events for each buyer-supplier link. We calculate standard errors clustered among observations related to the same vertical integration event.

The results confirm those presented in Section 3. Even after adding controls and including buyer, year and industry dummies, a vertical relationship is expected to end 28% sooner when

[26]The results are similar when specifying an exponential or Weibull distribution.

the supplier vertically integrates with one of the buyer's competitors compared to when vertical integration occurs with a non-competitor of the buyer. The mean survival time of relations is 4.3 years. While the point estimates vary slightly, the qualitative result that links threatened by vertical foreclosure are substantially more short-lived is robust to choosing alternative specifications of the model and the underlying sample.

Table XXII—: Impact of supplier's integration with buyer's competitor on hazard rate of buyer-supplier link breaking

	Hazard ratio of buyer-supplier link breaking					
	(1)	(2)	(3)	(4)	(5)	(6)
Supplier v. integrates w. competitor	1.432**	1.231*	1.256*	1.399**	1.197*	1.205*
	(0.115)	(0.110)	(0.115)	(0.126)	(0.109)	(0.113)
Controls		Yes	Yes		Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Buyer Industry FE			Yes			Yes
Supplier Industry FE			Yes			Yes
Events	All	All	All	First	First	First
R^2						
Observations	7031	7031	6308	5532	5532	4935

Note: Controls: number of upstream customers and competitors, age of the link. Robust standard errors clustered at the supplier-year level. $^+$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$.

B.4 Within-merger identification

Our baseline strategy is to compare the probability of relationships breaking *across* integration events, i.e. integrations with competitors versus non-competitors. An alternative strategy is to instead look *within* suppliers' integration events (call the supplier S), *across* different buyers B, and compare the probability of links breaking by whether B is a competitor of the acquirer. This is done using supplier-year fixed effects. The advantage is that the regression absorbs unobserved heterogeneity at the supplier-year level; the disadvantage is that it is incompatible with our IV strategy, since the exogenous variation that we exploit there is exactly at the supplier-year level.

Table XXIII shows regressions with supplier-year fixed effects. Column 1 shows the same benchmark specification as column 3 of Table V but with supplier-year fixed effects. The estimated coefficient, which is close to zero, hides a lot of heterogeneity. Some (very few) vertical integration events result in the breaking of many of the supplier's sales relationships (which suggests a large change in the scope of the firm's activities following integration), others—the majority—result in few links breaking (see Figure 11 for the distribution of customer links breaking following vertical integration). When we condition of vertical integration events where many (more precisely, more than 40% in column 2) of the suppliers' sales relationships break, we find a large negative coefficient. On the other hand, when we only look at vertical integration events where few relationships break (less than 40%, 20%, 10% in columns 3, 4, and 5), the coefficient is large and positive, like in the benchmark regressions.

We think of this result in the following way. Some vertical integration events are associated with large changes in product scope. In these situations, the integrated firm may sell off some divisions, and stop serving certain buyers. Buyers that are, however, in the "core" of the suppliers' operations and are therefore less likely to stop being served are also more likely to be competitors to the acquirer. This explains the large negative coefficient in column 2 of Table XXIII. On the other hand, vertical integration events where few relationships break are those where firm scope remains unchanged, and in those cases buyers that are vs are not competitors of the acquirer are more comparable.

Table XXIII—: Vertical integration and relationship break probability – Supplier-Year Fixed Effects

	Dependent variable: $\mathbb{1}\{\text{LinkBreaks}\}_{bst}$				
	(1)	(2)	(3)	(4)	(5)
Supplier v. integrates w. competitor	-0.002	-0.149^{+}	0.086	0.156**	0.178*
	(0.056)	(0.082)	(0.062)	(0.059)	(0.072)
Supplier × Year FE	Yes	Yes	Yes	Yes	Yes
Relation FE	Yes	Yes	Yes	Yes	Yes
Buyer × Year FE	Yes	Yes	Yes	Yes	Yes
Industry Pair × Year FE	Yes	Yes	Yes	Yes	Yes
VI break threshold	all	$>$ 40%	$<$ 40%	$<$ 20%	$<$ 10%
R^2	0.779	0.780	0.779	0.780	0.780
Observations	402526	402526	402526	402526	402526

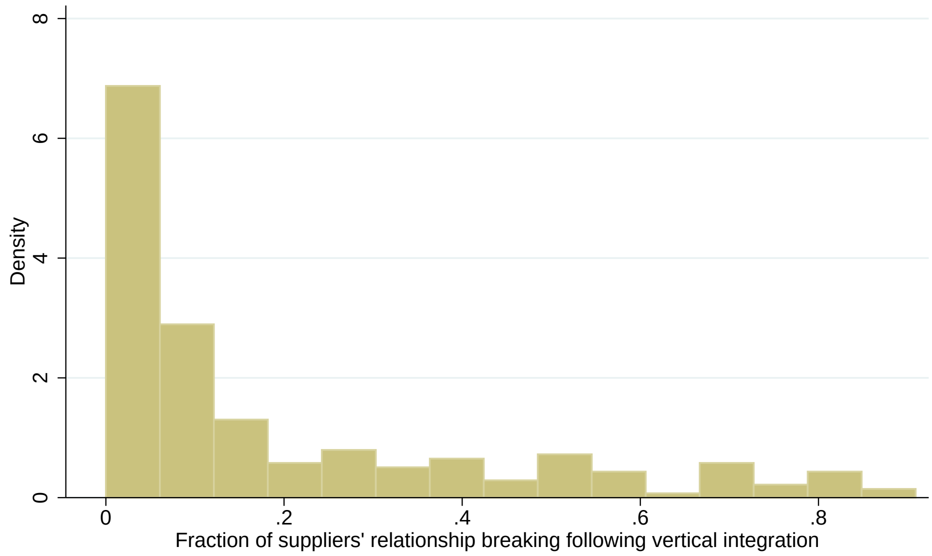
Note:

Specification varies by which vertical integration events are being considered in the independent variable. Column 1 uses all vertical integration events (as in baseline regressions). Column 2 uses only vertical integration events where at least 40% of the supplier's relationships break; column 3 uses only vertical integration events where less than 40% of the supplier's relationships break. Columns 4 and 4 lower this threshold to 20 and 10 percent, respectively. The Table reports robust standard errors, clustered at the supplier-year level. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

B.5 Alternative relationship definitions

As an additional robustness check, we repeat the baseline regressions with an alternative definition of the buyer-supplier network. In particular one might be worried that relationships break only temporarily and are ultimately reestablished so that the effects we attribute to vertical foreclosure are only transitory. To address this concern, we can remove gaps from buyer buyer-supplier relations. We count a relation as active in a given year if it has been reported active in previous and in future years, even when it is currently not reported to be active. Here, a link is not counted as breaking if it reforms at a later date.

Figure 11: Fraction of supplier's customer relationships breaking following vertical integration



Note: The graph shows a histogram of the fraction of the suppliers' customer relationships that break following vertical integration.

Figure XXIV shows that the baseline results are robust to using this alternative definition. The coefficients on the variable representing a merger of a supplier with the buyer's competitor remains statistically significant throughout and is even slightly larger than in the baseline results. This means that the correlations are not driven by brief pauses in a relationship which ultimately resumes.

B.6 Firm entry in the upstream segment?

Do vertical mergers with foreclosure potential deter entry of firms in the upstream segment? To investigate this question we count the number of suppliers that enter an industry as measured by three-digit NAICS cells in a given year and relate it to whether or not there has been a potential foreclosure event in that industry. This exercise is more tentative in nature for three main reasons: First, NAICS codes are a relatively crude measure of the upstream market that does not account for product or geographical differentiation. Second, the industry codes reported in our data are time invariant, meaning that we cannot capture existing firms moving into new product markets. Finally, as we document above, our sample consists mainly of large firms and we may therefore not be able to detect changes in the entry patterns of small firms.

Notwithstanding these caveats, we estimate the following regression:

$$LogEntry_{it} = \beta \mathbb{1}\{Potential\ foreclosure\}_{it} + \eta_i + \eta_t + \varepsilon_{it}$$

where $LogEntry_{it}$ is defined as the log of one plus the number of suppliers in industry i that have at least one customer in year t but did not have one the previous year.

Table XXV reports the results of this regression. We measure potential foreclosure in two different ways. The first approach is a dummy indicating whether a supplier in the industry had

Table XXIV—: Extensive margin regressions with stable buyer-supplier relations

	Dependent variable: $\mathbb{1}\{\text{LinkBreaks}\}_{bst}$			
	(1)	(2)	(3)	(4)
Supplier v. integrates	0.012 (0.008)	0.008 (0.007)	0.006 (0.007)	0.011 (0.007)
Supplier v. integrates w. competitor		0.186** (0.046)	0.204** (0.050)	0.186** (0.045)
Controls				Yes
Relation FE	Yes	Yes	Yes	Yes
Buyer × Year FE	Yes	Yes	Yes	Yes
Industry Pair × Year FE			Yes	Yes
R^2	0.434	0.434	0.451	0.492
Observations	3351207	3351188	2521097	2521097

Note: Controls: number of upstream customers and competitors, age of the link, dummy indicating other links of the supplier breaking. Robust standard errors clustered at the supplier-year level. The number of reported observations is the number of non-singleton observations. The drop in the number of observations in columns (3) and (4) is explained by firms with missing industry codes. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

a merger with foreclosure potential, i.e. the supplier merged with a buyer whose competitor it also supplied (columns 1-2). The second approach is a dummy indicating that a merger with foreclosure potential coincided with a break of the buyer-supplier link with the downstream competitor (columns 3-4). While the estimates are quite noisy and not statistically significant, the point-estimates are negative throughout. Perhaps foreclosure events have a negative impact on firm entry in the upstream industry. Because of the caveats mentioned above and the fact that estimates are not very precise, we hesitate to draw conclusions.

Table XXV—: Firm entry and vertical integrations with foreclosure potential

	Dep. var.: $log(1 + \#entering\ suppliers)_{it}$			
	(1)	(2)	(3)	(4)
V. integration w. foreclosure potential	-0.032 (0.111)		-0.079 (0.092)	
× buyer-supplier link breaks		-0.045 (0.130)		-0.110 (0.107)
Controls			Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
R^2	0.891	0.891	0.926	0.926
Observations	1236	1236	1236	1236

Note: Controls: number of buyer-supplier relations and number of suppliers in a given industry-year.
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

B.7 Relationship severance prior to integration?

We revisit the main regression presented in section 3 in order to investigate whether buyer-supplier relations are more likely to end already in the year before the supplier vertically integrates. If there was reverse causality for supply assurance reasons for instance, we might expect to find a positive correlation in the year before integration actually takes place. We repeat the baseline specification but replace the right-hand side variables by dummies that are one if a time-t competitor of b vertically integrates with s at time $t+1$.

Table XXVI presents the results of this exercise. We find no evidence that relationships are already more likely to break in the year preceding vertical integration. Quite to the contrary, these relationships are substantially less likely to break. This correlation is not mechanical and in particular persists when restricting the sample to relations with suppliers that keep at least one customer in year $t+1$ when the integration takes place.

Table XXVI—: Hazard of links breaking in year before vertical integration

	Dependent variable: $\mathbb{1}\{\text{LinkBreaks}\}_{bst}$			
	(1)	(2)	(3)	(4)
Supplier v. integrates in t+1	-0.031	-0.022	-0.008	0.008
	(0.020)	(0.020)	(0.019)	(0.019)
Supplier v. integrates w. competitor in t+1		-0.186**	-0.174**	-0.151**
		(0.041)	(0.043)	(0.043)
Controls				Yes
Relation FE	Yes	Yes	Yes	Yes
Buyer × Year FE	Yes	Yes	Yes	Yes
Industry Pair × Year FE			Yes	Yes
R^2	0.576	0.576	0.616	0.670
Observations	638681	638681	470788	470788

Note: Controls: number of upstream customers and competitors, age of the link, dummy indicating other links of the supplier breaking. Robust standard errors clustered at the supplier-year level. The number of reported observations is the number of non-singleton observations. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

B.8 Robustness for interactions with number of competitors

Table XXVII shows robustness checks of the specification in Table VI with bins for the number of the supplier's and the buyer's competitors.

Table XXVIII shows regressions only on the subsample of active buyer-seller relationships where the number of competitors of the supplier is positive (all columns), and where the number of competitors of the downstream firm is positive (columns 3 and 4). In this table, we also use log(#competitors) instead of log(1 + #competitors).

B.9 Direct impact of mutual fund outflow events on firms?

In Table XXIX we show that sales performances of firms are no different during mutual fund outflow events, supporting the view that outflow events do not have a direct short-term impact on the operations of firms. We regress firm sales on dummies describing MFHS events as in the IV specification (1 iff an outflow event in time t, $t-1$, or $t-2$). We find no statistically significant drop in firm sales following such events.

B.10 Is foreclosure a merger motive?

The correlations presented in the body of the paper are consistent with theories of vertical market foreclosure. That said, even if the timing of a vertical integration of the supplier is exogenous, the party with whom the supplier integrates may not be unrelated to firm or market structure: an acquirer that senses a foreclosure opportunity may be willing to pay a premium, and is therefore more likely than alternative bidders to be the winning bidder.

To study whether vertical foreclosure is a merger motive, we run the regression

$$\mathbb{1}\{b \text{ integrates with } s\}_{bst} = \alpha \mathbb{1}\{b \text{ has a competitor that is supplied by } s\}_{st} + \eta_{st} + \varepsilon_{bst} \quad (6)$$

on the sample of active buyer-supplier relationships (b, s) at time t when the supplier s is undergoing a vertical integration with one of its customers. Competitor status here refers to before the merger, i.e. at time $t-1$. The coefficient α tells us whether buyers that have a competitor that is also a customer of the supplier are more likely to be the one that is integrating with the supplier — conditional on the supplier vertically integrating. These buyers potentially have a motive to foreclose their competitors.

Table XXX shows the results. The point estimate of α is positive and statistically significant. Given that the unconditional probability of being the integrating party in this sample is about three percent, having a foreclosure motive is associated with a roughly 55% higher probability of being the firm that integrates with the supplier. In column (2) we control for the buyer's (log of one plus the) number of suppliers and competitors (again at time $t-1$), which proxies for size and alleviates the concern that buyers with a competitor among the seller's customers are just those that are larger. In column (3) we include dummies for the buyer's industry times year, to control for industry-time-specific shocks. Neither of these controls affect the estimate of α much. Hence, firms that have a foreclosure motive (in the sense that s is also supplying their competitor) are more likely to be the integrating party at a time when s vertically integrates. Columns (4) and (5) show that the correlation is weaker the more competitors the supplier has at time $t-1$.

B.11 Extensive vs. intensive margin in the anticompetitive effects

In Table XXXI we regress log sales on dummies for vertical integration of the supplier (and whether it's with a competitor) like in the baseline sales impact regression, but also including an interaction with a dummy that is one if the relationship breaks following integration (the outcome in equation (1)). Hence, we look at whether there is a sales impact differential depending on whether links break or not. Since the breaking of the relationship is clearly an endogenous outcome for which we do not have an additional IV, we omit the IV specifications here. All interpretations are of course subject to the same caveats as the OLS specifications in the paper.

The results are not entirely conclusive because the estimate for the link break dummy interaction coefficient is somewhat imprecisely estimated. Taking the point estimate at face value would imply that the sales loss is (ceteris paribus) about 5 to 6 percentage points larger when the relationship is cut (but note that the estimates are not significantly different from zero even at the 10% level). The estimates for the other coefficients are similar to those in the benchmark specifications of Table XIII, suggesting that there may be action on both the extensive margin (cutting of relationships) and intensive margin (higher costs while the relationship remains active).

B.12 Do firms form new links?

In Table XXXII we regress the change in the firm's number of suppliers over one- to five-year horizons (and winsorized so that firms with very large numbers of suppliers do not on their own drive results) on a dummy that is one if one of the firm's relationship breaks following vertical integration of the seller with a competitor of the firm (what we call a "potential foreclosure event"). We find that the change in the number of suppliers is lower by about one compared to the average change in the number of suppliers. Notably, that's very similar across the five different horizons. It seems that the potential foreclosure events result in lower numbers of suppliers even in the medium run.

The regressions in Table XXXIII are similar but do not condition on the events leading to a breaking of the buyer-supplier relationship (i.e. the independent variable is a dummy that is one iff the firm has a supplier that integrates with a competitor of the firm). We find coefficients that are a little bit lower but still close to one (and not significantly different from one).

B.13 Partial Acquisitions

In Table XXXIV we show the baseline extensive margin regressions but where the "vertical integration" dummy *only* includes partial acquisitions where the acquirer becomes a majority shareholder (pre-acquisition ownership share is in the interval $[0\%, 50\%)$) and the post-acquisition ownership share is in the interval $[50\%, 100\%)$). The results are a bit less precisely estimated, but qualitiatively similar to the benchmark specifications.

B.14 Alternative Suppliers and Break Probability

Here we investigate if links are more likely to break following vertical integration of the supplier with a competitor if the potential target of foreclosure has fewer alternative suppliers. We define alternative suppliers as those that are in competition with the integrating supplier and also supplying the buyer that is the potential target of foreclosure. Table XXXV reports regressions in which we interacted the number of alternative suppliers with the integration event. The interactions to be negative and significant: when buyers have alternative suppliers, their relationships with suppliers that vertically integrate with competitors are less likely to break.

B.15 MFHS outflow events and vertical mergers

Table XXXVI shows the relationship between MFHS outflow events and vertical integration in regression form.

B.16 Robustness checks for the IV regressions

In the following we present some alternative specifications and robustness checks to the IV regressions from the main text. First, Table XXXVII shows the results when using a simpler generating regression, namely

$$E\left(\mathbb{1}\{s \text{ vertically integrates}\}_{st}|Z\right) = \exp(\lambda_1 \text{MFHSEvent}_{st} + \alpha_{bs} + \alpha_{bt}).$$

Table XXXVIII shows specifications where we use a different functional form (Probit or Logit) for the generating regression (3). The point estimates are very similar to those from Table VIII.

Table XXVII—: Interaction with the number of upstream competitors – Robustness

	Dependent variable: $\mathbb{1}\{\text{LinkBreaks}\}_{bst}$			
	(1)	(2)	(3)	(4)
Supplier v. integrates	0.011	0.028^{**}	0.011	0.028^{**}
	(0.008)	(0.007)	(0.008)	(0.007)
Supplier v. integrates w. competitor	0.248^{+}	0.178	0.327^{*}	0.261^{+}
	(0.146)	(0.136)	(0.155)	(0.144)
× 6-10 Competitors	0.075	0.028	0.030	-0.013
	(0.175)	(0.164)	(0.178)	(0.166)
× 11-20 Competitors	-0.032	-0.015	-0.063	-0.045
	(0.155)	(0.145)	(0.156)	(0.146)
× 21 - 30 Competitors	-0.122	-0.118	-0.195	-0.183
	(0.173)	(0.161)	(0.176)	(0.164)
× 31 - 40 Competitors	-0.129	-0.054	-0.176	-0.091
	(0.160)	(0.150)	(0.164)	(0.153)
× 41 - 50 Competitors	-0.506	-0.453	-0.551	-0.482
	(0.410)	(0.383)	(0.421)	(0.393)
× 50+ Competitors	-0.268	-0.489	-0.288	-0.482
	(0.381)	(0.356)	(0.400)	(0.374)
× 6-10 Downstream Competitors			-0.287^{+}	-0.273^{+}
			(0.159)	(0.148)
× 11-20 Downstream Competitors			-0.059	-0.068
			(0.087)	(0.081)
× 21 - 30 Downstream Competitors			-0.034	-0.053
			(0.111)	(0.104)
× 31 - 40 Downstream Competitors			0.125	0.080
			(0.129)	(0.120)
× 41 - 50 Downstream Competitors			-0.059	-0.089
			(0.142)	(0.133)
× 50+ Downstream Competitors			0.000	0.000
			(.)	(.)
Controls		Yes		Yes
Competitor Bin Dummies	Yes	Yes	Yes	Yes
Relation FE	Yes	Yes	Yes	Yes
Buyer × Year FE	Yes	Yes	Yes	Yes
Industry Pair × Year FE	Yes	Yes	Yes	Yes
R^2	0.619	0.668	0.619	0.668
Observations	472832	472832	472832	472832

Note:

Controls: number of upstream customers, age of the link, dummy indicating other links of the supplier breaking. "Upstream competitors" is the number of competitors of the supplier; "downstream competitors" is the number of competitors of the buyer. Table reports robust standard errors, clustered at the supplier-year level. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

Table XXVIII—: Interaction with the number of upstream competitors: intensive margin of # competitors

	Dependent variable: $\mathbb{1}\{\text{LinkBreaks}\}_{bst}$			
	(1)	(2)	(3)	(4)
Supplier v. integrates w. competitor	0.691^{**}	0.602^{**}	0.279	0.230
	(0.183)	(0.174)	(0.272)	(0.258)
Supp. v. int. w. comp. × # upstream comp.	-0.137^{*}	-0.130^{*}	-0.125^{+}	-0.119^{+}
	(0.063)	(0.060)	(0.067)	(0.066)
Supplier v. integrates	0.017^{*}	0.032^{**}	0.016	0.032
	(0.008)	(0.008)	(0.020)	(0.021)
# upstream competitors	-0.013^{**}	-0.026^{**}	-0.014^{**}	-0.027^{**}
	(0.002)	(0.002)	(0.005)	(0.004)
Supp. v. int. w. competitor × # downstream competitors			0.103^{*}	0.093^{*}
			(0.046)	(0.041)
Controls		Yes		Yes
Relation FE	Yes	Yes	Yes	Yes
Buyer × Year FE	Yes	Yes	Yes	Yes
Industry Pair × Year FE	Yes	Yes	Yes	Yes
Sample	See note	See note	See note	See note
R^2	0.607	0.646	0.590	0.631
Observations	349251	349251	316078	316078

Note:

Controls: number of upstream customers, age of the link, dummy indicating other links of the supplier breaking. "Upstream competitors" is the log number of competitors of the supplier; "downstream competitors" is the log number of competitors of the buyer. Sample consists of all active buyer-supplier relationships where the number of competitors of the supplier is positive (all columns), and where the number of competitors of the downstream firm is positive (columns 3 and 4). Table reports robust standard errors, clustered at the supplier-year level. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

Table XXIX—: Impact of MFHS outflow events on firm sales

	Dependent variable: Log sales			
	(1)	(2)	(3)	(4)
MFHS event in t, $t-1$, or $t-2$	-0.004	-0.006	0.001	-0.000
	(0.008)	(0.008)	(0.008)	(0.008)
Firm trends	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes		
Industry × Year FE			Yes	Yes
Controls		Yes		Yes
Observations	80,491	80,491	77,202	77,202
R^2	0.99	0.99	0.99	0.99

Note:

The independent variable is a dummy that is one if and only if the firm experienced an outflow event in time t, $t-1$, or $t-2$. Controls: number of customers, competitors and suppliers. Robust standard errors, clustered at the firm level, are in parentheses. $^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$.

Table XXX—: Buyers with competitors that are also supplied by S are more likely to integrate with S

	Dependent variable: $\mathbb{1}\{\text{B and S integrate}\}_{bst}$				
	(1)	(2)	(3)	(4)	(5)
B has competitor supplied by S	0.014**	0.035***	0.038***	0.080***	0.117***
	(0.004)	(0.005)	(0.006)	(0.019)	(0.025)
× # upstream competitors				-0.008*	-0.015**
				(0.004)	(0.005)
Controls		Yes	Yes	Yes	Yes
Supplier × Year FE	Yes	Yes	Yes	Yes	Yes
Buyer Industry × Year FE			Yes		Yes
R^2	0.101	0.117	0.184	0.118	0.179
Observations	6812	6201	5414	5181	4567

Note: Sample consists of all active buyer-seller relationships at a time where the supplier vertically integrates with a buyer. Competitor status in independent variable and number of upstream competitors refer to year $t-1$. Controls: number of buyer's competitors and suppliers. Reported number of observations is net of singleton observations. The drop in the number of observations in column (3) is explained by firms with missing industry codes. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table XXXI—: Sales impact, extensive vs intensive margins

	Dependent variable: Log sales			
	(1)	(2)	(3)	(4)
Supplier v.integrates	0.042**	0.018+	0.042**	0.018+
	(0.010)	(0.010)	(0.010)	(0.010)
Supplier v. integrates w. competitor	-0.009	-0.026	-0.107	-0.117+
	(0.044)	(0.043)	(0.071)	(0.068)
× Link breaks	-0.057	-0.051	-0.061	-0.054
	(0.053)	(0.052)	(0.051)	(0.051)
× $log(1 + \#\text{ alt. suppliers})$			0.044**	0.041*
			(0.017)	(0.016)
Buyer FE	Yes	Yes	Yes	Yes
Industry × Year FE	Yes	Yes	Yes	Yes
Controls		Yes		Yes
Method	OLS	OLS	OLS	OLS
Observations	77202	77202	77202	77202
R^2	0.98	0.98	0.98	0.98

Note:

Regression specifications are as in Table XIII, but with an additional interaction with a dummy that is one if and only if the relationship breaks following vertical integration of the supplier with the competitor. Robust standard errors, clustered at the firm level, are in parentheses. $^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$.

Table XXXII—: Change in the number of suppliers: potential foreclosure cases

	Dependent variable: $\Delta_{t,t+h}\#Suppliers$				
	(1)	(2)	(3)	(4)	(5)
Potential Foreclosure Case	-1.396**	-0.939*	-1.557**	-0.960**	-0.990**
	(0.300)	(0.420)	(0.302)	(0.358)	(0.331)
Buyer FE	Yes	Yes	Yes	Yes	Yes
Industry × Year FE	Yes	Yes	Yes	Yes	Yes
Horizon (years)	1	2	3	4	5
Method	OLS	OLS	OLS	OLS	OLS
Observations	89,633	66,182	48,724	36,969	28,651
R^2	0.22	0.31	0.38	0.46	0.53

Note:

The dependent variable is the change in the number of suppliers between time t and $t+h$, winsorized at the 5th and 95th percentile of the distribution of annual changes (-4,4). The independent variable (potential foreclosure case) is a dummy that is one if and only if the firm has a supplier that vertically integrates with a competitor and the relationship with that supplier breaks between t and $t+1$. Robust standard errors, clustered at the firm level, are in parentheses. $^+$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$.

Table XXXIII—: Change in the number of suppliers (OLS)

	Dependent variable: $\Delta_{t,t+h}\#Suppliers$				
	(1)	(2)	(3)	(4)	(5)
Supplier v. integrates w. competitor	-0.951**	-0.919**	-1.226**	-0.925**	-1.077**
	(0.224)	(0.262)	(0.233)	(0.278)	(0.316)
Buyer FE	Yes	Yes	Yes	Yes	Yes
Industry × Year FE	Yes	Yes	Yes	Yes	Yes
Horizon (years)	1	2	3	4	5
Method	OLS	OLS	OLS	OLS	OLS
Observations	89,633	66,182	48,724	36,969	28,651
R^2	0.22	0.31	0.38	0.46	0.53

Note:

The dependent variable is the change in the number of suppliers between time t and $t+h$, winsorized at the 5th and 95th percentile of the distribution of annual changes (-4,4). The independent variable is a dummy that is one if and only if the firm has a supplier that vertically integrates with a competitor. Robust standard errors, clustered at the firm level, are in parentheses. $^+$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$.

Table XXXIV—: Impact of vertical integration on competitors' sales – majority stake partial acquisitions only

	Dependent variable: $\mathbb{1}\{\text{LinkBreaks}\}_{bst}$			
	(1)	(2)	(3)	(4)
Supp. partially acquired / acquired by a buyer (majority stake)	-0.008	-0.013	-0.026	-0.031
	(0.050)	(0.052)	(0.047)	(0.052)
Supp. partially acquired / acquired by competing buyer (majority stake)		0.091	0.159^{+}	0.155^{*}
		(0.076)	(0.088)	(0.077)
Controls				Yes
Relation FE	Yes	Yes	Yes	Yes
Buyer × Year FE	Yes	Yes	Yes	Yes
Industry Pair × Year FE			Yes	Yes
R^2	0.580	0.580	0.621	0.673
Observations	622481	622478	457496	457496

Note:

Specification as in the benchmark specification of Table V, except that vertical integration events are only acquisitions where the pre-acquisition ownership share is a minority share (in the interval $[0\%, 50\%)$) and the post-acquisition ownership share is in the interval $[50\%, 100\%)$.
$^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$.

Table XXXV—: Interaction with the number of upstream competitors and alternative suppliers

	Dep. variable: $\mathbb{1}\{\text{LinkBreaks}\}_{bst}$	
	(1)	(2)
Supplier v. integrates	0.012	0.028^{**}
	(0.008)	(0.007)
Supplier v. integrates w. competitor	0.338^{**}	0.267^{**}
	(0.061)	(0.057)
Supp. v. int. w. comp. × # alternative supp.	-0.126^{**}	-0.115^{**}
	(0.043)	(0.040)
# alternative suppliers	-0.032^{**}	-0.035^{**}
	(0.002)	(0.002)
Controls		Yes
Relation FE	Yes	Yes
Buyer × Year FE	Yes	Yes
Industry Pair × Year FE	Yes	Yes
R^2	0.619	0.668
Observations	472832	472832

Note: Controls: number of upstream customers, age of the link, dummy indicating other links of the supplier breaking. "Upstream competitors" is the number of competitors of the supplier; "alternative suppliers" is the number of competitors of the supplier that also supply the buyer. We use the log of one plus the number of upstream competitors / alternative suppliers to account for the skewness of the distribution. Table reports robust standard errors, clustered at the supplier-year level. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

Table XXXVI—: Vertical mergers following MFHS outflow events

	Dependent variable: Firm vertically integrates with buyer				
	(1)	(2)	(3)	(4)	(5)
Outflow event	-0.000				
	(0.001)				
$t-1$		0.013^{**}			
		(0.003)			
$t-2$			0.003		
			(0.002)		
$t-3$				0.002	
				(0.003)	
$max(t, t-1, t-2)$					0.005^{**}
					(0.001)
Firm FE	Yes	Yes	Yes	Yes	Yes
Industry × Year FE	Yes	Yes	Yes	Yes	Yes
Observations	154,050	154,050	154,050	154,050	154,050
R^2	0.26	0.26	0.26	0.26	0.26

Note:

This table shows regressions where the dependent variable is a dummy indicating whether a firm vertically integrates with a buyer and the independent variables are indicators for mutual fund capital outflow (defined as normalized MFHS being below the tenth percentile) at time t, $t-1$, $t-2$ and. $t-3$. The last indicator is equal to one if there was an outflow event in t, $t-1$ or $t-2$. All regression include firm and industry-year fixed effects. Robust standard errors, clustered at the firm level, are in parentheses. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

Table XXXVII—: Relationships breaking following Vertical Integration: Generated IV (Poisson with simple generating regression)

	Dependent variable: $\mathbb{1}\{\text{LinkBreaks}\}_{bst}$		
	(1)	(2)	(3)
Supplier v. integrates	0.026	0.016	0.022
	(0.022)	(0.020)	(0.019)
Supplier v. integrates w. competitor		0.322	0.296
		(0.205)	(0.194)
Controls			Yes
Method	IV	IV	IV
Relation FE	Yes	Yes	Yes
Buyer × Year FE	Yes	Yes	Yes
R^2	0.000	0.000	0.131
First stage F-stat	2020.277	17.596	17.587
Observations	640753	506335	506335

Note:

Controls: number of upstream customers, age of the link, dummy indicating other links of the supplier breaking. Table reports robust standard errors, clustered at the supplier-year level. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

Table XXXVIII—: Relationships breaking following Vertical Integration: Alternative Generating Regressions

	$\mathbb{1}\{\text{LinkBreaks}_{bst}\}$			
	(1)	(2)	(3)	(4)
Supplier v. integrates	0.018	0.025	0.019	0.026
	(0.020)	(0.019)	(0.020)	(0.019)
Supplier v. integrates w. competitor	0.309	0.286	0.308	0.284
	(0.206)	(0.195)	(0.204)	(0.194)
Controls		Yes		Yes
Buyer × Year FE	Yes	Yes	Yes	Yes
Relation FE	Yes	Yes	Yes	Yes
Estimator	IV	IV	IV	IV
Generating Regression	Probit	Probit	Logit	Logit
R^2	0.583	0.638	0.583	0.638
First-stage F statistic	16.494	16.487	16.573	16.566
N	507,453	507,453	507,453	507,453

Note:

Controls: number of upstream customers, age of the link, dummy indicating other links of the supplier breaking. Table reports robust standard errors, clustered at the supplier-year level. $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.