Hold-up and Investment: Empirical Evidence from Tariff Changes

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Abstract

We investigate the importance of hold-up problems between customers and suppliers for investment decisions. We exploit variation in the severity of hold-up problems due to improvements in customers' outside option resulting from reductions in import tariffs in their suppliers' industries. As theory predicts, customers respond by increasing investment. This finding is driven by customers that are not vertically integrated and suppliers producing differentiated inputs. Moreover, the effect is stronger if high uncertainty inhibits the use of comprehensive, long-term contracts and weaker for customers with high bargaining power. Finally, we show that tariff reductions lead to lower premiums in vertical mergers.

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1 Introduction

Most firms are part of vertical production chains. Instead of operating in isolation, they buy their input from upstream suppliers and sell their output to downstream customers. The theoretical literature has long recognized that such relations between customers and suppliers are prone to hold-up problems. Prominent examples are the transaction cost theory of Williamson (1975) and Klein, Crawford, and Alchian (1978) and the property rights theory of Grossman and Hart (1986) and Hart and Moore (1990). A key building block of both theories is the effect of hold-up problems on investment decisions: The anticipation of ex post bargaining over the gains from trade reduces investments ex ante.[1] Direct empirical evidence of an effect of hold-up problems on investment decisions, however, is very scarce. The goal of this paper is to provide such evidence.

To do so, we exploit large reductions in import tariffs as a source of variation in the severity of hold-up problems between customers and suppliers. When import tariffs in upstream industries are lowered, downstream customers' bargaining position vis-à-vis their (domestic) suppliers improves as the cost of procuring inputs from alternative (foreign) sources decreases. This, in turn, reduces the suppliers' ability to hold-up their customers after investments have been sunk.

Theory predicts that such a reduction in the threat of ex post hold-up induces customers to increase investments in their productive capacity. We find strong support for this prediction in the data: Downstream customers indeed increase their investments in response to import tariff reductions in upstream industries. Specifically, our estimates imply an increase of 5% to 6% in customers' capital expenditures for a one standard deviation increase in the fraction of supplier industries that are subject to large tariff reductions. To the best of our knowledge, we are the first

[1] See Whinston (2003) and Gibbons (2005) for discussions of the differences and commonalities of the two theories and Grout (1984) for an early formalization of the idea that ex post bargaining over the division of surplus can distort ex ante investments.

to document this effect.

Key assumptions of the underlying theory are that suppliers and customers are not vertically integrated, that investments are relationship specific, and that contracts are incomplete. Consistent with these premises, we find a significant effect of tariff reductions on investment decisions only for non-integrated customers and suppliers producing differentiated inputs (as proxied by their R&D expenditures). Further, the effect is more pronounced when a high level of uncertainty about future contingencies (as proxied by customers' sales volatility) makes the use of comprehensive, long-term contracts more difficult. Theory also predicts that the effect of tariff reductions on customers' investments varies with the customers' bargaining power vis-à-vis their suppliers. Consistent with this prediction, we find that customers' response to tariff reductions is decreasing in their bargaining power (as proxied by industry concentration and firm size).

We also explore the effect of import tariff reductions on the acquisition premiums paid in vertical mergers. An implication of the argument that tariff reductions in upstream industries alleviate hold-up problems between customers and suppliers is that such tariff reductions reduce the benefits of vertical integration. As a consequence, import tariff reductions should lead to a decline in the premiums paid in vertical mergers. The data support this prediction. Using information on mergers and acquisitions from the SDC Platinum database, we show that deal premiums paid in vertical mergers indeed decline after import tariff reductions in the target's industry.

We compute import tariff rates and their year-on-year changes at the industry level using data on the total value of imports and duties collected for all U.S. manufacturing industries (SIC codes 2000 to 3999) between 1974 and 2012. Following the literature, we define tariff rate changes as "large" if they are at least three times as large as the average change in the industry (Fresard and Valta (2016)). For each customer industry, we then use the 1992 U.S. Bureau of Economic Analysis (BEA) input-output table to compute the fraction of supplier industries that experienced large tariff reductions in prior years. Finally, we add firm- and industry-level data from Compustat and CRSP and examine how customers' capital expenditures respond to large tariff reductions in their suppliers' industries.

A benefit of our approach is that the import tariff rates in upstream industries are not direct choice variables of the downstream firms. Changes in these tariff rates are thus less likely to be correlated with unobserved, firm-level determinants of customers' investment decisions than other sources of variation in the severity of hold-up problems (e.g., differences in the level of vertical integration or the extent to which investments are relationship specific).

A potential concern, however, is that tariff reductions may coincide with unobserved changes in investment opportunities. For example, tariff reductions (or a lack thereof) may be the result of industrial lobbying, and firms' lobbying efforts may depend on their growth opportunities. Krugman, Obstfeld, and Melitz (2015) argue that multilateral trade negotiations are less likely to be captured by lobbying groups than the decision making process behind unilateral policy changes. We thus confirm that our findings are robust to relying only on tariff reductions resulting from multilateral trade agreements (i.e., the GSP introduction, the completion of GATT trade rounds, and the start of NAFTA).

Another concern is that import tariff reductions in suppliers' industries affect customers' investment decisions for reasons other than hold-up problems. In particular, increased import competition upstream may lead to lower input prices downstream that make new investments more attractive. While potentially consistent with a general increase in investment, this alternative explanation is difficult to reconcile with the cross-sectional variation that we document. For example, the alternative explanation that import tariff reductions in their suppliers' industries allow customers to demand price concessions that, in turn, spur new investments would predict that customers with high bargaining power (who can demand large concessions) increase their investments more than customers with low bargaining power. The data reject this prediction: We find that customers with high bargaining power respond less to tariff reductions in their suppliers' industries than customers with low bargaining power.

Similarly, the alternative explanation that customers simply react to lower input prices that result from increased competition suggests that the effect of tariff reductions in upstream industries on downstream customers' investment decisions should be weaker if the suppliers produce differentiated rather than generic inputs. The reason is that product differentiation shields domestic suppliers from foreign competition (Hombert and Matray (2016)). We, however, find that the effect is driven by tariff reductions in supplier industries that produce differentiated inputs.

Finally, the alternative explanation that there are no hold-up problems and that customers just react to lower input prices resulting from lower tariffs in upstream industries does not predict a change in the acquisition premiums paid in vertical mergers. If there are no hold-up problems between customers and suppliers, then it is unclear why tariff reductions would decrease the benefits of vertical integration. However, as predicted by the argument that tariff reductions mitigate hold-up problems, we find that deal premiums for vertical mergers (which reflect the economic surplus created by the acquisition) decline after import tariff reductions in the target's industry.

Our findings are important for two reasons. First, they show that hold-up problems in vertical production chains matter empirically for firms' investment decisions. As such, our analysis uncovers empirical evidence that hold-up problems indeed affect corporate investments – a key building block of both transaction cost economics and the property rights theory of the firm. An important implication of this finding is that the equilibrium level of vertical integration that we observe empirically does not eliminate all hold-up problems. Hence, our results point towards significant barriers to firms' ability to overcome hold-up problems through vertical integration or other contractual arrangements. Second, our findings show how tariff reductions in upstream industries affect the capital expenditures of downstream firms. Our analysis thus adds to our understanding of the propagation of economic shocks through production networks (e.g., Barrot and Sauvagnat (2015)).

The rest of the paper is organized as follows. Section 2 discusses how our work relates to the existing literature. Section 3 presents a simple model in the spirit of Hart (1995), which we use as a framework for our analysis and to formally derive our predictions. Section 4 describes the data. Section 5 presents the empirical results regarding the effect of import tariff reductions in upstream industries on downstream customers' investment decisions. Section 6 addresses potential alternative explanations for the increase in customers' investments that we find. Section 7 explores the effect of tariff reductions on acquisition premiums in vertical mergers. Section 8 concludes. The Appendix provides detailed variable descriptions as well as further analyses and robustness tests.

2 Related Literature

Our paper is related to the empirical literature on transaction cost and property rights based explanations for vertical integration as reviewed, for example, in Lafontaine and Slade (2007), Joskow (2008), and Klein (2008). We contribute to this literature by providing direct empirical evidence of a central building block of both transaction cost economics and the property rights theory of the firm: the importance of hold-up problems for investment decisions.

Our work is further related to a small number of papers that provide evidence of an effect of hold-up on investment in very particular settings. Ciliberto (2006) examines whether hospitals that have vertically integrated or formed joint ventures with their physicians add more healthcare services over time than hospitals that negotiate managed care contracts independently. Vukina and Leegomonchai (2006) provide some evidence that hold-up problems affect investment decisions in the U.S. broiler industry. Cookson (2014) studies the consequences of expropriation risk due to incomplete contracting and finds that better understood courts in American Indian reservations lead to greater employment and more establishments in high-sunk-cost industries such as golf courses. Geng, Hau, and Lai (2016) investigate whether joint equity ownership of firms that control complementary patents can mitigate hold-up problems and find that such "shareholder overlap" is associated with higher R&D expenditures and more patent filings.

Our paper contributes to this line of research by providing evidence of the importance of hold-up problems for corporate investment decisions in a panel of U.S. firms that spans a large number of different industries over a long period of time (from 1974 to 2012). Further, large import tariff reductions in upstream industries are more likely to be exogenous to unobserved determinants of downstream customers' investment decisions than variation in the severity of hold-up problems stemming from firms' attempts to maximize expected profits (i.e., variation due to decisions at the firm level). Hence, our analysis provides arguably cleaner evidence of the importance of hold-up problems for investment decisions than estimates based on, for example, firms' choice to vertically integrate (e.g., Ciliberto (2006)) or to invest in less relationship specific technologies (e.g., Vukina and Leegomonchai (2006)).

Our research is also related to the literature in trade and international economics that studies the consequences of trade liberalizations in general and tariff reductions in particular.[2] A key finding in this literature is that tariff reductions and other trade liberalizations lead to an increase in total factor productivity. Two important aspects distinguish our paper from this prior work.

First, the above mentioned literature typically studies the consequences of trade liberalizations in developing countries (e.g., Brazil, Chile, China, India, Indonesia, Mexico). We, instead, study

[2] E.g., Tybout, de Melo, and Corbo (1991), Tybout and Westbrook (1995), Krishna and Mitra (1998), Pavcnik (2002), Melitz (2003), Shor (2004), Trefler (2004), Amiti and Konings (2007), Kasahara and Rodrigue (2008), Melitz and Ottaviano (2008), Goldberg, Khandelwal, Pavcnik, and Topalova (2010), Vogel and Wagner (2010), Topalova and Khandelwal (2011), Amiti and Khandelwal (2013), Colantone and Crinò (2014), Fan, Li, and Yeaple (2015), Halpern, Koren, and Szeidl (2015), Acemoglu, Autor, Dorn, Hanson, and Price (2016)

how the investment decisions of U.S. firms are affected by tariff changes in upstream industries. This difference is important as one of the channels proposed in the literature through which trade liberalizations may affect downstream firms – access to superior, foreign technology embedded in imported inputs – is less likely to be an important factor for firms in developed, high-technology countries like the United States (Vogel and Wagner (2010)).

Second, our goal is not to test theories on the effects of trade liberalizations on productivity. Instead, our aim is to test theory that makes predictions about the effect of hold-up problems between customers and suppliers on investment decisions. As a consequence, we focus on firms' capital expenditures as the outcome of interest, not on measures of total factor productivity (as is common in the trade literature).

Finally, our work is related to a growing number of papers in economics and finance that examine the consequences of tariff reductions and the resulting increase in import competition on corporate actions and outcomes (e.g., Guadalupe (2007), Guadalupe and Cuñat (2009), Fresard (2010), Guadalupe and Wulf (2010), Valta (2012), Xu (2012), Fresard and Valta (2016)). An important difference between these papers and our research is that we do not study how firms are affected by or respond to tariff reductions in their *own* industry. Instead, we use tariff changes in upstream industries to examine how downstream customers' investment decisions depend on changes in the threat of being held up by their suppliers.

3 Conceptual Framework

To provide a framework for our analysis and formally derive the empirical predictions, we now present a simple model in the spirit of Hart (1995). There are two firms, C (for customer) and S (for supplier), and two dates, $t = 0$ and $t = 1$. At $t = 0$, C invests in its productive capacity. If C invests $i \in \mathbb{R}_+$, it can produce $f(i)$ units of output at $t = 1$, where f is a continuous, increasing, and concave function. For example, $f(i)$ could be the capacity of a factory built at cost i. Each unit of output is produced using one unit of input and thereafter sold at a price of one. C can buy the required input either from S or on a spot market populated by a large number of domestic and foreign suppliers. The (quality adjusted) price per unit of input is $p < 1$ on the spot market and x when bought from S, where x is determined through Nash bargaining between C and S at $t = 1$, after C's investment has been sunk. S's opportunity cost of supplying the input is $k < p$ per unit, and C's bargaining power is $\beta \in (0, 1)$. For simplicity, there is no discounting. Risk-aversion does not play a role because there is no uncertainty.

C's optimal investment at $t = 0$ is

$$i^* \in \arg\max_{i \in \mathbb{R}_+} f(i)\left[1 - p + \beta\left(p - k\right)\right] - i. \tag{1}$$

The intuition is that C expects to obtain its outside option $1 - p$ plus a fraction β of the gains from trade $p - k$ per unit of output $f(i)$. Given f's concavity in i, the unique solution is given by the first order condition[3]

$$f'(i^*) = \frac{1}{1 - p + \beta\left(p - k\right)}. \tag{2}$$

The price per unit of input that results from bargaining between C and S at $t = 1$ is[4]

$$x^* = \beta k + (1 - \beta)\, p, \tag{3}$$

and the quantity of input to be supplied is

$$q^* = f(i^*). \tag{4}$$

Note that i^* is smaller than the first-best investment i^{FB} given by $f'(i^{FB}) = 1/\left(1 - k\right)$. The reason is a hold-up problem: C's incentives to invest in its productive capacity at $t = 0$ are reduced because S can extract some of the surplus in the bargaining process at $t = 1$.

[3] We assume $f'(0) > 1/\left[1 - p + \beta\left(p - k\right)\right] > f'(\infty)$ to guarantee that an interior optimum exists.

[4] This follows from $f(i^*)\left[1 - x^*\right] - i^* = f(i^*)\left[1 - p + \beta\left(p - k\right)\right] - i^*$.

Four assumptions are important for this result. First, C and S cannot write a complete, long-term contract at $t = 0$. The reason could be, for example, that it is prohibitively costly to unambiguously describe all possibly relevant dimensions of the required input under all future contingencies ex ante.[5] Second, C's investment must be sunk at $t = 0$. That is, the investment cannot be delayed and is irreversible. Third, S's opportunity cost of supplying the input is lower than the cost of C's best alternative. The marginal return from C's investment is therefore larger if trade with S occurs than if it does not. This condition is what makes the investment "relationship specific" in the sense of Hart (1995). Fourth, C does not have all the bargaining power. As a consequence, C must share the gains from trade with S.

We now introduce one additional assumption: The spot market price p of the input is an increasing function of the import tariff rate τ in the suppliers' industry, i.e.,

$$p = p(\tau) \text{ with } p'(\tau) > 0. \tag{5}$$

This can be motivated, for example, by assuming that each unit of input can be produced by domestic suppliers (other than S) at cost k_d and by foreign suppliers at cost k_f and that the tariff rate satisfies $\tau < k_d/k_f - 1$. Under perfect competition among the foreign suppliers, the spot market price is then $p(\tau) = k_f\,(1 + \tau)$.

Applying the implicit function theorem to Equation (2) and using $p'(\tau) > 0$, we obtain

$$\frac{di^*}{d\tau} = (1 - \beta)\, p'(\tau) \frac{f'(i^*)^2}{f''(i^*)} < 0. \tag{6}$$

This result motivates our first empirical prediction:

[5] Under some conditions, certain mechanisms can solve the hold-up problem even when contracts are incomplete. For brevity, we simply assume that these conditions are not met. See Hart (1995) for a discussion of the different mechanisms that have been proposed in the literature and their validity.

Prediction 1: *Customers increase their investments in response to import tariff reductions in their suppliers' industries.*

The model also implies that the effect of a tariff reduction on the level of investment varies with C's bargaining power (i.e., in general, $\frac{d^2 i^*}{d\tau d\beta} \neq 0$).[6] This motivates our second prediction:

Prediction 2: *The response of customers' investments to tariff reductions in their suppliers' industries varies with the customers' bargaining power.*

Note, however, that without making further assumptions, the sign of $\frac{d^2 i^*}{d\tau d\beta}$ is ambiguous. It therefore remains an empirical question whether customers with high bargaining power respond more or less to tariff reductions than customers with low bargaining power.

Further predictions can be derived by relaxing different assumptions of the model.[7] First, there is no hold-up problem if C and S are vertically integrated. Second, there is no hold-up problem if the required input is generic and can be supplied by many alternative, domestic suppliers (at opportunity cost k). Third, there is no hold-up problem if C and S can write a complete, long-term contract. We thus obtain three additional predictions:

Prediction 3.a: *The increase in customers' investments in response to import tariff reductions in their suppliers' industries is driven by customers that are not vertically integrated into their suppliers' industries.*

Prediction 3.b: *The increase in customers' investments in response to import tariff reductions in their suppliers' industries is driven by tariff reductions in industries that produce differentiated rather than generic goods.*

[6] Specifically, Equation (6) implies $\frac{d^2 i^*}{d\tau d\beta} = -p'(\tau)\frac{f'(i^*)^2}{f''(i^*)} - (1-\beta)\,p'(\tau)\frac{2f''(i^*)^2 - f'''(i^*)f'(i^*)^2}{f''(i^*)^2}\,[p(\tau)-k]\,\frac{f'(i^*)^2}{f''(i^*)}$.

[7] We provide a formal analysis in the Appendix.

Prediction 3.c: *The increase in customers' investments in response to import tariff reductions in their suppliers' industries is stronger if complete, long-term contracts are more difficult to write.*

4 Data

4.1 Import Tariffs

We obtain data on U.S. imports in manufacturing industries (SIC codes 2000 to 3999) between 1974 and 2012 from Peter Schott's website and the Center for International Data at UC Davis.[8] Throughout the paper, we define industries at the four-digit SIC code level and compute the import tariff rate for each industry-year combination as the total value of duties collected divided by the total value of imports.

[Figure 1 around here.]

Figure 1 shows the (equally weighted) average import tariff rate across all industries in our data for each year between 1974 and 2012. As can be seen from the figure, the average import tariff has steadily declined over the past 40 years, from 8.23% in 1974 to 1.86% in 2012.

[8] `http://faculty.som.yale.edu/peterschott/` and `http://cid.econ.ucdavis.edu/`, respectively.

4.2 Large Tariff Reductions

Following Fresard and Valta (2016), we define "large" tariff reductions as follows:[9] We classify a tariff reduction in year t as large if it is more than three times as large as the average absolute year-on-year tariff change in the industry. Because we are not interested in transitory changes – e.g., tariff reductions that are immediately reversed by subsequent tariff increases – we also require that the implied tariff reductions from years $t-1$ to $t+1$, $t-2$ to $t+2$, and $t-3$ to $t+3$ are larger than three times the average absolute tariff change. Further, because tariff reductions are unlikely to have an economically significant effect if the tariff rate is very small to begin with, we do not classify a tariff reduction as large if the tariff rate before the reduction is already smaller than 1% (Fresard and Valta (2016)).

[Figure 2 around here.]

Figure 2 shows the number of large tariff reductions across industries in each year from 1974 to 2012. The figure reveals two distinct features. First, large tariff reductions occur in almost all sample years but are less numerous after the year 1998. Second, there are three noticeable spikes in the number of large tariff reductions, corresponding to major events in international trade policy: The implementation of the Generalized System of Preferences (GSP) in 1976, which eliminated import tariffs on several thousand types of products when imported from a number of designated beneficiary countries, the completion of the seventh and eighth General Agreement on Tariffs and Trade (GATT) rounds in 1979 and 1994 – the so called "Tokyo round" and the "Uruguay round,"

[9] There are also large tariff increases in our data, but they are much less frequent: Consistent with the secular downward trend in U.S. import tariffs during the sample period, we observe 493 large tariff reductions but only 55 large increases. As a consequence, estimates of the effect of large tariff increases on firms' investment decisions are significantly more noisy than estimates of the effect of large reductions. For this reason, we focus on the effect of large tariff reductions. Using also large tariff increases, however, does not change our findings (see column (4) of Table 2).

which lead to the creation of the World Trade Organization (WTO) – and the start of the North American Free Trade Agreement (NAFTA) in 1994.[10]

[Figure 3 around here.]

Figure 3 shows how the average tariff rate evolves during the five years before and after large reductions. On average, such reductions imply a decrease in the tariff rate by 1.74 percentage points, corresponding to a 27% decrease relative to the average rate of 6.43% before the reduction. Tariff reductions of this magnitude are generally considered important events in the literature and have been shown to have significant economic effects (e.g., Trefler (2004); Fresard and Valta (2016)).

4.3 Customer-Supplier Relations and Suppliers with Large Tariff Reductions

As in Acemoglu, Autor, Dorn, Hanson, and Price (2016), we identify customer-supplier relations at the industry level based on the gross flows of goods between industries reported in the 1992 U.S. Bureau of Economic Analysis (BEA) input-output table. An advantage of this approach – compared to identifying customer-supplier relations at the firm level – is that relations at the industry level are more likely to be determined by the industries' innate production technologies than an individual firm's choice to buy from a particular supplier. As a consequence, customer-supplier relations at the industry level are more likely to be exogenous to unobserved firm level characteristics than relations at the firm level. Based on the customer-supplier relations derived from the input-output table, we then compute for each industry-year combination the (gross-flow-weighted) fraction of supplier industries that have experienced large tariff reductions in the past.[11]

[10]While the general pattern is the same, the precise number of large tariff reductions in each year does not exactly match that in Fresard and Valta (2016), primarily because we are using a longer sample period – 1974 to 2012 vs. 1974 to 2005 – so that the cutoff defining "large" tariff changes (three times the average tariff change in an industry during the sample period) is not exactly the same in the two samples.

[11]We exclude intra-industry flows in this process (i.e., flows within the same industry).

The resulting variable, denoted *Supplier Tariff Reduction*, is the main regressor of interest in our analysis. *Supplier Tariff Reduction* ranges from zero to one. It is equal to zero if none of the upstream industries have experienced a large tariff reduction. It is equal to one if large tariff reductions have occurred in all supplier industries.

4.4 Investment and Control Variables

We measure investment as capital expenditures in year t scaled by the book value of total assets at the end of year $t-1$ (e.g., Baker, Stein, and Wurgler (2003)). We also compute *Ln(Assets)*, *Tobin's Q*, *Cash/Assets*, *Debt/Assets*, *EBITDA/Assets*, *Cash Flow/Assets*, *Sales Growth*, *Excess Return*, and *Excess Volatitlity* for each firm-year combination and *Industry Sales Growth* and *Industry Concentration* for each industry-year combination in our sample. All data are obtained from Compustat and CRSP, and all variables are winsorized at the 1st and 99th percentile as in Baker, Stein, and Wurgler (2003).[12] Detailed definitions are provided in the Appendix.

4.5 Summary Statistics

Table 1 presents summary statistics. Our sample comprises 44,590 firm-year observations from 1974 to 2012. The mean value of *Supplier Tariff Reduction* indicates that, on average, about 11% of a firm's suppliers have previously experienced large tariff reductions.

[Table 1 around here.]

The summary statistics for the different firm- and industry-level variables are similar to the corresponding statistics for the universe of all firms in Compustat during the sample period (unreported). The average book value of assets is USD 1 billion. Our sample, however, ranges from firms with assets of USD 2 million to firms with assets of more than USD 25 billion. The average value

[12]We show in the Appendix that using non-winsorized variables leads to very similar results (Table A.1).

of our measure of investment, *Capex/Assets*, is 0.06. As for the value of total assets, the variation across observations is large and ranges from a minimum value of 0.001 to a maximum of 0.347.

5 Empirical Results

5.1 Effect of Supplier Tariff Reductions on Customers' Investment

To assess the empirical importance of hold-up problems for customers' investment decisions, we now examine how customers' capital expenditures are affected by large tariff reductions in upstream industries (Prediction 1). Specifically, we estimate OLS regressions of the following form:

$$\frac{\textit{Customer Capex}_{i,j,t}}{\textit{Customer Assets}_{i,j,t-1}} = \beta \cdot \textit{Supplier Tariff Reduction}_{j,t} + \gamma' X_{i,j,t-1} + \delta_i + \eta_t + \varepsilon_{i,j,t} \qquad (7)$$

where i indexes firms, j industries (defined at the four-digit SIC code level), and t years.

For each (downstream) customer industry j in year t, *Supplier Tariff Reduction*$_{j,t}$ is the (gross-flow-weighted) fraction of (upstream) supplier industries (excluding industry j itself) that have experienced large tariff reductions in the past. $X_{i,j,t-1}$ is a vector of lagged firm- and industry-level controls: *Ln(Assets)*, *Tobin's Q*, *Cash/Assets*, *Debt/Assets*, *EBITDA/Assets*, *Cash Flow/Assets*, *Sales Growth*, *Excess Return*, *Excess Volatility*, *Industry Sales Growth*, and *Industry Concentration*. We further control for firm fixed effects (δ_i) and year fixed effects (η_t). Following Baker, Stein, and Wurgler (2003), we cluster all standard errors at the firm level (see also Petersen (2009)).[13]

[Table 2 around here.]

Table 2 presents the results. In column (1), we only control for firm and year fixed effects (δ_i and η_t). In column (2), we add the different firm- and industry-level control variables ($X_{i,j,t-1}$). As predicted by theory, the coefficient estimate on *Supplier Tariff Reduction* is positive and statistically significant in both specifications (at the 1% level in column (1) and at the 5% level in

[13]We show in the Appendix that our results are robust to alternative clustering choices (Table A.2).

column (2)). The point estimates imply an increase in customer investment by 5% to 6% for a one-standard-deviation increase in *Supplier Tariff Reduction* (relative to the average level of *Capex/Assets* of 0.06). This finding is evidence of an economically significant effect of hold-up problems on customers' investment decisions and consistent with Prediction 1.

A concern is that tariff changes are not randomly assigned and may coincide with unobserved changes in investment opportunities. In particular, tariff changes (or a lack thereof) may be the result of industrial lobbying. Firms in industries with lucrative growth opportunities may lobby for a reduction in import tariffs in their suppliers' industries. Similarly, suppliers to industries with declining growth opportunities may lobby for an increase in import tariffs to be protected from foreign competitors in times of declining demand. Krugman, Obstfeld, and Melitz (2015) argue that multilateral trade negotiations are less likely to be captured by lobbying groups than the decision making process behind unilateral policy changes.[14] Tariff changes due to multilateral trade agreements are thus more likely exogenous to changes in customers' investment opportunities.

In column (3), we thus only rely on large tariff reductions occurring in 1976, 1980, and 1995, following the implementation of the Generalized System of Preferences (GSP), the completion of the seventh and eighth General Agreement on Tariffs and Trade (GATT) rounds, and the start of the North American Free Trade Agreement (NAFTA) (see also Fresard and Valta (2016)). As in columns (1) and (2), we find a positive coefficient estimate on *Supplier Tariff Reduction* that is statistically significant at the 5% level.

The magnitude of the coefficient estimate in column (3), 0.053, is very similar to the magnitude

[14] The key argument is as follows. Unilateral trade liberalizations may face opposition from import-competing domestic producers, who stand to lose from a tariff reduction and are typically better informed and organized than the domestic consumers that stand to gain. In multilateral trade negotiations, domestic exporters provide a counterweight: They stand to gain from a liberalization of trade between the involved countries and are arguably as well informed and organized as the import-competing producers.

of the estimates in columns (1) and (2), 0.053 and 0.042, respectively. This finding suggests that a potential correlation between tariff reductions in upstream industries and unobserved growth opportunities of downstream customers resulting from industrial lobbying is unlikely to generate a quantitatively important bias in our estimations. At the same time, relying only on large tariff reductions in 1976, 1980, and 1995, as we do in column (3), ignores variation in hold-up problems between suppliers and customers stemming from large tariff reductions in other years. For this reason, throughout the paper, we exploit all large tariff reductions during the entire sample period.[15]

In column (4), we add *Supplier Tariff Increase* as an explanatory variable, the fraction of supplier industries that have experienced large tariff *increases* in the past.[16] Consistent with the steady decline in the average tariff rate during our sample period (Figure 1), large tariff increases are much less frequent than large tariff reductions: Between 1974 and 2012, there are 493 large reductions but only 55 large increases. As a consequence, estimates of the effect of large tariff increases on firms' investment decisions are significantly more noisy than estimates of the effect of large reductions.

Nevertheless, consistent with the predictions of our model, the coefficient estimate on *Supplier Tariff Increase* is negative and statistically significant (at the 10% level). The coefficient on *Supplier Tariff Reduction* remains positive and statistically significant (at the 5% level). The point estimate of the coefficient on *Supplier Tariff Increase* is noticeably larger in magnitude than the coefficient estimate on *Supplier Tariff Reduction*. However, the standard error of the estimate is large, and the null hypothesis that the magnitudes of the coefficient estimates on *Supplier Tariff Increase* and *Supplier Tariff Reduction* do not differ cannot be rejected at conventional levels.[17]

[15] Unreported analyses confirm that our findings are generally robust to using only large tariff reductions following multilateral trade agreements (as we do in column (3) of Table 2) in all our analyses.

[16] *Supplier Tariff Increase* is constructed analogously to *Supplier Tariff Reduction*.

[17] Specifically, the p-value of a Wald test of the hypothesis that the sum of the coefficients is equal to zero is 0.22.

In columns (5) and (6), we show that our results do not hinge on how exactly we measure tariff reductions or investment. In column (5), we replace *Supplier Tariff Reduction* with *Supplier Tariff Rate*, the weighted average tariff rate across all supplier industries of a given customer. In column (6), we replace *Capex/Assets* with the natural logarithm of capital expenditures, *Ln(Capex)*.[18] As predicted by our model, we find a negative and statistically significant coefficient estimate on *Supplier Tariff Rate* in column (5). Further, as in columns (1) to (4), the coefficient estimate on *Supplier Tariff Reduction* in column (6) is positive and statistically significant (at the 1% level).

5.2 Effect of Bargaining Power

We now examine how the increase in investment in response to tariff reductions in upstream industries depends on the customers' bargaining power vis-à-vis their suppliers (Prediction 2). Our first approach is to distinguish between large tariff reductions in supplier industries that are concentrated and in supplier industries that are dispersed. The idea is that suppliers in more concentrated industries have more bargaining power. At one end of the spectrum would be maximum concentration: an industry with a single, monopolistic supplier that has all the bargaining power vis-à-vis its customers. The polar opposite would be maximum dispersion: an industry with atomistic suppliers in perfect competition and zero bargaining power. Based on this intuition, we assess the suppliers' bargaining power by computing the Herfindahl-Hirschman Index (HHI) of sales in each industry and year. We then classify an industry-year combination as "concentrated" if the HHI is larger than the sample median. Otherwise, the industry is classified as "dispersed."

Our second approach is to test whether the estimated effect of tariff reductions varies with the customers' bargaining power. To do so, we measure the level of concentration in each customer's industry (using the HHI of sales) as well as the size of each customer (using the natural logarithm

[18]We show in the Appendix that our results are robust to using $Ln(Capex)$ throughout all analyses (Table A.3).

of total assets). We then add interaction terms between *Supplier Tariff Reduction* and *Customer Industry Concentration* and *Customer Size* to the regressions, expecting that both industry concentration and size increase a customer's bargaining power.

[Table 3 around here.]

Table 3 presents the results. All regressions include the full set of firm- and industry-level controls ($X_{i,j,t-1}$) specified in Equation (7).[19] To conserve space, we do not report the associated coefficient estimates and t-statistics.

Column (1) shows the estimation results obtained from the regression in which we distinguish between large tariff reductions in concentrated and in dispersed supplier industries. In this specification, we also control for the average level of concentration across all of a customer's supplier industries (*Avg. Supplier Industry Concentration*). The regression reveals a positive effect on customers' capital expenditures for large tariff reductions in concentrated supplier industries (statistically significant at the 1% level). In contrast, the estimated effect of large tariff reductions in dispersed supplier industries is close to zero and not statistically significant. The null-hypothesis that the effect of large tariff reductions in dispersed supplier industries is the same as in concentrated supplier industries is rejected at the 5% level by a Wald test (unreported).

In columns (2) and (3), we interact *Supplier Tariff Reduction* with *Customer Industry Concentration* and *Customer Size*. In line with our earlier results (Table 2), we find positive coefficient estimates on *Supplier Tariff Reduction* that are statistically significant at the 1% level in both columns. Further, we find negative coefficient estimates on the interactions with *Customer Industry Concentration* and *Customer Size* (both statistically significant at the 5% level). This result is consistent with the first column: The effect is stronger if *suppliers* have more bargaining power (column (1)) and thus weaker if *customers* have more bargaining power (columns (2) and (3)).

[19] Note that $X_{i,j,t-1}$ includes both proxies of customers' bargaining power, *Industry Concentration* and *Ln(Assets)*.

Overall, our findings support Prediction 2. Specifically, our findings imply that customers with higher bargaining power vis-à-vis their suppliers increase their investments less in response to large tariff reductions in upstream industries than customers with lower bargaining power.

5.3 Effect of Integration, Differentiation, and Uncertainty

We now test Predictions 3.a, 3.b, and 3.c. To do so, we distinguish between customers that are vertically integrated into their suppliers' industries and those that are not (Prediction 3.a). We also distinguish between suppliers that produce differentiated inputs and those that produce generic inputs (Prediction 3.b). Finally, we examine whether customers' response to large tariff reductions in their suppliers' industries is stronger if a higher level of uncertainty about future contingencies makes the use of comprehensive, long-term contracts more difficult (Prediction 3.c). Table 4 presents the results.

[Table 4 around here.]

In panel A, for each customer, we distinguish between large tariff reductions in supplier industries into which the customer is vertically integrated and large tariff reductions in supplier industries into which the customer is not vertically integrated. Our model predicts that customers increase their investments in response to tariff reductions if they are *not* vertically integrated with their suppliers. The reason is that, in this case, tariff reductions reduce hold-up problems. In contrast, our model predicts no reaction to tariff reductions if suppliers and customers *are* vertically integrated because, in that case, there is no hold-up problem to begin with.

In line with this argument, we find a significant effect of upstream tariff reductions only for customers that are *not* vertically integrated into their suppliers' industries. The difference between the estimated effects for customers that are not integrated and customers that are integrated is statistically significant at the 5% level (unreported). The empirical evidence thus supports Prediction 3.a.

In panel B we distinguish between supplier industries that produce differentiated inputs and those that produce generic inputs. We do so, because our model predicts an increase in customers' investments in response to tariff reductions if the suppliers produce differentiated inputs – but not if the inputs are generic. The intuition is as follows: Ex post bargaining about the price of differentiated inputs creates a hold-up problem that can be mitigated by import tariff reductions. If, instead, the inputs are perfectly generic and can be bought from a large number of suppliers at the same (quality adjusted) price, then there is no hold-up problem in the first place.

Following Barrot and Sauvagnat (2015), we classify a supplier industry as producing differentiated inputs if the average ratio of R&D expenditures to sales in the industry is higher than the sample median. Otherwise, the industry is classified as producing generic inputs. Based on this classification, we find a significant effect of large tariff reductions only if the suppliers produce differentiated inputs. In contrast, the estimated effect for suppliers producing generic inputs is close to zero and not statistically significant. These results are consistent with Prediction 3.b. However, while the point estimate is close to zero, the effect for suppliers producing generic inputs is estimated with low precision. As a consequence, the hypothesis that the effect of tariff reductions does not vary between differentiated and generic inputs cannot be rejected at conventional levels (unreported).

In panel C, we examine how the effect of large tariff reductions in upstream industries varies with the volatility of the customers' sales. The idea behind this analysis is as follows. There is no hold-up problem if the customer and the supplier can write a complete, long-term contract. However, such a contract is arguably more difficult to write if the level of uncertainty about relevant future contingencies is high. Hence, a high level of uncertainty is likely to inhibit the use of comprehensive, long-term contracts as a means to overcome the hold-up problem.

We thus predict that the effect of tariff reductions in upstream industries has a stronger effect on customers' investment decisions if the level of uncertainty about future contingencies is high (Prediction 3.c). Using *Customer Sales Volatility* as a proxy for such uncertainty, we find strong support for this prediction. The coefficient estimate on the interaction term between *Supplier Tariff Reduction* and *Customer Sales Volatility* is positive and statistically significant at the 1% level.[20]

6 Alternative Explanations for the Increase in Investment

We now discuss potential alternative explanations for our results and the extent to which these explanations can or cannot be reconciled with the empirical evidence that we find.

6.1 Lower Input Prices Resulting from Increased Import Competition

One concern is that import tariff reductions in upstream industries lead to more competition among suppliers, that increased competition leads to lower prices, and that customers respond to lower prices by increasing their investments – even if there is no hold-up problem. Suppose, for example, customers choose their investments to maximize $\Pi = f(i)\,[1-p] - i$, where the price p per unit of input is determined by monopolistic competition among suppliers, and $i \in \mathbb{R}_+$ is the level of investment. In that case, a tariff reduction that increases the level of competition among the suppliers leads to a lower price, and a lower price leads to an increase in investment.

However, while consistent with a general increase in investment, the above explanation is difficult to reconcile with the cross-sectional patterns in the data. In particular, we find that customers with higher bargaining power vis-à-vis their suppliers increase their capital expenditures less than

[20]Note that *Customer Sales Volatility* is estimated using the time-series of a customer's annual sales during the sample period. Hence, it is a constant for a given customer, and its main effect is absorbed by the firm fixed effects.

customers with lower bargaining power (Table 3). This result is consistent with the importance of hold-up problems for investment decisions (Prediction 2). It is inconsistent with the proposed alternative explanation, in which bargaining power does not play a role.

Consider, for example, the monopolistically competitive model of trade in Melitz and Ottaviano (2008). Liberalizing trade (e.g., reducing import tariffs) leads to increased competition and lower prices. Customers' bargaining power, however, does not matter because there is no bilateral bargaining between customers and suppliers. Instead, suppliers simply post prices at which they are willing to sell to any customer. Further, one would expect that if bargaining power were to play a role, customers with higher bargaining power should be able to demand larger price concessions after tariff reductions than customers with lower bargaining power. As a result, customers with higher bargaining power should increase their investments more than customers with lower bargaining power. The data reject this prediction.

Similarly, the alternative explanation that customers simply react to lower input prices that result from increased competition suggests that the effect of tariff reductions in upstream industries on downstream customers' investment decisions should be weaker if the suppliers produce differentiated rather than generic inputs. The reason is that product differentiation shields domestic suppliers from foreign competition (Hombert and Matray (2016)). As a consequence, import tariff reductions in industries that produce differentiated goods should lead to smaller reductions in input prices and smaller increases in customers' investments. We, however, find that the increase in customers' investments is driven by tariff reductions in supplier industries that produce differentiated inputs (Table 4, Panel B). This is consistent with the importance of hold-up problems (Prediction 3.b) but inconsistent with the alternative explanation.

Finally, we show that the effect of import tariff reductions in upstream industries on the investment decisions of downstream firms is driven by customers that are not vertically integrated and more pronounced if the use of comprehensive, long-term contracts is made more difficult by a higher level of uncertainty about future contingencies (Table 4, Panels A and C). These results are predicted by the importance of hold-up problems for investment decisions (Predictions 3.a and 3.c). In contrast, the alternative explanation that tariff reductions simply lead to lower prices that, in turn, lead to more investment does not predict this cross-sectional variation.

6.2 Relaxation of Financial Constraints Due to Tariff Reductions

Another concern is that our findings may be explained by an effect of tariff changes in upstream industries on downstream customers' financial constraints. For example, upstream tariff reductions may lead to lower input prices, make downstream customers more profitable, and through this channel affect the customers' ability to finance additional investments.

To mitigate this concern, we examine sub-samples of customers that are unlikely to be financially constrained. Specifically, we restrict attention to (i) firms that pay dividends, (ii) firms with a KZ-index (Kaplan and Zingales (1997)) that is smaller than the sample median, and (iii) firms with a WW-index (Whited and Wu (2006)) that is smaller than the sample median. Under the alternative explanation that large tariff reductions in their suppliers' industries affect customers' investment decisions through their effect on the customers' financial constraints, we should not find any effect when focusing on sub-samples of presumably unconstrained firms.

[Table 5 around here.]

Table 5 shows that we find positive coefficient estimates on *Supplier Tariff Reduction* in all three sub-samples of financially unconstrained customers (statistically significant at the 1% level in column (1) and at the 5% level in columns (2) and (3)). The magnitude of the estimated coefficients is similar to the magnitude of the coefficients reported in Table 2. These findings are inconsistent with the alternative explanation that our results are driven by changes in customers' financial constraints.

7 Further Implications: Effect on Premiums in Vertical Mergers

We argue that tariff reductions in upstream industries reduce hold-up problems between customers and suppliers and, as a consequence, lead to an increase in customer investment. The results of our empirical analysis support this argument: Downstream customers indeed increase their investments in response to import tariff reductions in upstream industries. In this section, we examine an additional, closely related implication of our model. Specifically, we test the prediction that tariff reductions in upstream industries reduce acquisition premiums in vertical mergers.

The intuition is as follows. Hold-up problems between customers and suppliers lead to inefficiently low investment levels. Vertical integration reduces hold-up problems and leads to more efficient investment decisions, thus creating a surplus (relative to non-integration). This surplus is reflected in the acquisition premiums paid in vertical mergers (e.g., Grossman and Hart (1980)). Tariff reductions in upstream industries reduce hold-up problems and, through this channel, the surplus created by vertical mergers. As a consequence, upstream tariff reductions reduce the premiums paid in such mergers:[21]

> ***Prediction 4:*** *Tariff reductions in upstream industries lead to a reduction in acquisition premiums paid in vertical mergers.*

To test this prediction, we rely on information from the SDC Dealscan database from 1978 (the first year in the database) to 2012 (the end of our sample period). We retain only completed acquisitions of majority stakes ($> 50\%$) in public U.S. targets by U.S. acquirers and exclude bankrupt

[21] We formalize this intuition in the Appendix.

targets, LBOs, share repurchases, and targets with a market capitalization less than USD 10 million or a stock price less than USD 1 (both measured 45 days prior to the announcement of the acquisition). We then merge this data with information from Compustat and CRSP. Finally, we compute the relative acquisition premium (*Rel. Prem.*) for each deal as the natural logarithm of the price per share paid by the acquirer divided by the target's share price 45 days before the announcement of the deal. We also compute the absolute acquisition premium (*Abs. Prem.*) defined as the natural logarithm of the total price paid by the acquirer minus the market value of the acquired stake 45 days before the acquisition announcement.

To measure the extent to which an acquisition constitutes a vertical merger, we compute the percentage of inputs used in the acquirer's industry that are supplied by the target's industry.[22] The resulting variable is denoted *Percentage of Acquirer Inputs Supplied by Target Industry.* A higher value of this variable indicates a higher degree of "vertical relatedness" between the target and the acquirer. Similarly, we compute the percentage of inputs used in the target's industry that are supplied by the acquirer's industry and denote this variable *Percentage of Target Inputs Supplied by Acquirer Industry.*

To assess whether tariff reductions in upstream industries reduce acquisition premiums in vertical mergers as we predict, we then regress the premiums on variables indicating whether or not the target's or the acquirer's industry has experienced a large tariff reduction in prior years, the percentage of inputs supplied by the target's to the acquirer's industry and vice versa, and interactions

[22]To do so, we rely on the gross flows of goods between industries as reported in the 1992 BEA input-output table.

between these variables. That is, we estimate OLS regression of the following form:

$$\begin{aligned} \textit{Premium} \quad = \quad & \beta_1 \cdot \textit{Tariff Reduction in Target Industry} \\ & \quad \times \textit{Percentage of Acquirer Inputs Supplied by Target Industry} \\ & + \beta_2 \cdot \textit{Tariff Reduction in Acquirer Industry} \\ & \quad \times \textit{Percentage of Target Inputs Supplied by Acquirer Industry} \\ & + \beta_3 \cdot \textit{Tariff Reduction in Target Industry} \\ & + \beta_4 \cdot \textit{Percentage of Acquirer Inputs Supplied by Target Industry} \\ & + \beta_5 \cdot \textit{Tariff Reduction in Acquirer Industry} \\ & + \beta_6 \cdot \textit{Percentage of Target Inputs Supplied by Acquirer Industry} \\ & + \gamma' \textit{Controls} + \textit{Target Industry FE} + \textit{Year of Announcement FE} + \varepsilon. \end{aligned} \tag{8}$$

Controls is a vector of control variables that are commonly used in the M&A literature (e.g., Betton, Eckbo, and Thorburn (2008)): *Target Size*, *Target Book-to-Market > Industry Median*, *Target Runup*, *Amihud Liquidity*, *Positive Toehold*, *Public Acquirer*, *Same Industry*, *Tender Offer*, *All Cash*, and *Hostile Response*.[23] *Target Industry FE* are fixed effects based on the four-digit SIC code of the target. *Year of Announcement FE* are fixed effects based on the year during which the acquisition is announced. The acquisition premium and all continuous control variables are winsorized at the 1st and 99th percentile. All standard errors are clustered by year.

[Table 6 around here.]

Table 6 presents the results. We estimate the effect on the relative premium (*Rel. Prem.*) in columns (1) and (2) and on the absolute premium (*Abs. Prem.*) in columns (3) and (4). In columns (2) and (4), we replace the industry and year fixed effects with indicators for each possible

[23]We provide detailed descriptions of these variables in the Appendix.

industry-year combination.[24] All regressions include the control variables specified in Equation (8). To conserve space, we do not report the associated coefficient estimates and t-statistics.

In all four columns, the coefficient estimate on the interaction term between *Tariff Reduction in Target Industry* and *Percentage of Acquirer Inputs Supplied by Target Industry* is negative and statistically significant (at the 1% level in columns (1) and (3) and at the 5% and 10% level in columns (2) and (4), respectively). This result supports Prediction 4. Further, the coefficient estimate on *Percentage of Acquirer Inputs Supplied by Target Industry* is positive and statistically significant in all four columns. This finding supports the premise that vertical mergers create a surplus that is reflected in the premium paid by the acquirer.

In contrast to the results related to tariff reductions in the target's industry, we find no evidence of an effect of tariff reductions in the acquirer's industry: The coefficient on the interaction term between *Tariff Reduction in Acquirer Industry* and *Acquirer to Target Flow* is not statistically significant. Overall, however, Table 6 provides evidence that is consistent with our prediction: Firms indeed pay lower premiums when acquiring upstream suppliers after large tariff reductions in the suppliers' industries.

8 Conclusion

Hold-up problems between customers and suppliers have long been recognized in the theoretical literature as an important impediment to corporate investment (Williamson (1975); Klein, Crawford, and Alchian (1978); Grossman and Hart (1986); Hart and Moore (1990)). Direct empirical evidence of an effect of hold-up problems on investment decisions, however, is very scarce. To provide such evidence, we examine how the capital expenditures of downstream customers respond

[24]Note that the industry-year fixed effects absorb the variable *Tariff Reduction in Target Industry*. Further, the number of observations is lower in this specification because not all industry-year cells contain multiple observations.

to large import tariff reductions in upstream industries. The intuition behind this approach is that such tariff reductions improve customers' bargaining position vis-à-vis their upstream suppliers and thus mitigate hold-up problems.

A simple model in the spirit of Hart (1995), which we use as a framework for our analysis, predicts that customers increase their investments after tariff reductions in their suppliers' industries. Further predictions are that the increase in investment varies with the customers' bargaining power, that the increase is stronger if the suppliers produce differentiated rather than generic inputs, and that the increase is driven by customers that are not vertically integrated into their suppliers' industries. Finally, theory predicts that the increase in investment is stronger if a high level of uncertainty about future contingencies limits the use of comprehensive, long-term contracts. Our analysis of the investment decisions of U.S. firms in response to large import tariff reductions in manufacturing industries from 1974 to 2012 uncovers strong support for these predictions. To the best of our knowledge, we are the first to document this evidence.

We also explore the effect of import tariff reductions on the acquisition premiums paid in vertical mergers. The argument that tariff reductions in upstream industries alleviate hold-up problems between customers and suppliers implies that such tariff reductions decrease the benefits of vertical integration and, as a consequence, lead to a decline in the deal premiums paid in vertical mergers. Using information on mergers and acquisitions from the SDC Platinum database, we document that this is indeed the case.

An important implication of our empirical findings is that the level of vertical integration that we observe in equilibrium does not eliminate all hold-up problems. Hence, our results point towards significant barriers to firms' ability to overcome such problems through vertical integration or other contractual arrangements. An interesting avenue for future research is to study these barriers.

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Figure 1: Average Import Tariff Rate in U.S. Manufacturing Industries (SIC codes 2000 to 3999) from 1974 to 2012

This figure shows the (equally weighted) average import tariff rate (in percent) across all U.S. manufacturing industries in our data (SIC codes 2000 to 3999) in each year from 1974 to 2012. Import tariff rates for each industry-year combination are computed as the total value of duties collected divided by the total value of imports. Data on the value of imports and duties are from Peter Schott's website (`http://faculty.som.yale.edu/peterschott/`) and the Center for International Data at UC Davis (`http://cid.econ.ucdavis.edu/`).

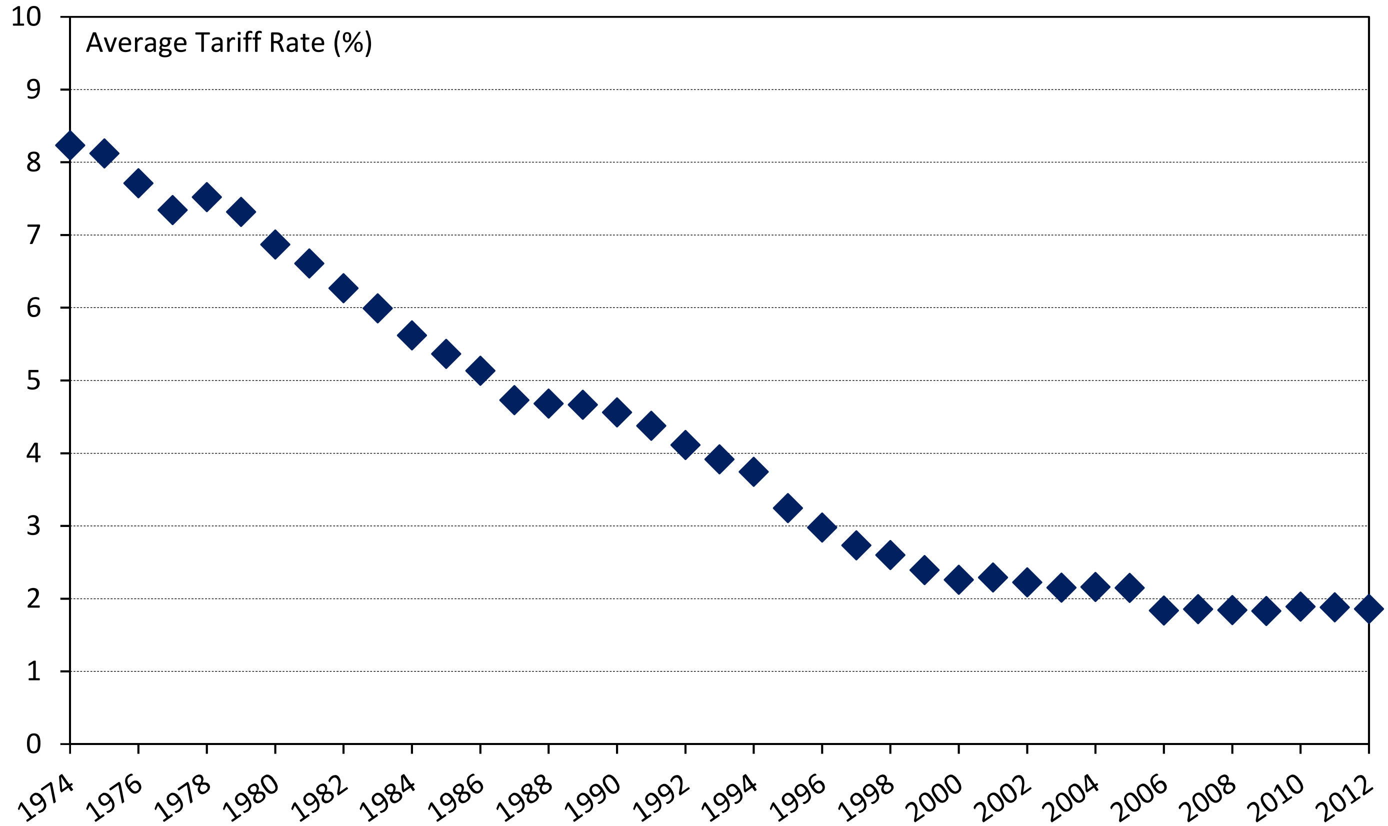

Figure 2: Number of Large Tariff Reductions in U.S. Manufacturing Industries (SIC codes 2000 to 3999) from 1974 to 2012

This figure shows the number of large import tariff reductions in manufacturing industries in the U.S. (SIC codes 2000 to 3999) for each year during the sample period from 1974 to 2012. Tariff rates for each industry-year combination are computed as the total value of duties collected divided by the total value of imports. Year-on-year tariff reductions are classified as "large" if they are more than three times as large as the average absolute year-on-year tariff change in the industry. Data on the value of imports and duties are from Peter Schott's website (`http://faculty.som.yale.edu/peterschott/`) and the Center for International Data at UC Davis (`http://cid.econ.ucdavis.edu/`).

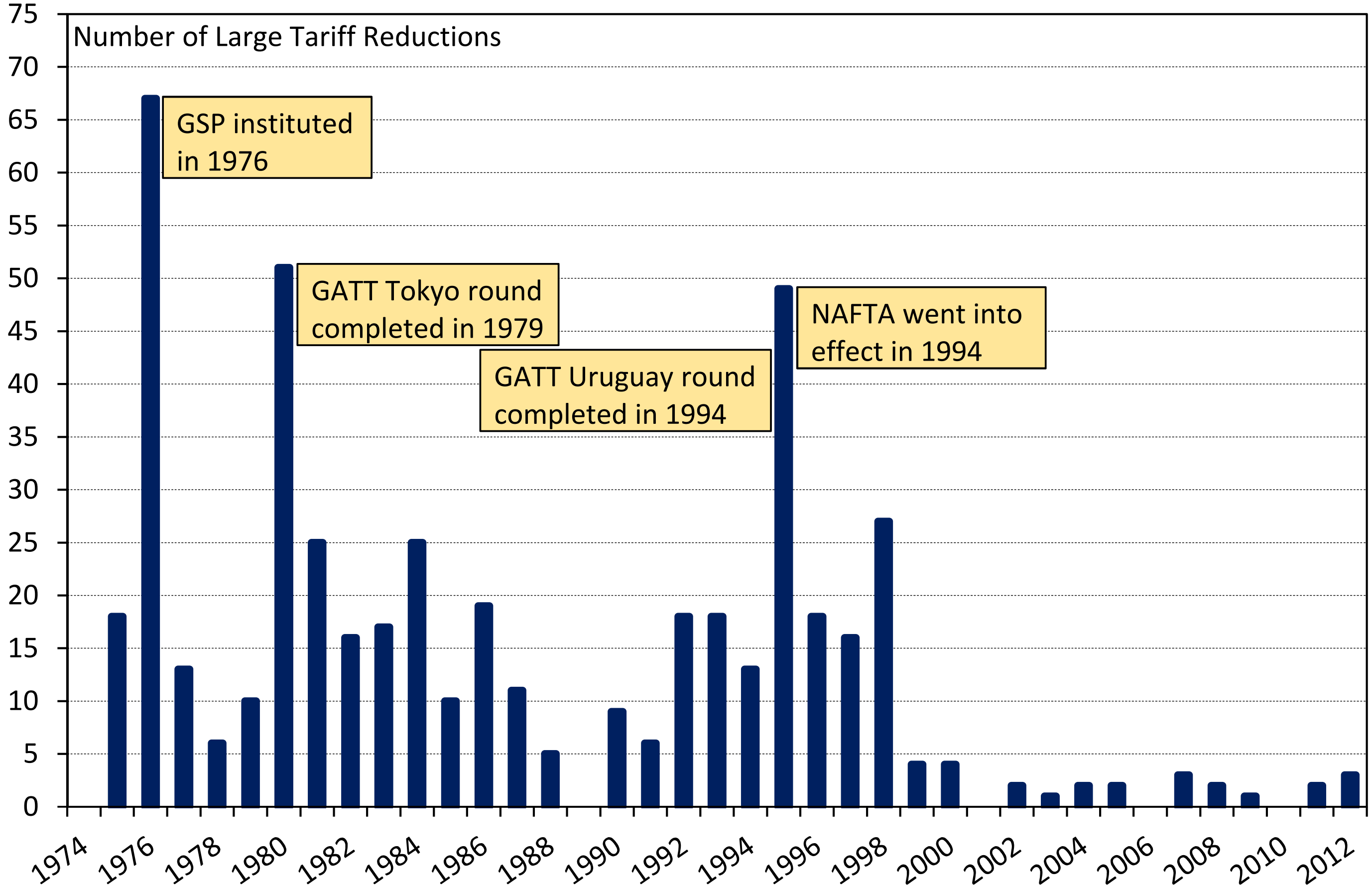

Figure 3: Average Tariff around Large Tariff Reductions in U.S. Manufacturing Industries (SIC codes 2000 to 3999) from 1974 to 2012

This figure shows the (equally weighted) average import tariff rate (in percent) around large tariff reductions in U.S. manufacturing industries (SIC codes 2000 to 3999) during the sample period from 1974 to 2012. Tariff rates for each industry-year combination are computed as the total value of duties collected divided by the total value of imports. Year-on-year tariff reductions are classified as "large" if they are more than three times as large as the average absolute year-on-year tariff change in the industry. Data on the value of imports and duties are from Peter Schott's website (`http://faculty.som.yale.edu/peterschott/`) and the Center for International Data at UC Davis (`http://cid.econ.ucdavis.edu/`).

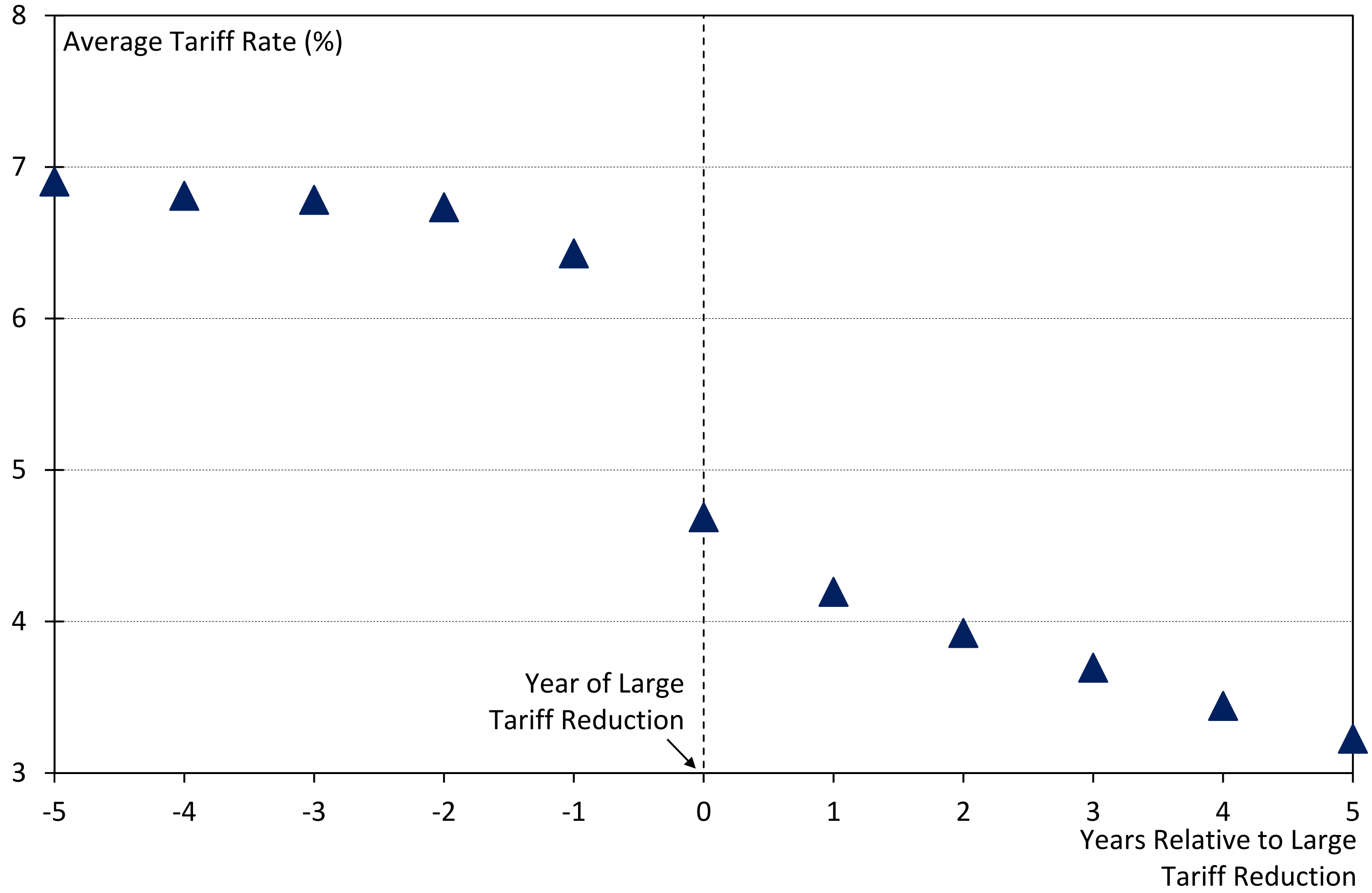

Table 1: Summary Statistics

This table presents summary statistics for our sample of 44,590 customer firm-year observations over the period from 1974 to 2012. For a given customer firm-year combination, *Supplier Tariff Reduction* is the fraction of supplier industries that have experienced large tariff reductions in the past. Detailed variable definitions are provided in the Appendix.

Variable	Observations	Mean	Std. Dev.	Min.	25%	Median	75%	Max.
Supplier Tariff Reduction	44,590	0.108	0.072	0.000	0.055	0.104	0.151	0.503
Capex/Assets	44,590	0.061	0.061	0.001	0.022	0.043	0.079	0.347
Assets (in USD million)	44,590	1,031	3,445	2	24	87	397	25,636
Ln(Assets)	44,590	4.676	2.061	0.688	3.179	4.466	5.984	10.152
Tobin's Q	44,590	1.985	1.732	0.560	1.015	1.391	2.191	11.010
Cash/Assets	44,590	0.190	0.221	0.001	0.030	0.097	0.270	0.911
Debt/Assets	44,590	0.201	0.180	0.000	0.039	0.172	0.312	0.783
EBITDA/Assets	44,590	0.060	0.226	-1.022	0.031	0.117	0.180	0.380
Cash Flow/Assets	44,590	-0.030	0.234	-1.226	-0.034	0.040	0.082	0.235
Sales Growth	44,590	0.195	0.564	-0.731	-0.023	0.101	0.254	3.939
Excess Return	44,590	0.037	0.713	-0.939	-0.376	-0.101	0.224	3.782
Excess Volatility	44,590	0.028	0.020	0.001	0.013	0.023	0.037	0.103
Industry Sales Growth	44,590	0.088	0.170	-0.364	-0.002	0.080	0.171	0.752
Industry Concentration (HHI)	44,590	0.274	0.193	0.055	0.135	0.217	0.362	0.922

Table 2: Effect of Large Import Tariff Reductions in Supplier Industries on Customers' Investment

This table presents coefficient estimates for the effect of large import tariff reductions in supplier industries on customers' capital expenditures. The sample period is 1974 to 2012. *Supplier Tariff Reduction (Increase)* is the fraction of supplier industries that have experienced large tariff reductions (increases) in the past. *Supplier Tariff Rate* is the weighted average import tariff rate across supplier industries. *Capx/At* is a customer's capital expenditures in year t scaled by the book value of total assets at the end of year t-1. *Ln(Capx)* is the natural logarithm of the customer's capital expenditures in year *t*. Detailed variable definitions are provided in the Appendix. Column (3) uses only large tariff reductions in 1976, 1980, and 1995, following the GSP implementation, completion of the seventh and eighth GATT rounds, and start of NAFTA. Standard errors are clustered by firm, and *t*-statistics are reported in parentheses. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:	Capx/At	Capx/At	Capx/At	Capx/At	Capx/At	Ln(Capx)
Supplier Tariff Reduction	0.053***	0.042**	0.053**	0.039**		0.861***
	(3.03)	(2.37)	(2.41)	(2.22)		(3.33)
Supplier Tariff Increase				-0.138*		
				(-1.79)		
Supplier Tariff Rate					-0.006**	
					(-1.97)	
Ln(Assets)		-0.011***	-0.011***	-0.011***	-0.011***	0.890***
		(-13.46)	(-13.58)	(-13.48)	(-13.48)	(66.84)
Tobin's Q		0.007***	0.007***	0.007***	0.007***	0.129***
		(16.60)	(16.63)	(16.58)	(16.64)	(19.92)
Cash/Assets		-0.006*	-0.006*	-0.006*	-0.006*	-0.280***
		(-1.83)	(-1.79)	(-1.81)	(-1.81)	(-4.48)
Debt/Assets		-0.038***	-0.038***	-0.038***	-0.038***	-0.722***
		(-11.91)	(-11.92)	(-11.91)	(-11.88)	(-11.97)
EBITDA/Assets		0.044***	0.044***	0.044***	0.044***	0.806***
		(10.27)	(10.22)	(10.27)	(10.26)	(9.53)
Cash Flow/Assets		-0.004	-0.004	-0.004	-0.004	0.043
		(-1.33)	(-1.28)	(-1.34)	(-1.31)	(0.67)
Sales Growth		0.004***	0.004***	0.004***	0.004***	0.082***
		(6.14)	(6.16)	(6.13)	(6.15)	(7.27)
Excess Return		0.004***	0.004***	0.004***	0.004***	0.076***
		(9.06)	(9.04)	(9.07)	(9.04)	(10.38)
Excess Volatility		-0.257***	-0.256***	-0.257***	-0.257***	-5.502***
		(-10.40)	(-10.35)	(-10.42)	(-10.41)	(-11.19)
Industry Sales Growth		0.006***	0.006***	0.006***	0.006***	0.081***
		(4.04)	(4.02)	(4.04)	(4.05)	(3.33)
Industry Concentration		0.002	0.004	0.002	0.002	0.058
		(0.48)	(0.91)	(0.52)	(0.46)	(0.82)
Firm & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.417	0.475	0.475	0.475	0.474	0.919
Observations	44,590	44,590	44,590	44,590	44,590	44,590

Table 3: Cross-Sectional Variation Depending on Customers' and Suppliers' Bargaining Power

This table presents coefficient estimates for the effect of large import tariff reductions in supplier industries on customers' capital expenditures. The sample period is 1974 to 2012. In column (1), we distinguish between tariff reductions in concentrated and in dispersed supplier industries. A supplier industry is classified as concentrated if the Herfindahl-Hirschman Index (HHI) of sales in the industry is larger than the sample median and as dispersed otherwise. *Avg. Supplier Industry Concentration* is the weighted average industry concentration across a customer's supplier industries. *Customer Industry Concentration* is the Herfindahl-Hirschman Index (HHI) of sales in the customer's industry. *Customer Size* is the natural logarithm of the book value of the customer's total assets. *Control Variables* is a vector of all firm- and industry-level control variables as specified in Equation (7) and includes *Customer Industry Concentration* and *Customer Size*. All other variables are defined as in Table 2. Detailed variable definitions are provided in the Appendix. Standard errors are clustered by firm, and t-statistics are reported in parentheses. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	(1)	(2)	(3)
Dependent Variable:	Capx/At	Capx/At	Capx/At
Supplier Tariff Reduction	0.053***		
(Concentrated Supplier Industry)	(2.82)		
Supplier Tariff Reduction	-0.008		
(Dispersed Supplier Industry)	(-0.24)		
Avg. Supplier Industry Concentration	0.094		
	(1.40)		
Supplier Tariff Reduction		0.080***	0.109***
		(3.35)	(3.25)
Supplier Tariff Reduction		-0.113**	
× Customer Industry Concentration (HHI)		(-2.50)	
Supplier Tariff Reduction			-0.010**
× Customer Size (Ln(Assets))			(-2.06)
Control Variables	Yes	Yes	Yes
Firm & Year Fixed Effects	Yes	Yes	Yes
R^2	0.475	0.475	0.475
Observations	43,779	44,590	44,590

Table 4: Cross-Sectional Variation Depending on Vertical Integration, Input Differentiation, and Contingency Uncertainty

This table presents coefficient estimates for the effect of large import tariff reductions in supplier industries on customers' capital expenditures. The sample period is 1974 to 2012. In panel A, we distinguish between tariff reductions in supplier industries into which the customer is vertically integrated and in supplier industries into which the customer is not vertically integrated. *Avg. Customer Integration* is the fraction of supplier industries into which the customer is vertically integrated. In panel B, we distinguish between tariff reductions in supplier industries producing differentiated inputs and in supplier industries producing generic inputs. A supplier industry is classified as producing differentiated inputs if the average ratio of R&D expenditures divided by sales in the industry is larger than the sample median and as producing generic inputs otherwise. *Avg. Supplier Differentiation* is the fraction of a customer's supplier industries that are classified as producing differentiated inputs. In panel C, we interact *Supplier Tariff Reduction* with *Customer Sales Volatility*, the demeaned standard deviation of the customer's annual sales over the sample period scaled by the customer's average sales. *Control Variables* is a vector of all firm- and industry-level control variables as specified in Equation (7). All other variables are defined as in Table 2. Detailed variable definitions are provided in the Appendix. Standard errors are clustered by firm, and t-statistics are reported in parentheses. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

Panel A: Vertical Integration		Panel B: Input Differentiation		Panel C: Contingency Uncertainty	
Dependent Variable:	Capx/At	Dependent Variable:	Capx/At	Dependent Variable:	Capx/At
Supplier Tariff Reduction	0.050**	Supplier Tariff Reduction	0.042**	Supplier Tariff Reduction	0.046**
(Customer Not Integrated)	(2.46)	(Differentiated Input)	(2.25)		(2.53)
Supplier Tariff Reduction	-0.070	Supplier Tariff Reduction	0.001	Supplier Tariff Reduction	0.188***
(Customer Integrated)	(-1.20)	(Generic Input)	(0.02)	× Customer Sales Volatility	(4.39)
Avg. Customer Integration	0.164***	Avg. Supplier Differentiation	-0.056		
	(3.18)		(-1.27)		
Control Variables	Yes	Control Variables	Yes	Control Variables	Yes
Firm & Year Fixed Effects	Yes	Firm & Year Fixed Effects	Yes	Firm & Year Fixed Effects	Yes
R^2	0.479	R^2	0.475	R^2	0.475
Observations	41,145	Observations	43,779	Observations	44,590

Table 5: Effect of Large Import Tariff Reductions on Financially Unconstrained Customers

This table presents coefficient estimates for the effect of large import tariff reductions in their suppliers' industries on customers' capital expenditures for three samples of customers that are unlikely to be financially constrained. In column (1), we focus on customers that pay out dividends. In column (2), we focus on customers whose Kaplan and Zingales (1997) index is smaller than the sample median. In column (3), we focus on customers whose Whited and Wu (2006) index is smaller than the sample median. The sample period is 1974 to 2012. *Control Variables* is a vector of all firm- and industry-level control variables as specified in Equation (7). All other variables are defined as in Table 2. Detailed variable definitions are provided in the Appendix. Standard errors are clustered by firm, and t-statistics are reported in parentheses. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	(1)	(2)	(3)
Sample:	Dividend Payers	KZ-Index $<$ Median	WW-Index $<$ Median
Dependent Variable:	Capx/At	Capx/At	Capx/At
Supplier Tariff Reduction	0.057***	0.049**	0.046**
	(2.74)	(2.29)	(2.25)
Control Variables	Yes	Yes	Yes
Firm & Year Fixed Effects	Yes	Yes	Yes
R^2	0.511	0.532	0.561
Observations	17,904	21,067	21,837

Table 6: Effect of Large Tariff Reductions on Acquisition Premiums in Vertical Mergers

This table presents coefficient estimates for the effect of large import tariff reductions on acquisition premiums in vertical mergers. The sample comprises completed acquisitions of majority stakes (> 50%) in public U.S. targets by U.S. acquirers between 1978 and 2012 in the SDC Dealscan database. We exclude bankrupt targets, LBOs, share repurchases, and targets with a market capitalization less than USD 10 million or a stock price less than USD 1 (both measured 45 days prior to the acquisition announcement). *Rel. Prem.* is the natural logarithm of the price per share paid by the acquirer divided by the target's shareprice 45 days before the acquisition announcement. *Abs. Prem.* is the natural logarithm of the total price paid by the acquirer minus the market value of the acquired stake (in USD million) 45 days before the acquisition announcement. *Tariff Reduction in Target (Acquirer) Industry* is an indicator that takes the value one if the target's (acquirer's) industry has experienced a large tariff reduction in prior years. *Percentage of Acquirer (Target) Inputs Supplied by Target (Acquirer) Industry* is the percentage of inputs used in the acquirer's (target's) industry that are supplied by the target's (acquirer's) industry. *Control Variables* is a vector of control variables: *Target Size*, *Target Book-to-Market > Industry Median*, *Target Runup*, *Amihud Liquidity*, *Positive Toehold*, *Public Acquirer*, *Same Industry*, *Tender Offer*, *All Cash*, and *Hostile Response*. Detailed variable definitions are provided in the Appendix. Standard errors are clustered by year, and t-statistics are reported in parentheses. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	(1)	(2)	(3)	(4)
Dependent Variable:	Rel. Prem.	Rel. Prem.	Abs. Prem.	Abs. Prem.
Tariff Reduction in Target Industry × Percentage of Acquirer Inputs Supplied by Target Industry	-0.050***	-0.146**	-0.136***	-0.380*
	(-2.94)	(-2.12)	(-3.00)	(-1.92)
Tariff Reduction in Target Industry	0.084		0.468*	
	(0.79)		(1.87)	
Percentage of Acquirer Inputs Supplied by Target Industry	0.044***	0.192***	0.114***	0.430**
	(3.88)	(2.97)	(3.54)	(2.21)
Tariff Reduction in Acquirer Industry × Percentage of Target Inputs Supplied by Acquirer Industry	0.013	0.001	0.057	-0.016
	(0.80)	(0.04)	(1.32)	(-0.18)
Tariff Reduction in Acquirer Industry	0.006	0.100	-0.012	0.113
	(0.14)	(0.96)	(-0.10)	(0.52)
Percentage of Target Inputs Supplied by Acquirer Industry	0.007	-0.011	0.011	0.009
	(0.47)	(-0.37)	(0.31)	(0.13)
Control Variables	Yes	Yes	Yes	Yes
Target Industry & Year Fixed Effects	Yes	No	Yes	No
Target Industry × Year Fixed Effects	No	Yes	No	Yes
R^2	0.446	0.692	0.843	0.886
Observations	503	181	478	167

Appendix to "Hold-up and Investment: Empirical Evidence from Tariff Changes"

Variable Definitions

Variable	**Definition**
Supplier Tariff Reduction	Fraction of supplier industries that have experienced large tariff reductions in the past. Source: Peter Schott's website, Center for International Data at UC Davis, 1992 BEA input-output table.
Capex/Assets	Capital expenditures (capx) in year t / total assets (at) in year $t-1$. Source: Compustat.
Assets	Total assets (at). Source: Compustat.
Ln(Assets)	Natural logarithm of total assets (at). Source: Compustat.
Tobin's Q	[Total assets (at) - book value equity (ceq) + market value of equity (chso*prcc_f)] / total assets (at). Source: Compustat.
Cash/Assets	Total cash holdings (che) / total assets (at). Source: Compustat.
Debt/Assets	Total long-term and short-term debt (dllt + dlc) / total assets (at). Source: Compustat.
EBITDA/Assets	EBITDA (ebitda) / total assets (at). Source: Compustat.
Cash Flow/Assets	Income before extraordinary items (ibc) / total assets (at). Source: Compustat.
Sales Growth	[Sales (sale) in year t / Sales in year $t-1$] - 1. Source: Compustat.
Excess Return	Stock Return ([prcc_f / prcc_f_{t-1}] - 1) - Market Return ([usdval / usdval_{t-1}] - 1). Source: Compustat.
Excess Volatility	Yearly standard deviation of daily returns - yearly standard deviation of daily market returns. Source: CRSP.
Industry Sales Growth	Average sales growth in a given industry and year. Source: Compustat.
Industry Concentration	Herfindahl-Hirschman Index (HHI) of sales in a given industry. Source: Compustat.
Customer Sales Volatility	(Demeaned) standard deviation of a customer's annual sales scaled by the customer's average sales. Source: Compustat.

Variable	**Definition**
Dividend Payer	Dummy variable which takes on the value 1 if the firm paid a dividend in the previous year and 0 otherwise. Source: Compustat.
Kaplan-Zingales (KZ) Index	$-1.001909 * [(ib + dp)/ppent_{t\text{-}1}] + 0.2826389 * [(at + csho * prcc_f - ceq - txdb)/at] + 3.139193 * [(dltt + dlc)/(dltt + dlc + seq)]$ $-39.3678 * [(dvc + dvp/ppent_{t\text{-}1})] - 1.314759 * [che/ppent_{t\text{-}1}]$. Source: Compustat.
Whited-Wu (WW) Index	$-0.091 * [ibc/at] - 0.044 * ln(at) + 0.102 * industrysalesgrowth - 0.035 * salesgrowth - 0.062 * dividendpayer + 0.021 * [dltt/at]$. Source: Compustat.
Avg. Supplier Industry Concentration	Gross-flow weighted average of supplier industry concentration. For each downstream industry, we compute the fraction of inputs from each upstream industry using the 1992 BEA input-output table. We multiply this weight with the Herfindahl-Hirschman Index (HHI) of sales for each upstream industry-year combination. Then we sum across upstream industry-year combinations, excluding the downstream industry itself. Source: Compustat, 1992 BEA input-output table.
Avg. Customer Integration	Gross-flow weighted average of customer integration. Source: Compustat, 1992 BEA input-output table.
Avg. Supplier Differentiation	Gross-flow weighted average of supplier differentiation. Source: Compustat, 1992 BEA input-output table.
Rel. Prem.	Natural logarithm of the price per share paid by the acquirer divided by the target's shareprice 45 days before the acquisition announcement. Source: SDC Dealscan, CRSP.
Abs. Prem.	Natural logarithm of the total price paid by the acquirer minus the market value of the acquired stake (in USD million) 45 days before the acquisition announcement. Source: SDC Dealscan, CRSP.
Tariff Reduction in Target (Acquirer) Industry	Indicator equal to one if there has been a large tariff reduction in the target's (acquirer's) industry. Source: SDC Dealscan, Peter Schott's website, Center for International Data at UC Davis, 1992 BEA input-output table.
Percentage of Acquirer (Target) Inputs Supplied by Target (Acquirer) Industry	Percentage of inputs used in the acquirer's (target's) industry that are supplied by the target's (acquirer's) industry. Source: SDC Dealscan, 1992 BEA input-output table.
Target Size	Natural logarithm of the target's market capitalization (in USD million) 45 days before the acquisition announcement. Source: CRSP.

Variable	**Definition**
Target Book-to-Market > Industry Median	Indicator equal to one if the target's book-to-market ratio is larger than the industry median. Source: Compustat.
Target Runup	Natural logarithm of the target's share price 2 days before the acquisition announcement divided by the target's share price 45 days before the acquisition announcement. Source: CRSP.
Amihud Liquidity	Average value of $\|R_i\| / (P_i S_i)$ over the last 120 days starting 45 days before the acquisition announcement, where R_i is the stock return, P_i is the price, and S_i is the trading volume of target i. Source: CRSP.
Positive Toehold	Indicator equal to one if the acquirer has a positive toehold in the target before the acquisition. Source: SDC Dealscan.
Public Acquirer	Indicator equal to one if the acquirer is publicly listed. Source: SDC Dealscan.
Same Industry	Indicator equal to one if the target and the acquirer have the same 4-digit SIC code. Source: SDC Dealscan.
Tender Offer	Indicator equal to one if the acquisition technique is a tender offer. Source: SDC Dealscan.
All Cash	Indicator equal to one if the method of payment is 100% cash. Source: SDC Dealscan.
Hostile Response	Indicator equal to one if the target's response to the takeover bid is hostile. Source: SDC Dealscan.

Relaxing Assumptions of the Model to Derive Predictions 3.a-c

Vertical Integration. Suppose C and S are vertically integrated and operate as a single entity V that maximizes the joint surplus of C and S. In that case, the optimal investment at $t = 0$ is

$$i^V \in \arg\max_{i \in \mathbb{R}_+} f(i)\,(1-k) - i \tag{A1}$$

and equal to the first-best investment i^{FB} given by $f'(i^{FB}) = 1/\,(1-k)$, which does not depend on the tariff rate τ. Hence, tariff changes do not lead to changes in the level of investment. This result motivates Prediction 3.a.

Generic Input. Suppose the marginal return from C's investment does not depend on whether trade with S occurs because the required input is generic and can be bought from many alternative (domestic) suppliers whose opportunity cost per unit of input is k. C will then push down S to its reservation utility during the bargaining process, and the input price per unit will be $x = k$. C's optimal investment at $t = 0$ is then the first-best investment i^{FB} given by $f'(i^{FB}) = 1/\,(1-k)$ and does not depend on the tariff rate. Hence, tariff changes do not lead to changes in the level of investment. This result motivates Prediction 3.b.

Complete Contract. Suppose C and S can write a complete contract at $t = 0$. The optimal contract specifies the first-best investment level i^{FB} given by $f'(i^{FB}) = 1/\,(1-k)$ and an input price x given by

$$f(i^{FB})(1-x) - i^{FB} = f(\hat{i})\,[1-p(\tau)] - \hat{i} + \beta \left\{ f(i^{FB})(1-k) - i^{FB} - f(\hat{i})\,[1-p(\tau)] + \hat{i} \right\}, \tag{A2}$$

where $\hat{i}$ is given by $f'(\hat{i}) = 1/\,[1-p(\tau)]$. The quantity to be supplied is $q^{FB} = f(i^{FB})$.

The intuition is that C and S maximize the total surplus by specifying the first-best level of investment and set the price per unit of input so that C obtains its outside option plus a fraction

β of the gains from trade. With a complete contract, the investment is efficient, and bargaining between C and S just re-distributes the surplus. A crucial difference compared to the model with a hold-up problem is that C's investment does not depend on the tariff rate in this case. Hence, tariff changes do not lead to changes in the level of investment. This motivates Prediction 3.c.

Effect on premiums in vertical mergers (Prediction 4)

Denote the stand-alone values of C and S with V_C and V_S, respectively, and the value of the vertically integrated entity that maximizes the joint surplus of C and S with V_{C+S}. The joint (per-period) surplus $\Pi(i)$ for a given level of investment i is

$$\Pi(i) \equiv f(i)\,(1-x) - i + f(i)\,(x-k) = f(i)\,(1-k) - i. \tag{A3}$$

This implies that the vertically integrated entity optimally chooses the first-best investment i^{FB} given by $f'(i^{FB}) = 1/\,(1-k)$. The investment under non-integration is $i^* < i^{FB}$ (see Section 3). It follows that the per-period surplus created by vertical integration is positive, i.e., $\Pi(i^{FB}) - \Pi(i^*) > 0$. Hence, vertical integration creates a positive total surplus (relative to non-integration):[25]

$$\Delta \equiv V_{C+S} - V_C - V_S > 0. \tag{A4}$$

$\Pi(i)$ is increasing in i for $i < i^{FB}$, and i^* is decreasing in the tariff rate τ, i.e., $di^*/d\tau < 0$ (see Section 3). The surplus created by vertical integration is thus increasing in τ, i.e., $d\Delta/d\tau > 0$.

Consider now a model of corporate takeovers in which the acquisition premium is increasing in the surplus created by the merger (e.g., Grossman and Hart (1980)). In that case, import tariff reductions in upstream industries lead to a reduction in the premiums paid in vertical mergers. This result motivates Prediction 4.

[25]We model only a single period. In general, the total surplus is the present value of the per-period surplus in all future periods. There is no uncertainty in our model, so the appropriate discount rate is the risk-free rate.

Table A.1: Regression Results Using Non-Winsorized Variables

This table displays the key coefficient estimates when using non-winsorized variables in all analyses. "Corresponds to: T.X.(Y)" indicates that the corresponding regression using winsorized variables is reported in column (Y) of Table X. T.4.Z indicates Panel Z of Table 4. All regressions are specified as in the corresponding tables. We only report the key coefficients to conserve space. Standard errors are clustered by firm, and t-statistics are reported in parentheses. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

DV.: Capx/At	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Corresponds to:	T.2.(1)	T.2.(2)	T.2.(3)	T.2.(4)	T.2.(5)	T.3.(1)	T.3.(2)	T.3.(3)	T.4.A	T.4.B	T.4.C	T.4.(1)	T.4.(2)	T.4.(3)
Supplier Tariff	0.051***	0.041**	0.066***	0.037**			0.094***	0.056			0.048**	0.062***	0.057***	0.056***
Reduction (STR)	(2.71)	(2.17)	(2.65)	(1.97)			(3.63)	(1.41)			(2.42)	(2.98)	(2.58)	(2.63)
Supplier Tariff				-0.196**										
Increase				(-2.23)										
Supplier Tariff					-0.004									
Rate					(-1.23)									
STR						0.055***								
(Conc. Suppliers)						(2.67)								
STR						-0.018								
(Disp. Suppliers)						(-0.50)								
STR							-0.156***							
× Cust. Conc.							(-3.08)							
STR								-0.002						
× Cust. Size								(-0.41)						
STR									0.046**					
(Cust. Not Int.)									(2.01)					
STR									-0.031					
(Cust. Integr.)									(-0.51)					
STR										0.041**				
(Differentiated)										(2.04)				
STR										0.006				
(Generic)										(0.09)				
STR											0.281***			
× Cust. Sales Vol.											(4.94)			
Control Variables	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm & Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.349	0.388	0.388	0.388	0.388	0.388	0.388	0.388	0.388	0.388	0.389	0.482	0.483	0.514
Observations	44,590	44,590	44,590	44,590	44,590	43,779	44,590	44,590	41,145	43,779	44,590	17,904	21,067	21,837

Table A.2: Regression Results Using Alternative Clustering Levels

This table displays the key coefficient estimates reported in Table 2 and the associated t-statistics for alternative clustering levels (in parentheses). The first t-statistic reported under each coefficient estimate is based on standard errors that are clustered by industry×year. The second t-statistic is based on standard errors that are (two-way) clustered by firm and by industry×year. The third is based on standard errors that are (two-way) clustered by firm and by year. The fourth is based on standard errors that are clustered by industry. The fifth is based on standard errors that are (two-way) clustered by industry and by year. All regressions are specified as in Table 2. We only report the key coefficients to conserve space. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:	Capx/At	Capx/At	Capx/At	Capx/At	Capx/At	Ln(Capx)
Supplier Tariff Reduction	0.053	0.042	0.053	0.039		0.861
(Cluster: Industry×Year)	(4.17)***	(3.57)***	(3.67)***	(3.32)***		(5.42)***
(Cluster: Firm & Ind.×Year)	(2.79)***	(2.23)**	(2.33)**	(2.09)**		(3.18)***
(Cluster: Firm & Year)	(2.91)***	(2.38)**	(2.41)**	(2.23)**		(3.07)***
(Cluster: Industry)	(2.37)**	(1.88)*	(2.49)**	(1.75)*		(2.82)***
(Cluster: Industry & Year)	(2.45)**	(1.96)*	(2.59)**	(1.83)*		(2.74)***
Supplier Tariff Increase				-0.138		
(Cluster: Industry×Year)				(-2.76)***		
(Cluster: Firm & Ind.×Year)				(-1.73)*		
(Cluster: Firm & Year)				(-1.60)		
(Cluster: Industry)				(-1.79)*		
(Cluster: Industry & Year)				(-1.66)		
Supplier Tariff Rate					-0.006	
(Cluster: Industry×Year)					(-3.03)***	
(Cluster: Firm & Ind.×Year)					(-1.87)*	
(Cluster: Firm & Year)					(-1.94)*	
(Cluster: Industry)					(-1.69*	
(Cluster: Industry & Year)					(-1.74)*	
Control Variables	No	Yes	Yes	Yes	Yes	Yes
Firm & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.417	0.475	0.475	0.475	0.474	0.919
Observations	44,590	44,590	44,590	44,590	44,590	44,590

Table A.3: Regression Results Using *Ln(Capx)* as the Dependent Variable

This table displays the key coefficient estimates when using *Ln(Capx)* as the dependent variable. "Corresponds to: T.X.(Y)" indicates that the corresponding regression using *Capx/At* as the dependent variable is reported in column (Y) of Table X. T.4.Z indicates Panel Z of Table 4. All regressions are specified as in the corresponding tables. We only report the key coefficients to conserve space. Standard errors are clustered by firm, and *t*-statistics are reported in parentheses. Statistical significance at the 1%, 5%, and 10% level is denoted by ***, **, and *, respectively.

DV: Ln(Capx)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Corresponds to:	T.2.(1)	T.2.(3)	T.2.(4)	T.2.(5)	T.3.(1)	T.3.(2)	T.3.(3)	T.4.A	T.4.B	T.4.C	T.4.(1)	T.4.(2)	T.4.(3)
Supplier Tariff	0.256	0.756**	0.792***			1.299***	1.136*			0.934***	0.964***	0.917***	0.770***
Reduction (STR)	(0.55)	(2.40)	(3.05)			(3.40)	(1.93)			(3.43)	(3.85)	(3.31)	(3.06)
Supplier Tariff			-3.884**										
Increase			(-2.57)										
Supplier Tariff				-0.097*									
Rate				(-1.78)									
STR					1.000***								
(Conc. Suppliers)					(3.48)								
STR					0.452								
(Disp. Suppliers)					(0.99)								
STR						-1.303*							
× Cust. Conc.						(-1.77)							
STR							-0.041						
× Cust. Size							(-0.52)						
STR								0.827***					
(Cust. Not Int.)								(2.87)					
STR								0.518					
(Cust. Integr.)								(0.42)					
STR									0.903***				
(Differentiated)									(3.29)				
STR									0.351				
(Generic)									(0.39)				
STR										3.028***			
× Cust. Sales Vol.										(4.00)			
Control Variables	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm & Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.869	0.919	0.919	0.919	0.919	0.919	0.919	0.918	0.919	0.919	0.947	0.942	0.917
Observations	44,590	44,590	44,590	44,590	43,779	44,590	44,590	41,145	43,779	44,590	17,904	21,067	21,837