The Downstream Impact of Upstream Tariffs: Evidence from Investment Decisions in Supply Chains

Abstract

We study how US manufacturing firms' investment responds to tariff reductions in supplier industries. Our estimates, based on tariff reductions following multinational trade agreements, suggest that a hypothetical 10% reduction of all upstream tariffs would increase downstream investment by 4% to 6%. This estimate is not explained by decreasing uncertainty and stems from tariff reductions for homogeneous and low-R&D inputs, consistent with the investment response resulting from cost reductions rather than superior foreign technology embodied in imported inputs. Evidence from an instrumental variable estimation using the sudden increase in Chinese import penetration suggests that import competition also increases downstream investment.

JEL Classification: F14, F23, G31

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1 Introduction

Protectionist trade policies in the form of higher import tariffs have recently gained in political popularity. While such policies help some domestic industries by sheltering them from foreign competition, they hurt others by increasing the price of imported inputs that are needed for production. For example, import tariffs on steel may help domestic steel producers but hurt downstream firms that use steel. Consequently, as their input costs increase, steel-using firms may reduce their investment in productive capacity (e.g., decide not to build a new factory). Given that trade in intermediate inputs accounts for as much as two thirds of all international trade (Johnson and Noguera 2012), understanding such consequences is important.

In this paper, we study the impact of upstream tariffs on downstream investment in US manufacturing firms. The reason for our focus on firms' investment is twofold: First, investment is a major driver of economic growth (De Long and Summers 1991; Mankiw et al. 1992) and therefore provides a natural link between trade policies today and future economic prosperity. Understanding how tariffs affect investment is thus of high importance. Second, the prime benefit of lower tariffs in highly developed economies like the US is presumably a lower cost of imported goods. Hence, as lower input costs increase the value of productive capacity, an intuitive prediction is that tariff reductions lead to an increase in downstream investment.

Theoretically, however, the relation between upstream tariffs and downstream investment can be ambiguous (e.g., Acemoglu et al. 2016): On the one hand, lower tariffs upstream may entail lower input costs downstream and lead to more investment. On the other hand, lower tariffs may increase the risk that domestic suppliers succumb to competition and go out of business, leading to supply chain disruptions, which may reduce firms' willingness to invest in productive capacity.

Overall, our empirical findings suggest that the former effect dominates. Specifically, we estimate that a hypothetical 10% decrease of all import tariffs in manufacturing industries (e.g., from 5% to 4.5%) would lead to an increase in downstream investment by 4% to 6% (relative to the mean). Put differently, our findings suggest that a 10% decrease in import tariffs, which we estimate to reduce downstream input costs by about 1%, would enlarge the downstream firms' investment opportunity set and that the investment required to undertake the new projects would amount to 4% to 6% of the firms' total investment. In terms of timing, we find that the increase in investment starts showing up in year two following the tariff reductions and lasts until the end of our sample period, seven years later, thus suggesting a long-lived rather than transitory impact.

The increase in investment, however, need not be efficient but could reflect over-investment. It is difficult to empirically distinguish optimal from over-investment, but we provide some suggestive evidence that our findings are not due to over-investment. First, we examine the relation between upstream tariff reductions and downstream profitability and productivity, which we would expect to decline following over-investment. Our tests, however, do not support this prediction. Instead, we find evidence pointing in the other direction, i.e., that profitability and productivity increase. Second, we find that the overall increase in investment stems from firms with higher increases in profitability and productivity and firms with stronger corporate governance (as proxied by higher institutional ownership). Both findings seem less consistent with over-investment.

In a number of further tests, we find that the average impact of upstream tariff reductions on downstream investment masks significant cross-sectional variation. In particular, the increase in investment is stronger for firms whose input costs account for a larger share of their overall production costs and for users of homogeneous, low-R&D inputs (e.g., cement). These results suggest that, for US firms, input cost reductions are the primary reason for the increase in investment, rather than improved access to superior foreign technology embodied in imported goods. As such, the cross-sectional variation that we find provides an important distinction between our paper, which studies firms in a highly industrialized economy (the US), and prior work on trade liberalizations in developing countries (e.g., Brazil, Indonesia, Chile, India), where the effects have been attributed to better access to foreign goods of greater quality and variety. We also find that the response to upstream tariff reductions is stronger in concentrated than in dispersed industries, i.e., when firms are likely to have more bargaining power vis-à-vis suppliers and customers. Finally, we find an increase in investment only for firms that are not financially constrained, suggesting that financing frictions can reduce the extent to which tariff cuts translate into increased downstream investment.

A concern is that tariffs may be endogenous to investment opportunities as policymakers may set import tariffs to protect domestic industries that have few growth opportunities. To help alleviate this concern, we exploit tariff revisions following multinational trade agreements. Krugman et al. (2015) suggest that these agreements are less likely to be influenced by lobbying. Arguably, they are thus less likely to reflect individual industries' growth opportunities (Frésard and Valta 2016). The idea is that the lobbying activities of exporters that stand to gain from freer trade may offset the lobbying activities of import-competing producers that stand to lose from a liberalization.

For our analysis, we thus rely on tariff revisions following the implementation of the Generalized System of Preferences (GSP) in 1976, tariff revisions agreed upon during the seventh General Agreement on Tariffs and Trade (GATT) round implemented from 1980 onwards, and tariff revisions due to the North American Free Trade Agreement (NAFTA) and the eighth GATT round implemented from 1994 and 1995 onwards. Specifically, we compare downstream firms' investment before and after these tariff revisions in a difference-in-differences (DiD) framework.

Reassuringly, we do not find any evidence that the tariff revisions are related to pre-treatment firm- or industry-characteristics. In particular, we find no evidence of a relation between the tariff revisions and observable proxies for downstream growth opportunities (Tobin's Q and sales growth) in the pre-treatment years. Controlling for these proxies does not affect our results either. Further, we find no evidence of differential pre-treatment trends in investment, i.e., no evidence of a relation between tariff revisions and downstream investment before the revisions are implemented.

We also address the concern that the trade agreements may have led not only to lower tariffs but also to lower uncertainty (e.g., due to the resolution of trade policy uncertainty) and that reductions in downstream uncertainty may explain our findings. Specifically, we show that, while lower uncertainty does translate into higher investment, controlling for reductions in downstream uncertainty has virtually no effect on the estimated impact of the upstream tariff reductions. Finally, we find that the estimated effect of upstream tariffs (which we construct for each SIC4-industry and year) is robust to the inclusion of SIC3$\times$year fixed effects. Time-varying differences between firms in different SIC3-industries can thus not explain the results.

In a second test to address endogeneity concerns, we rely on a different identification assumption and use data from a different setting and period. Specifically, we exploit the sudden increase in Chinese import penetration in US manufacturing industries between 1991 and 2011. Here, the identification strategy is based on the idea that the increase in imports from China is the result of economic reforms in the 1980s and 1990s in China and its accession to the World Trade Organization in 2001. This suggests that Chinese import penetration in other developed countries (which is presumably driven by the same economic reforms in China and its WTO accession) can be used as an instrument for Chinese import penetration in the US (Autor et al. 2013; Acemoglu et al. 2016; Hombert and Matray 2018). Using this approach, we find that higher Chinese import penetration in upstream industries leads to higher investment by downstream firms. This result is consistent with the following interpretation of our tariff-related findings: Lower import tariffs foster competition from foreign rivals, output prices fall, and downstream firms respond to the reduction in input costs by increasing investment. Further tests support this interpretation. We find that upstream tariff reductions are indeed followed by lower input material prices for downstream firms.

Our paper is related to work on the impact of freer trade in the US.[1] Autor et al. (2013) find that competition from China led to higher unemployment, reduced labor-force participation, and lower wages. Acemoglu et al. (2016) show that Chinese import competition was a key contributor to the decline in manufacturing employment in the 2000s. Pierce and Schott (2016) also focus on employment and link its decline to the granting of permanent normal trade relations to China.[2]

The aforementioned papers highlight that freer trade in the US leads to substantial adjustment costs. We look at the other side of the cost-benefit equation. Unlike the short-run adjustment costs that are concentrated among the directly affected industries, workers, and communities however, the long-run benefits are likely to be more dispersed. Hence, while potentially large in aggregate, the benefits of freer trade are likely to be small at the individual level and difficult to document. Our goal is to advance our understanding of these benefits by quantifying the impact of US tariff reductions for intermediate goods on the investment decisions of downstream firms that use these goods as inputs. Relative to prior findings that firms reduce their investment after trade liberalizations in their *own* industries (Frésard and Valta 2016; Pierce and Schott 2018), our contribution is

[1] Also related are recent papers on the US-China trade war of 2018 and 2019, including Amiti et al. (2019), Amiti et al. (2020a, 2020b), Fajgelbaum et al. (2020), Flaaen and Pierce (2019), and Flaaen et al. (2020).

[2] In a recent working paper, Bown et al. (2021) also focus on employment and find that antidumping duties against China reduced downstream employment. In one test using industry-level data, they also show a decline in investment, but they do not provide any firm-level evidence, nor do they examine any cross-sectional variation in the response.

thus to show how the response to tariff reductions propagates along the firms' supply chains.

Tariffs on intermediate goods have also been linked to total factor productivity (TFP). Specifically, the literature has found that, in developing countries, lower input tariffs are associated with higher TFP and attributes this relation to the superior foreign technology that is embodied in imported inputs and the greater variety of foreign inputs (Schor 2004; Amiti and Konings 2007; Kasahara and Rodrigue 2008; Goldberg et al. 2010; Topalova and Khandelwal 2011; Halpern et al. 2015). Our work is different because an increase in TFP is not the same as an increase in investment, and neither one necessitates the other.

Further, none of the aforementioned papers examine the impact on firms' investment. An exception is Kandilov and Leblebicioğlu (2012), who use Mexican data from 1984 to 1990 to show that reductions in tariffs and import license coverage on intermediate inputs result in higher investment. Several important features distinguish our analysis from theirs: First, unlike Mexico in the 1980s, the US are not a developing country and, as argued by Trefler (2004), it is not clear which results extend from developing/transitioning countries to highly industrialized economies like the US. Second, Kandilov and Leblebicioğlu (2012) estimate panel regressions on seven years of data around a single, unilateral trade liberalization. We, in contrast, exploit four multilateral trade agreements and estimate difference-in-differences models on thirty-one years of data (1971 to 2001). Third, because we use data on public firms that have observable share prices, we can control for proxies of growth opportunities and uncertainty (e.g., Tobin's Q, stock returns, and return volatility). Fourth, we not only examine how the downstream firms' response to upstream tariff reductions varies with the characteristics of the downstream firms themselves, but also how the downstream response depends on the characteristics of the upstream suppliers.

We proceed as follows. In Section 2, we describe the conceptual framework that guides our analysis and lay out the predictions. All formal derivations are provided in the Internet Appendix. In Section 3, we describe the data. In Section 4, we present the results. In Section 5, we conclude.

2 Conceptual Framework and Predictions

We have in mind firms that decide how much to invest in productive capacity by trading off the cost of investment with the expected payoff from producing more output. Upstream tariff reductions can affect this trade-off by increasing the expected profit per unit of output. This can occur through multiple, non mutually exclusive channels: First, lower upstream tariffs can reduce the firms' cost of producing the output by reducing the price at which they can buy input from their suppliers (De Loecker et al. 2016; Blaum et al. 2018). A lower tariff reduces, for example, the cost at which the input can be imported. It can also increase import competition, which can in turn lead to an increase in supplier productivity and thus a decrease in the marginal cost of producing the input (Melitz and Trefler 2012) or a reduction in the markup that the suppliers charge. Second, lower upstream tariffs can increase the quality or variety of the available input (Goldberg et al. 2010) and, through this channel, increase the price at which the downstream firms can sell their output. By increasing the expected profit per unit of output, upstream tariff reductions can thus increase the firms' incentives to invest in productive capacity. This motivates our main prediction:

Prediction 1 *Upstream tariff reductions entail an increase in downstream investment.*

The link between upstream tariffs and downstream investment in the above framework is the firms' supply chain: Lower upstream tariffs can increase the expected profit per unit of output by reducing the cost of input procured from upstream suppliers.[3] The cost of other resources not

[3]Note that increases in the input's quality or variety can also be interpreted as decreases in its quality-adjusted cost.

obtained from upstream suppliers (e.g., labor), however, should not be directly affected. Hence, upstream tariff reductions should have a larger effect on the expected profit per unit of output – and thus the incentives to expand productive capacity – if the input procured from upstream suppliers makes up a larger share of the overall production costs. This leads to the following prediction:

Prediction 2 *All else equal, upstream tariff reductions entail a larger increase in downstream investment if the firms' input costs account for a larger share of their overall production costs.*

Notwithstanding the above arguments, there are also reasons why upstream tariff reductions may not entail higher downstream investment: They could increase the risk of supply chain disruptions, which could in turn reduce firms' incentives to expand their productive capacity.

For concreteness, suppose that a downstream firm's supply chain is disrupted with some probability because its upstream supplier goes out of business. Suppose further that import tariff reductions increase this probability because they expose the supplier to more competition from abroad. If the supplier produced a homogeneous good (e.g., cement) and can be easily replaced with another (possibly foreign) supplier, then its demise is unlikely to have a significant impact on the downstream firm. If the supplier produced a differentiated good (e.g., industrial machinery) and cannot be easily replaced, however, then the supply chain disruption is likely to reduce the downstream firm's payoff. The reason is that the use of differentiated inputs is likely to require relationship-specific investments that loose some of their value if the supplier must be switched ex post. Any positive effect on the profit per unit of output conditional on the supplier's survival is thus mitigated by the increase in the risk that the supplier succumbs to foreign competition. Tariff reductions in upstream industries that produce differentiated goods are therefore likely to entail smaller increases in the downstream firms' incentives to expand their productive capacity. This motivates:

Prediction 3 *All else equal, upstream tariff reductions for homogeneous goods entail a larger increase in downstream investment than upstream tariff reductions for differentiated goods.*

The idea that upstream tariff reductions increase the downstream firms' profit per unit of output – and, hence, their incentives to expand productive capacity – rests on an implicit assumption: The firms can negotiate lower prices from their suppliers but do not need to pass on all of the cost savings to their own customers. Or they can negotiate higher prices from the customers but do not need to pass on all of the gains to the suppliers. That is, the firms must have some bargaining power. Otherwise, without bargaining power, they would not be able to appropriate any of the cost savings from lower import tariffs or would be forced to pass on any of the gains to their own customers. In that case, upstream tariff reductions would not change the downstream firms' profit per unit of output and, hence, would not change their incentives to expand their productive capacity. This suggests that the investment response to upstream tariff reductions should be more pronounced if the downstream firms have more bargaining power vis-à-vis their suppliers and customers:

Prediction 4 *All else equal, upstream tariff reductions entail a larger increase in downstream investment if the firms have more bargaining power vis-à-vis their suppliers and customers.*

All predictions so far implicitly assume that the downstream firms can finance new investments. If they are financially constrained, however, then they may not be able to expand their productive capacity because they cannot come up with the required up-front financing. Imagine, for example, that the firms' internal cash flows from existing operations are insufficient and that moral hazard or adverse selection problems limit the pledgeability of any future cash flows from new investments. In that case, the downstream firms may respond less to upstream tariff reductions.

On the other hand, the tariff reductions could also relax the firms' financial constraints, leading to a larger response. Imagine, for example, that lower upstream tariffs not only increase the attractiveness of new investments but also the cash flows from existing operations (e.g., through lower input costs). A firm that was already unconstrained before would then expand from the old to the new optimum. A firm whose investment was below the old (unconstrained) optimum because of financial constraints, however, may expand even more if it now also "catches up" on investments that it could not undertake before but that it can finance now due to the higher internal cash flows.

A priori, whether financial constraints reduce or increase firms' response to upstream tariff reductions is thus an empirical question. Consequently, we formulate the prediction as follows:

Prediction 5 *The increase in downstream investment in response to upstream tariff reductions differs, all else equal, between financially constrained and unconstrained downstream firms.*

3 Data

We obtain data on imports in US manufacturing industries (four-digit SIC codes 2000-3999) from the Center for International Data at UC Davis (`http://cid.econ.ucdavis.edu/`). The customs value of imports is available from 1972 and the value of import duties from 1974 onwards. We begin by computing the effective import tariff rate for each combination of an industry, year, and country of origin as the value of import duties divided by the customs value of imports. Thereafter, for each industry and year, we compute the average import tariff rate across the different countries of origin, using the customs values of imports as weights. The resultant variable, $\textit{Import Tariff}_{j,t}$, can thus be interpreted as the import-value-weighted average effective tariff rate in industry j and year t across the different countries of origin.

A potential concern is that changes in $\textit{Import Tariff}_{j,t}$ may not actually reflect changes in tariff rates but instead changes in the amounts of imports from different countries. To avoid this problem, when computing the implied changes in $\textit{Import Tariff}_{j,t}$ around the multinational trade agreements that we exploit in our subsequent tests, we hold the weight of each country of origin constant at the value of imports during the last year before the implementation of each trade agreement.

To construct upstream-downstream linkages (i.e., supplier-customer relations), we follow Acemoglu et al. (2016) and rely on the gross flows of goods between industries as reported in the US Bureau of Economic Analysis (BEA) input-output tables. An advantage of this approach is that the flows of goods between industries are likely to be determined by the industries' innate production technologies rather than individual firms' decisions to buy from a particular supplier. For example, unlike the use of steel in the production of industrial machinery in general, any given firm's choice to buy steel from a particular supplier may be driven by unobservable firm characteristics. Relying on industry- rather than firm-level upstream-downstream linkages helps mitigate such concerns.

Using the above data on industry-level import tariffs and upstream-downstream linkages, we then compute in each year and for each industry the gross-flow-weighted average import tariff in its upstream (i.e., supplier) industries. Specifically, for each industry j and year t, we compute

$$\textit{Up Tariff}_{j,t} = \sum_{s \in S_{\text{-}j}} \omega_{s,j} \times \textit{Import Tariff}_{s,t}. \tag{1}$$

$\textit{Import Tariff}_{s,t}$ is the tariff in industry s and year t, $S_{\text{-}j}$ is the set of all industries other than j, and

$$\omega_{s,j} = \frac{\textit{Gross flow of goods from industry } s \textit{ to industry } j}{\textit{Total gross flow of goods from all industries to industry } j}. \tag{2}$$

Analogously, we compute the average tariff in the downstream (i.e., customer) industries as

$$\textit{Down Tariff}_{j,t} = \sum_{s \in S_{\text{-}j}} \nu_{j,s} \times \textit{Import Tariff}_{s,t} \tag{3}$$

with

$$\nu_{j,s} = \frac{\textit{Gross flow of goods from industry } j \textit{ to industry } s}{\textit{Total gross flow of goods from industry } j \textit{ to all industries}}. \tag{4}$$

Similar to the above-discussed concern about changes in the amounts of imports from different countries when computing changes in $\textit{Import Tariff}_{j,t}$, a concern regarding changes in $\textit{Up Tariff}_{j,t}$ and $\textit{Down Tariff}_{j,t}$ is that these may reflect changes in the gross-flows of goods between industries. To avoid this problem, when computing the changes in $\textit{Up Tariff}_{j,t}$ and $\textit{Down Tariff}_{j,t}$ that we use in our difference-in-differences analysis, we fix the industry weights $\omega_{s,j}$ in (2) and $\nu_{j,s}$ in (4) at the values implied by the last available BEA input-output table before each trade agreement.

As in Baker et al. (2003), we measure firms' investment in a given year as capital expenditures scaled by the book value of total assets at the end of the previous year. We also construct the following firm- and industry-level control variables: *Ln(Assets)*, *Tobin's Q*, *Cash/Assets*, *Debt/Assets*, *EBITDA/Assets*, *Sales Growth*, *Excess Return*, *Excess Volatility*, *Industry Sales Growth*, and *Industry Concentration*. Definitions of all variables are in the Appendix. All data come from Compustat and CRSP, and all variables are winsorized at the 1st and 99th percentiles as in Baker et al. (2003). Using non-winsorized variables leads to similar results.

4 Results

4.1 Difference-in-Differences Estimation Around Multinational Trade Agreements

A concern when attempting to estimate the impact of upstream tariffs on downstream investment is that tariffs are not randomly assigned but the outcome of policy making. In particular, industry lobbyists may try to influence the tariff setting process, and the extent of the lobbying may depend on firms' growth opportunities. Whether such lobbying would lead to an upward or downward bias, however, is difficult to say. On the one hand, the upstream suppliers to declining industries with few growth opportunities may lobby for higher tariffs to be protected from foreign competition. On the other hand, the downstream customers may lobby for lower tariffs to obtain cheaper inputs from abroad. We further note that any individual industry typically accounts for only a small fraction of any other industry's total sales or purchases. Indeed, Table A.1 in the Internet Appendix reveals that even the most important downstream (upstream) industry in terms of purchase (sales) volume accounts, on average, for only 7% (9%) of the upstream (downstream) industry's total sales (purchases). This evidence helps reduce the concern that the growth opportunities in any one industry are the key driver behind the lobbying efforts aimed at influencing upstream import tariffs.

Nonetheless, to alleviate the concern that lobbying efforts may confound our analysis, we use a difference-in-differences framework that exploits tariff revisions following multinational trade agreements.[4] The motivation for this strategy is based on Krugman et al. (2015), who suggest that such agreements are less likely to be influenced by industrial lobbying. Arguably, they are thus less likely to reflect individual industries' growth opportunities (Frésard and Valta 2016). The key idea is that the lobbying activities of exporters that stand to gain from freer trade may offset the lobbying activities of import-competing producers that stand to lose from a trade liberalization.

For our analysis, we therefore rely on tariff revisions following large, multinational trade agreements: the implementation of the GSP (from 1976 onwards), tariff revisions agreed upon during the 7th GATT round (from 1980 onwards), and tariff revisions due to NAFTA and the 8th GATT round (from 1994 and 1995 onwards). Specifically, around each trade agreement, we compute the

[4]Table A.2 in the Internet Appendix shows that simple panel regressions confirm the findings from the DiD framework.

reductions in import tariffs from one year before to three years after the agreement. We do so to capture the full extent of the tariff revisions, noting that some were not implemented immediately but phased in over several years. In the Internet Appendix, Table A.3, we show that computing tariff reductions over alternative horizons does not change the results.

For each trade agreement k and industry j, we thus compute the reduction in upstream tariffs $\left(\Delta \textit{Up Tariff}_{k,j}\right)$, tariffs in industry j $\left(\Delta \textit{Own Tariff}_{k,j}\right)$, and downstream tariffs $\left(\Delta \textit{Down Tariff}_{k,j}\right)$,

$$\Delta \textit{Up Tariff}_{k,j} = \textit{Up Tariff}_{k,j,t=-1} - \textit{Up Tariff}_{k,j,t=3}, \tag{5}$$

$$\Delta \textit{Own Tariff}_{k,j} = \textit{Own Tariff}_{k,j,t=-1} - \textit{Own Tariff}_{k,j,t=3}, \tag{6}$$

$$\Delta \textit{Down Tariff}_{k,j} = \textit{Down Tariff}_{k,j,t=-1} - \textit{Down Tariff}_{k,j,t=3}. \tag{7}$$

$t = -1$ is the last year before the implementation of the trade agreement. That is, for the GSP, we compute tariff reductions from 1975 to 1979. For the 7th GATT round, we compute reductions from 1979 to 1983. For NAFTA and the 8th GATT round, given their close timing, we do not try to distinguish between the two and instead compute a single set of reductions from 1993 to 1997.

Importantly, as noted in Section 3, we use the 1972 BEA input-output table when computing $\Delta \textit{Up Tariff}_{k,j}$ and $\Delta \textit{Down Tariff}_{k,j}$ between 1975 and 1979, the 1977 table when computing changes from 1979 to 1983, and the 1992 table when computing changes from 1993 to 1997. This approach helps ensure that our results are not confounded by changes in the gross-flows of goods between industries after the trade agreements. Similarly, the value-weighted average tariff rates in each industry and year ($\textit{Import Tariff}_{j,t}$), from which the variables $\textit{Up Tariff}_{j,t}$, $\textit{Own Tariff}_{j,t}$, and $\textit{Down Tariff}_{j,t}$ are derived, are constructed using the import values from each country of origin as of year $t = -1$ as weights, which helps ensure that changes in the amounts of imports from the different countries following the trade agreements do not contaminate our findings.

Next, for each trade agreement (GSP, 7th GATT round, and NAFTA/8th GATT round), we distinguish between a five-year pre-agreement period from $t = -5$ to $t = -1$, a three-year implementation phase from $t = 0$ to $t = 2$, and a five-year post-agreement period from $t = 3$ to $t = 7$. For each trade agreement, we thus create a firm-year panel from $t = -5$ to $t = 7$, where $t = -1$ denotes the last year before the implementation of the tariff revisions began. Considering a longer time period, until years $t = 10$, $t = 15$, or $t = 20$, leads to very similar results.

In the following step, we construct a regression sample by stacking all observations from the three panels. As in Gormley and Matsa (2011) and Deshpande and Li (2019), observations are thus included multiple times in the regression sample if they appear in more than one panel. Dropping observations from each panel that pertain to firms that already experienced large upstream tariff reductions in prior trade agreements does not change our findings (Internet Appendix, Table A.4).

Finally, we estimate a difference-in-differences model with continuous treatment intensity:

$$\begin{aligned}\textit{Investment}_{k,i,j,t} = {} & \left(\beta_1 \Delta \textit{Up Tariff}_{k,j} + \gamma_1 \Delta \textit{Own Tariff}_{k,j} + \delta_1 \Delta \textit{Down Tariff}_{k,j}\right) \times \textit{Imp}_{k,t} \\ & + \left(\beta_2 \Delta \textit{Up Tariff}_{k,j} + \gamma_2 \Delta \textit{Own Tariff}_{k,j} + \delta_2 \Delta \textit{Down Tariff}_{k,j}\right) \times \textit{Post}_{k,t} \\ & + \theta_1' \textit{Controls}_{k,i,j} \times \textit{Imp}_{k,t} + \theta_2' \textit{Controls}_{k,i,j} \times \textit{Post}_{k,t} + \alpha_{k,i} + \lambda_{k,t} + \rho_j \times t + \varepsilon_{k,i,j,t}. \end{aligned} \quad (8)$$

This model estimates the impact of upstream tariffs on downstream investment by asking how much the change in investment from before to after a trade agreement (the "effect" of *Post*) varies with the size of the tariff reduction (Δ*Up Tariff*). The parameter of interest is thus the coefficient β_2 on the interaction between the post-indicator and the size of the upstream tariff reduction.[5]

Trade agreements (GSP, 7th GATT, NAFTA/8th GATT) are indexed by k and years by t. The

[5] As a robustness test, we have also used indicators for size-based categories of tariff reductions. Doing so suggests that the increase in downstream investment is strongest for the largest tariff reductions (Internet Appendix, Table A.5).

2,351 firms and 128 (SIC4-)industries in the sample are indexed by i and j. $Investment_{k,i,j,t}$ is capital expenditures scaled by beginning of year assets. Table A.6 in the Internet Appendix shows that our results are robust to using $Ln(Capex_{k,i,j,t})$ instead. $\Delta Up\ Tariff_{k,j}$, $\Delta Own\ Tariff_{k,j}$, and $\Delta Down\ Tariff_{k,j}$ are the reductions in upstream, own industry, and downstream tariffs from $t = -1$ to $t = 3$. $Controls_{k,i,j}$ are the pre-treatment values (i.e., as of $t = -1$) of *Ln(Assets)*, *Tobin's Q*, *Cash/Assets*, *Debt/Assets*, *EBITDA/Assets*, *Sales Growth*, *Excess Return*, *Excess Volatility*, *Industry Sales Growth*, and *Industry Concentration*. We include these to account for firm size, growth opportunities, financial slack, leverage, profitability, uncertainty, and competition. We use pre-treatment values because the tariff changes whose impact we want to estimate may affect not only firms' investment but also the firm- and industry-level variables we use as controls. In that case, the contemporaneous values of these variables (i.e., as of year t) would be endogenous, rendering them "bad controls" (Angrist and Pischke 2009). Nonetheless, we have checked that using contemporaneous controls does not change our findings. $Imp_{k,t}$ is an indicator for the implementation phase and equal to one in years $t = 0, 1, 2$. $Post_{k,t}$ is an indicator equal to one in years $t = 3, 4, \ldots, 7$. $\alpha_{k,i}$ and $\lambda_{k,t}$ are trade agreement specific firm and year fixed effects. $\rho_j \times t$ is an industry specific time trend. We cluster the standard errors by industry (Bertrand et al. 2004; Petersen 2008).

Table 1 provides summary statistics for the pre-treatment values (i.e., as of year $t = -1$) of the different variables. The average values of *Up Tariff*, *Own Tariff*, and *Down Tariff* are 1.3%, 5.0%, and 1.2%, respectively. Δ*Up Tariff*, Δ*Own Tariff*, and Δ*Down Tariff* have average values of 0.2%, 1.2%, and 0.2%. The correlation of Δ*Up Tariff* with Δ*Own Tariff* is 0.32 and 0.25 with Δ*Down Tariff*, and the correlation between Δ*Own Tariff* and Δ*Down Tariff* is 0.11 (unreported). The mean value of *Investment*, defined as capital expenditures scaled by total assets, is 0.07. *Tobin's Q*, *Cash/Assets*, *Debt/Assets*, and *EBITDA/Assets* have mean values of 1.6, 0.13, 0.22, and

0.11. The average values of *Sales Growth*, *Excess Return*, *Excess Volatility*, *Industry Sales Growth*, and *Industry Concentration* are 0.14, 0.11, 0.03, 0.10, and 0.24.

Before estimating the difference-in-differences model (Eq. (8)), we test whether the pre-treatment values of the control variables (*Controls*) or their pre-treatment changes are correlated with our treatment variable of interest (Δ*Up Tariff*). To do so, we regress the pre-treatment values and the pre-treatment changes of the control variables on Δ*Up Tariff* and trade agreement fixed effects:

$$Y_{k,i,j} = \alpha_k + \beta \times \Delta \mathit{Up\ Tariff}_{k,j} + \varepsilon_{k,i,j}. \tag{9}$$

$Y_{k,i,j}$ is the pre-treatment value of the control variable or its pre-treatment change $(\Delta Y_{t=-5,t=-1})$ from $t = -5$ to $t = -1$. The standard errors are clustered by (SIC4-)industry. Table 2 presents the results.[6] It is reassuring to see that we do not find evidence of a correlation between Δ*Up Tariff* and the pre-treatment values or the pre-treatment changes of the different control variables.

Table 3 presents the results of the difference-in-differences estimation (Eq. (8)). In column (1), we regress *Investment* on the interactions between Δ*Up Tariff*, *Imp*, and *Post* while controlling for trade agreement specific firm and year fixed effects ($\alpha_{k,i}$ and $\lambda_{k,t}$). In column (2), we add the interactions between Δ*Own Tariff*, *Imp*, and *Post* as well as between Δ*Down Tariff*, *Imp*, and *Post*. In column (3), we add the interactions between the pre-treatment values of the control variables and *Imp* and *Post*. This specification thus allows firms' investment in the pre-, implementation-, and post-period to differ depending on the values of the control variables. In column (4), we add the industry-specific time trends ($\rho_j \times t$). Table A.7 in the Internet Appendix shows that

[6]The reported number of observations refers to the observations that are effectively used in the estimation and varies between specifications as some variables are not available for all observations and cases with only a single observation for a given fixed effect ("singletons") are dropped in an iterative procedure. This note applies to all tables.

replacing the time trends with SIC3×year fixed effects does not change the results. Our preferred specification does not include SIC3×year fixed effects, however, because these remove not only potential confounders at the SIC3×year level but also a lot of the variation in the import tariffs.

The estimated coefficients on Δ*Up Tariff* × *Post* are positive and statistically significant at the 1% level in all four columns, ranging from 2.31 to 3.28 with *t*-statistics between 2.79 and 3.72. Δ*Up Tariff* measures the magnitude of the reductions in upstream tariffs around the trade agreements (from $t = -1$ to $t = 3$). The positive coefficient estimates thus provide evidence that tariff reductions in upstream industries entail an increase in downstream investment (Prediction 1). Unreported robustness tests show that this result is not driven by any particular industry: Removing any individual (SIC2-)industry from the sample does not affect our findings. In terms of economic magnitude, the estimates suggest that a hypothetical 10% decrease of all import tariffs in manufacturing industries (e.g., from 5% to 4.5%) would translate into an increase in downstream investment by 4% to 6% (relative to the mean level of investment).[7]

Table 3 also shows that controlling for tariff changes in firms' own industries (Δ*Own Tariff*) has little effect on the estimated coefficients on changes in upstream tariffs (Δ*Up Tariff*). Consistent with this result, unreported analyses reveal no significant correlation between Δ*Up Tariff* and Δ*Own Tariff* (Δ*Down Tariff*), conditional on trade agreement fixed effects. These findings are useful because they help to mitigate the concern that firms may respond not to changes in upstream import tariffs but instead to tariff changes in their own export markets.

[7] The pre-treatment average of *Up Tariff* is 1.264%, so a 10% reduction of all upstream tariffs would correspond to Δ*Up Tariff* $= 0.1264\%$. To improve readability, all estimates in Table 3 were multiplied by 100. An estimate of, e.g, 2.606 thus suggests that a 10% tariff cut would entail an increase in downstream investment by $2.606 \times 0.1264 \times 0.01$ $= 0.0033$, corresponding to $0.0033/0.074 = 4.46\%$ of the pre-treatment average of *Investment*.

The most direct way to address this concern would be to control for changes in outbound tariffs in each firm's own industry (e.g., changes in the weighted average import tariff imposed by the different destination countries). Unfortunately, we are not aware of any database that provides the necessary information on industry-level tariffs for the different export destinations during our sample period. However, controlling for changes in US tariffs in each firm's own industry (Δ*Own Tariff*), as we do, may help because changes in US tariffs tend to be positively correlated with changes in foreign countries' tariffs in the same industry (e.g., Bernard et al. 2006), so that including Δ*Own Tariff* can help to partially control also for changes in outbound tariffs.

As an (unreported) robustness test, we have also re-estimated Table 3 for the sub-sample of observations with the smallest reductions in *Own Tariff* (and/or *Down Tariff*). Doing so does not change the results: If anything, keeping only the bottom quartile of observations with the smallest reductions in *Own Tariff* (and/or *Down Tariff*) increases the estimated impact of changes in upstream tariffs. In additional (unreported) tests, we further find that the investment response that we document is driven by domestic US firms rather than multinational firms and that there is no increase in the relative importance of the firms' foreign sales. Both findings appear at odds with the concern that the observed increase in investment is due to an increase in firms' exports. Finally, we note that absorbing any changes in outbound tariffs at the SIC3-level by controlling for SIC3$\times$year fixed effects does not change our findings either (Table A.7 in the Internet Appendix).

The estimated impact of tariff reductions in firms' own industries is consistent with Frésard and Valta (2016). The coefficients on Δ*Own Tariff* $\times$ *Imp* are negative and significant. The coefficients on Δ*Own Tariff* $\times$ *Post* are not significant but similar in magnitude. Indeed, the differences between the estimated coefficients on Δ*Own Tariff* $\times$ *Post* and Δ*Own Tariff* $\times$ *Imp* are insignificant.

The findings are mixed regarding the impact of Δ*Down Tariff*: The coefficients are unstable in sign and significance. In particular, the positive and significant coefficient on Δ*Down Tariff* $\times$ *Imp* appears to be an outlier and is not robust to alternative specifications. Further, the sum of the coefficients on Δ*Down Tariff* $\times$ *Imp* and Δ*Down Tariff* $\times$ *Post* is not statistically different from zero in any specification. In contrast, the sum of the coefficients on Δ*Up Tariff* $\times$ *Imp* and Δ*Up Tariff* $\times$ *Post* and the sum of the coefficients on Δ*Own Tariff* $\times$ *Imp* and Δ*Own Tariff* $\times$ *Post* are significantly different from zero in all specifications.

Taking all estimates at face value, our findings suggest that a hypothetical 10% decrease of all import tariffs in manufacturing industries would lead to a net increase in investment across all firms by 0.2% to 1.6% during the implementation phase and 1.6% to 4.6% during the post-period (relative to the mean level of investment in the year before the tariff revisions, i.e., year $t = -1$).

4.1.1 Difference-in-Differences Dynamics

To investigate the timing of downstream firms' investment response, we now estimate a model in which we interact the changes in upstream, own industry, and downstream tariffs with indicators for the different years before and after the trade agreements ($\mathbb{1}\{t = \tau\}$). Specifically, we estimate

$$\begin{aligned} \textit{Investment}_{k,i,j,t} = & \sum_{\tau=-5}^{7} \left(\beta_\tau \Delta \textit{Up Tariff}_{k,j} + \gamma_\tau \Delta \textit{Own Tariff}_{k,j} + \delta_\tau \Delta \textit{Down Tariff}_{k,j}\right) \times \mathbb{1}\{t = \tau\} \\ & + \sum_{\tau=-5}^{7} \theta_\tau' \, \textit{Controls}_{k,i,j} \times \mathbb{1}\{t = \tau\} + \alpha_{k,i} + \lambda_{k,t} + \rho_j \times t + \varepsilon_{k,i,j,t}. \end{aligned} \tag{10}$$

We use year $t = -1$ as the reference year and thus omit $\mathbb{1}\{t = -1\}$. This specification can also be interpreted as a falsification test. Tariff changes (i.e., treatment) should be unrelated to investment before the tariff changes actually occur (i.e., absent treatment). In other words, future tariff reductions should not predict investment increases in the years prior to the trade agreements.

Table 4 shows the results. The coefficient estimates on the interactions between Δ*Up Tariff* and the indicators for the years $t = -5$ to $t = -2$ are small in magnitude and not statistically significant in any column. Indeed, the null-hypothesis that the coefficients are jointly equal to zero cannot be rejected at conventional levels (*p*-values ranging from 0.63 to 0.89). This result is comforting: We do not find evidence of a treatment effect before the actual onset of treatment. Similarly, when we repeat our difference-in-differences estimation (Eq. (8)) using only observations from the years before each trade agreement (i.e., $t = -5$ to $t = -1$) and falsely assume that the tariff reductions already occurred in year $t = -3$, then the estimated "effects" of the upstream tariff reductions are small in magnitude and not statistically significant (Internet Appendix, Table A.8).

Table 4 further reveals that we also do not find any evidence of a relation between Δ*Up Tariff* and firms' investment during the first two years of the implementation phase (years $t = 0$ and $t = 1$). In contrast, the coefficient estimates on the interactions between Δ*Up Tariff* and the indicators for the years $t = 2$ to $t = 7$ are positive and statistically significant. This result suggests that downstream firms begin to respond to upstream tariff reductions after about two years and that the response continues (at least) until year seven. Our findings thus point towards a permanent rather than transitory impact of upstream tariff reductions on downstream investment.

Figures 1 and 2 present our findings graphically. Specifically, Figure 1 shows the decline in average upstream tariffs after the trade agreements. It depicts the β_τ coefficients and 95% confidence intervals obtained from model (10) when using *Up Tariff* instead of *Investment* as the dependent variable. Table A.9 in the Internet Appendix reports the corresponding coefficient estimates and *t*-statistics. Figure 2, shows the increase in firms' investment. It depicts the β_τ coefficients reported in column (4) of Table 4 and the corresponding 95% confidence intervals.

4.2 Efficient Investment vs. Over-Investment

The estimates in Tables 3 and 4 suggest that downstream firms increase their investment following upstream tariff reductions. This increase, however, need not be efficient but could reflect over-investment. Empirically distinguishing between these alternatives is challenging because we do not observe the optimal amount of investment and thus lack the reference point above which efficient investment turns into over-investment. Nonetheless, we provide some suggestive evidence that the increase in investment is not primarily due to over-investment.

We begin by examining the relation between upstream tariff reductions and downstream profitability and productivity. The idea is that inefficient over-investment should entail a subsequent decline in profitability and productivity. To test this prediction, we replace investment as the outcome in our difference-in-differences analysis (Eq. (8)) with both firm- and industry-level measures of profitability and productivity: At the firm-level, we measure profitability as gross profit scaled by assets (Novy-Marx 2013) and productivity as total factor productivity (TFP) estimated based on Giupponi and Landais (2022). At the industry-level, we use TFP data from the NBER-CES Manufacturing Industry Database and gross profit scaled by output (because the NBER-CES data do not include the value of the assets). Definitions are in the Appendix.

Table 5, Panel A, shows the results.[8] At the firm-level, the coefficient estimate on the interaction between Δ*Up Tariff* and *Post* is positive and significant at the 1% level when we look at *Gross Profit/Assets*. When looking at *Ln(TFP)*, the estimate is positive but insignificant. At the industry-level, we find positive estimates that are significant at the 1% level when looking at *Gross*

[8] As pre-treatment controls at the industry-level we use *Ln(TFP)*, *Sales Growth*, and *Production Workers/Employment*. Not controlling for the pre-treatment value of *Ln(TFP)* when *Ln(TFP)* is the outcome does not change the results.

Profit/Output and 5% level when looking at *Ln(TFP)*.[9] In terms of economic magnitudes, the estimates suggest that a hypothetical 10% decrease of all import tariffs would translate into an increase in downstream *Gross Profit/Assets* at the firm-level by about 2% and *Gross Profit/Output* and TFP at the industry-level by about 5% and 1% (all relative to the respective variables' sample means).

Panel A of Table 5 thus presents evidence that downstream profitability and productivity increase after upstream tariff reductions. This finding appears less consistent with over-investment, which we would expect to result in lower profitability and productivity. A caveat, however, is that the firms whose profitability and productivity increase might not be the ones that increase their investment. In Panel B, columns (1) to (4), we thus repeat our investment analysis (Eq. (8)) on sub-samples that are formed based on whether the firms' realized changes in profitability and productivity from $t = -1$ to $t = +7$ are above or below the sample median ("high" and "low," respectively). We find positive and significant coefficient estimates on the interactions between Δ*Up Tariff* and *Post* only in the sub-samples of firms with high increases in profitability and productivity. This result is consistent with the hypothesis that the overall increase in investment stems from firms whose profitability and productivity increase. The differences between the coefficient estimates in the different sub-samples, however, are not statistically significant.

A further test is presented in columns (5) and (6). Here, the sub-samples are formed based on whether the firms' institutional ownership is above or below the sample median.[10] The idea

[9]This result is consistent with the findings of Schor (2004), Amiti and Konings (2007), Kasahara and Rodrigue (2008), Goldberg et al. (2010), Topalova and Khandelwal (2011), and Halpern et al. (2015), who show that imported inputs led to increased TFP in Brazil, Indonesia, Chile, India, and Hungary, and with Bøler et al. (2015), who propose complementarities between imported inputs and firms' own R&D efforts as a source of such productivity gains.

[10]To form the sub-samples around the GSP (1976) and 7th GATT round (1980), we use the firms' institutional owner-

is that over-investment is an agency problem and thus to test whether the increase in investment stems from firms with weak corporate governance (as proxied by low institutional ownership). In contrast, we find a positive and statistically significant coefficient estimate on the interaction between Δ*Up Tariff* and *Post* only in the sub-sample of firms' with high institutional ownership. Similar to the results in columns (1) to (4), this finding seems less consistent with the increase in investment reflecting over-investment, but a caveat is that the difference between the coefficient estimates in columns (5) and (6) is not statistically significant. In sum, however, while none of the above-discussed tests allow us to conclusively rule out that some of the firms' investments are inefficient, the combined evidence in panels A and B of Table 5 does not seem to point towards over-investment as the major driver of the increase in investment that we observe.

4.3 Controlling for Changes in Uncertainty

A possibility in the context of multinational trade agreements is that they may have led not only to lower tariffs but also lower uncertainty, for example, due to the resolution of trade policy uncertainty (Handley and Limão 2015, 2017). Given the known link between uncertainty and investment (McDonald and Siegel 1986; Dixit 1989; Leahy and Whited 1996; Bloom et al. 2007) one could thus be worried that reductions in uncertainty explain the increase in investment that we find.

Two features of our analysis help alleviate this concern. First, changes in aggregate uncertainty are absorbed by the year fixed effects in the regressions (and by the SIC3$\times$year fixed effects in Table A.7 in the Internet Appendix). Second, controlling for firm-level uncertainty in the form of *Excess Volatility* does not change our results (Table 3). Nonetheless, we now show that explicitly

ship as of 1980, the first year for which the data are available. Our findings are similar when we drop observations around the GSP. For the sub-sample around the NAFTA/8th GATT round (1994/1995), we use the data as of 1993.

allowing for the impact of reductions in uncertainty has virtually no effect on the estimated relation between upstream tariff reductions and downstream investment. Specifically, we rely on the well-established insight that empirical measures of uncertainty can be constructed based on share price volatility (e.g., Leahy and Whited 1996; Bloom et al. 2007) and use the reduction in *Excess Volatility* from $t = -1$ to $t = 3$ as a proxy for the reduction in uncertainty, i.e.,

$$\Delta \textit{Uncertainty}_{k,i} = \textit{Excess Volatility}_{k,i,t=-1} - \textit{Excess Volatility}_{k,i,t=3}. \tag{11}$$

We then add interactions between Δ*Uncertainty* and *Imp* and *Post* to the regression specifications.

Table 6 shows the results. Consistent with prior work (e.g., Leahy and Whited 1996), we find that reductions in uncertainty entail higher investment: The coefficients on Δ*Uncertainty* $\times$ *Post* and Δ*Uncertainty* $\times$ *Imp* are positive and significant at the 1% level in all columns. Importantly, however, the coefficients on Δ*Up Tariff* $\times$ *Post* and Δ*Up Tariff* $\times$ *Imp*, as well as the corresponding *t*-statistics, are almost identical to the ones in Table 3. That is, while we find that changes in the uncertainty faced by the downstream firms are related to their investment decisions, this relation does not appear to explain the relation between upstream tariff reductions and downstream investment.

4.4 Cross-Sectional Variation

So far, we have documented an increase in downstream investment following upstream tariff reductions (consistent with Prediction 1). Now, we examine how the magnitude of the investment response varies with several firm- and industry-characteristics (Predictions 2 to 5). Studying such cross-sectional heterogeneity is important for at least three reasons. First, the variation can be informative about the relative importance of different channels through which the effect of upstream tariffs may operate. Second, understanding which firms are affected most and why is important for the design of transfer programs aimed at redistributing the gains from freer trade and thus critical for policy making. Third, to the extent that the cross-sectional variation corresponds to theoretical predictions, documenting such variation can help substantiate the inference that the increase in downstream investment is indeed due to the reduction in upstream tariffs.

4.4.1 Input Cost Importance

We begin by looking at the importance of input costs for the total cost of production (Prediction 2). Specifically, using information from the NBER-CES Manufacturing Industry Database, we compute for each downstream industry the ratio of material costs to the sum of material costs, energy costs, and wages.[11] We then classify industries with a ratio above (below) the median in year $t = -1$ as having high (low) material costs. Using the ratio of cost of goods sold (COGS) to the sum of COGS and selling, general, and administrative expenses or the ratio of COGS to sales at the firm-level to gauge the importance of input costs does not change our findings.

Consistent with Prediction 2, Panel A of Table 7 shows that the estimated relation between upstream tariff reductions and downstream investment is positive and statistically significant (at the 1% level) only in the sub-sample of firms for which material costs are relatively more important. In contrast, the coefficient estimates are noticeably smaller and not statistically significant in the sub-sample of firms for which material costs are relatively less important. The differences between the estimated coefficients in the two sub-samples are statistically significant at the 1% level.

[11] We measure all variables in real terms. Using nominal terms does not change the results.

4.4.2 Input Differentiation

Next, we examine Prediction 3 and discern between tariff reductions for homogeneous inputs (e.g., cement) and differentiated inputs (e.g., industrial machinery). For a first test, we distinguish between tariff reductions in upstream industries that produce homogeneous goods (Δ*Up Tariff for Homogeneous Goods*) versus differentiated goods (Δ*Up Tariff for Differentiated Goods*) using the classification of Rauch (1999).[12] Column (1) in Panel B of Table 7 shows the results. We find a positive and statistically significant coefficient estimate on the interaction between Δ*Up Tariff for Homogeneous Goods* and *Post*. In contrast, the coefficient estimate on the interaction between Δ*Up Tariff for Differentiated Goods* and *Post* is small in magnitude and not significant. The difference between the two estimates is statistically significant at the 5% level.

Hombert and Matray (2018) show that higher R&D leads to more product differentiation. For a second test of Prediction 3, we thus distinguish between tariff reductions in high-R&D industries and tariff reductions in low-R&D industries. We use the industries' aggregate R&D expenditures scaled by aggregate sales to measure their R&D-intensity and label those with above-median R&D-to-sales ratios as of year $t = -1$ as high-R&D industries. Measuring R&D-intensity with the ratio of R&D expenses to total assets leads to similar results. Column (2) in Panel B of Table 7 displays the findings. Consistent with the results based on Rauch's (1999) classification in column (1), we find a positive and significant coefficient estimate on the interaction between

[12] We obtain the required data from `econweb.ucsd.edu/~jrauch/rauch_classification.html`. Rauch (1999) classifies goods as homogeneous if they are traded on organized exchanges and/or have reference prices (e.g., price quotations published in trade journals) and otherwise as differentiated. We follow Barrot and Sauvagnat (2016) and classify an industry as producing differentiated goods if the ratio of differentiated to homogeneous goods produced by the industry is greater than the median ratio of differentiated to homogeneous goods across all industries.

Δ*Up Tariff for Low-R&D Goods* and *Post* but not on the interaction between Δ*Up Tariff for High-R&D Goods* and *Post*. The difference between the two estimates is significant at the 1% level.

The results in both columns (1) and (2) thus suggest that US manufacturing firms that rely on homogeneous, low-R&D inputs benefit more from upstream tariff reductions than those relying on differentiated, high-R&D inputs. This is particularly relevant regarding the channel through which upstream tariffs affect downstream investment. In the context of developing countries, where prior work has linked freer trade in intermediate goods to higher total factor productivity, the effect of upstream tariff reductions has been primarily attributed to superior foreign technology embodied in imported inputs and their greater variety. While highly plausible in the context of developing countries, this channel may seem less plausible in the context of a highly developed economy like the US, where imports are arguably less likely to be a substantial source of superior technology or otherwise unavailable inputs. Indeed, our findings would seem to be most consistent with the idea that, for US firms, the increase in downstream investment following upstream tariff cuts is primarily due to lower input costs (rather than superior foreign technology or greater input variety).

4.4.3 Bargaining Power

We now examine Prediction 4, i.e., whether the increase in downstream investment is more pronounced for firms that have more bargaining power. However, because we cannot observe firms' bargaining power directly, we use a proxy: industry concentration. The idea is that firms in concentrated, rather than dispersed, downstream industries are likely to have more bargaining power in price-negotiations with their suppliers and customers. Specifically, we split our sample based on the downstream industries' concentration, measured in two ways, with the Herfindahl-Hirschman Index (*HHI*) of sales in the industry and with the percentage of sales accounted for by the four companies with the largest sales volume (*Top4Share*). Panel C of Table 7 shows the results.

Both in the implementation and in the post-reduction period, we find a positive and significant relation between upstream tariff reductions and downstream investment only in concentrated, but not in dispersed, downstream industries. The differences between the coefficient estimates in the high- versus low-concentration industries are statistically significant, except for the difference in the estimated coefficients on the interactions between Δ*Up Tariff* and *Post* in columns (3) and (4). Overall, the results of Panel C are thus consistent with the notion that higher industry concentration endows the downstream firms with more bargaining power vis-à-vis their suppliers and customers, which in turn results into a stronger response to upstream tariff reductions (Prediction 4).

4.4.4 Financial Constraints

The last cross-sectional dimension that we examine are financial constraints (Prediction 5). To do so, we use three proxies: size as measured by the book value of assets, an indicator for firms that pay dividends, and an index of financial constraints based on Whited and Wu (2006) (*WW-Index*). We then consider those downstream firms financially constrained that do not pay dividends or whose size is smaller or *WW-Index* larger than the median in year $t = -1$.

Panel D of Table 7 shows our findings. The estimated coefficients on the interactions between Δ*Up Tariff* and *Post* are positive and statistically significant at the 1% level for those downstream firms that are presumably unconstrained, irrespective of which proxy we use. In contrast, the estimates are much smaller and not statistically significant for the firms that are presumably financially constrained.[13] The difference between the estimated coefficients is statistically significant (at the 5% level for firm size and at the 1% level for the indicator for dividend-paying firms and the *WW-*

[13]We also find no evidence that upstream tariff cuts relax the downstream firms' financial constraints (unreported).

Index). These findings suggest that financial frictions can reduce the extent to which upstream tariff reductions translate into increased downstream investment.

4.5 Outcomes at the Industry-Level

So far, we relied on firm-level data from Compustat and CRSP with detailed information from financial statements and security prices. This allowed us to study the cross-sectional variation in firms' investment response as well as to check for balance on observables, to verify the absence of pre-treatment trends, and to control for differences in observable, firm-level characteristics. In particular, the observable market valuations of public firms allowed us to construct proxies for important determinants of investment decisions such as growth expectations and uncertainty.

A disadvantage of data from Compustat and CRSP is the omission of private firms. This is relevant with regards to aggregate effects as it is conceivable that lower upstream tariffs entail higher downstream investment for public firms (as we find) but lower downstream investment for private firms (which are not in the sample). In that case, the aggregate effect of upstream tariffs could be different or even opposite in sign from the firm-level effect we estimate for public firms.

In this section, we thus complement our firm-level results with an industry-level analysis based on information from the NBER-CES Manufacturing Industry Database that covers both public and private US manufacturing firms (SIC codes 2000-3999). Table 8 provides summary statistics.

Using the industry-level data, we estimate the following difference-in-differences model:

$$
\begin{aligned}
\mathit{Investment}_{k,j,t} = {} & \big(\beta_1 \Delta \mathit{Up\ Tariff}_{k,j} + \gamma_1 \Delta \mathit{Own\ Tariff}_{k,j} + \delta_1 \Delta \mathit{Down\ Tariff}_{k,j}\big) \times \mathit{Imp}_{k,t} \\
& + \big(\beta_2 \Delta \mathit{Up\ Tariff}_{k,j} + \gamma_2 \Delta \mathit{Own\ Tariff}_{k,j} + \delta_2 \Delta \mathit{Down\ Tariff}_{k,j}\big) \times \mathit{Post}_{k,t} \\
& + \theta_1' \mathit{Controls}_{k,j} \times \mathit{Imp}_{k,t} + \theta_2' \mathit{Controls}_{k,j} \times \mathit{Post}_{k,t} + \alpha_{k,j} + \lambda_{k,t} + \rho_j \times t + \varepsilon_{k,j,t}.
\end{aligned} \tag{12}
$$

We index trade agreements, (SIC4-)industries, and years by k, j, and t and use observations from $t = -5$ to $t = 7$ around each agreement, where $t = -1$ denotes the last year before the implementation of the tariff revisions. *Investment* is capital expenditures scaled by beginning of year capital.[14] *Controls* are the $t = -1$-values of *Ln(TFP)*, *Sales Growth*, and *Production Workers/Employment*, which we include to account for differences in productivity, growth opportunities, and skill intensity of the workforce. The Appendix provides definitions. All other variables are defined as before. We cluster the standard errors by industry (Bertrand et al. 2004; Petersen 2008).

The estimated coefficient on the interaction between Δ*Up Tariff* and *Post* in the first column of Table 9 is positive and statistically significant at the 5% level, consistent with our firm-level results (Table 3) and recent evidence in Bown et al. (2021). The economic magnitude is also in line with the firm-level findings: A coefficient of 1.381 suggests that a hypothetical 10% decrease of all import tariffs would translate into an increase in downstream investment by about 3%. The finding that the estimated effect-size at the industry-level is slightly lower than the effect-size suggested by the firm-level estimates (4% to 6%) is consistent with the cross-sectional finding that financially constrained firms seem to respond less to upstream tariff reductions and the notion that private firms may be more likely to be financially constrained than public firms.

An additional benefit of using the NBER-CES data, apart from the inclusion of private firms, is the availability of high-quality information on industry-level prices, input and output quantities, and employment. Such information is useful because it allows us to conduct several ancillary tests. For example, we can now test directly if tariff reductions lead to lower input prices in downstream industries (as we have argued). Likewise, we can test if upstream tariff reductions entail an increase

[14] We scale by capital as the NBER-CES data do not include the book value of assets used in the firm-level analysis.

in downstream input and output quantities (as one would expect given the increase in investment). We can also study the extent to which upstream tariff reductions affect downstream employment. Hence, we now replace *Investment* in Eq. (12) with the following variables: *Input Price*, *Ln(Real Input)*, *Ln(Real Output)*, and *Ln(Employment)*. Definitions are in the Appendix.

Column (2) of Table 9 provides some evidence that input material prices indeed decline after upstream tariff reductions. The estimated coefficient of -14.088 suggests that a 10% reduction in upstream tariffs would lead to a decrease in downstream input prices by about 1%. Columns (3) and (4) suggest that downstream input and output quantities increase in real terms.[15] Column (5) suggests an increase in downstream employment, a result that is mirrored by the findings of Barattieri and Cacciatore (2020) and Bown et al. (2021) that temporary trade barriers and antidumping duties reduce employment in downstream industries. In terms of economic magnitudes, the coefficient estimates in columns (3) to (5) suggest that a hypothetical 10% decrease of all import tariffs would translate into an increase in downstream input, output, and employment by about 3%.

4.6 Instrumental Variable Estimation Using Chinese Import Penetration

Up to this point, we exploited tariff revisions following multinational trade agreements with the identifying assumption that changes in upstream tariffs (Δ*Up Tariff*) are uncorrelated with unobserved determinants of downstream firms' investment. Reassuringly, we indeed found no evidence that the tariff revisions are related to pre-treatment firm- or industry-characteristics (Table 2). In particular, we found no evidence that the tariff revisions are correlated with observable proxies for downstream growth opportunities (e.g., Tobin's Q or sales growth) in the pre-treatment years.

[15]This result is consistent with Vandenbussche and Viegelahn's (2018) finding that Indian firms use fewer imported inputs after tariff hikes due to anti-dumping measures and that this accounts for a loss of up to 10% of output growth.

Controlling for these proxies did not affect our results either (Table 3). Finally, there was no evidence of differential pre-treatment trends in investment, i.e., we found no relation between the tariff revisions and downstream investment before the revisions were implemented (Table 4).

To alleviate endogeneity concerns further and to verify the external validity of the difference-in-differences results around multinational trade agreements, in this section, we rely on a different identification assumption and use data from a different setting and period. In particular, we now extend our analysis beyond import tariffs and examine the relation between import competition and downstream investment. The conceptual link between this and our previous analysis is the following idea: Lower import tariffs can foster greater competition from foreign suppliers. Greater import competition can in turn create downward pressure on prices, to which downstream firms may respond by increasing investment. Hence, instead of looking at the relation between import tariffs and downstream investment, we now look at the impact of import competition directly. Specifically, we test how import competition in upstream industries affects downstream investment.

As in the analysis of the relation between import tariffs and investment, a concern is that the amount of import competition in an industry may be correlated with unobserved determinants of downstream investment (e.g., downstream growth opportunities that affect the expected demand for the upstream industries' output). To help mitigate this concern, we borrow a well-established identification strategy from the literature (e.g., Autor et al. 2013; Acemoglu et al. 2016; Hombert and Matray 2018) and exploit the sudden increase in Chinese import penetration in US manufacturing industries between 1991 and 2011. The idea is that the increase in import penetration from China may not be due to US demand shocks for Chinese goods but the result of economic reforms in the 1980s and 1990s in China as well as China's WTO accession in 2001. In that case, Chinese import penetration in other developed countries (which is presumably driven by the same economic reforms and WTO accession) can be used as an instrument for Chinese import penetration in the US. The key identifying assumption here is that demand shocks for Chinese imports in the US are uncorrelated with demand shocks for Chinese imports in these other developed countries and that Chinese manufacturing is not subject to strongly increasing returns to scale.

Building on Acemoglu et al. (2016), we thus proceed as follows.[16] First, for each US manufacturing industry, we compute the amount of Chinese import penetration (CIP) as the amount of imports (M^{UC}) from China, scaled by the industry's initial absorbtion measured as output (Y) plus total imports (M) minus exports (E) in 1991 (the first year where the necessary data are available):

$$\mathit{CIP}_{j,t} = \frac{M^{UC}_{j,t}}{Y_{j,91} + M_{j,91} - E_{j,91}}. \tag{13}$$

We also compute the amount of Chinese import penetration in eight other high-income countries (Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain, and Switzerland),

$$\mathit{CIPO}_{j,t} = \frac{M^{OC}_{j,t}}{Y_{j,91} + M_{j,91} - E_{j,91}}, \tag{14}$$

where M^{OC} is the total amount of imports from China in these countries.

Next, in analogy to *Up Tariff*, we compute the weighted average of *CIP* in upstream industries:

$$\mathit{Up\ CIP}_{j,t} = \sum_{s \in S_{\cdot j}} \omega_{s,j} \times \mathit{CIP}_{s,t} \tag{15}$$

with

$$\omega_{s,j} = \frac{\textit{Gross flow of goods from industry } s \textit{ to industry } j}{\textit{Total gross flow of goods from all industries to industry } j}. \tag{16}$$

Similarly, we compute *Up CIPO* as the weighted average of *CIPO* in upstream industries and *Down CIP* (*Down CIPO*) as the weighted average of *CIP* (*CIPO*) in downstream industries.[17]

[16]We obtain the data from `https://economics.mit.edu/faculty/acemoglu/data/empsag/`.

[17]When computing *Down CIP* and *Downstream CIPO*, we use $\nu_{j,s} = \frac{\textit{Gross flow of goods from industry } j \textit{ to industry } s}{\textit{Total gross flow of goods from industry } j \textit{ to all industries}}$.

Finally, we estimate the effect of upstream import penetration from China on downstream investment in US manufacturing firms by two-stage-least-squares (2SLS). Specifically, we estimate

$$\mathit{Investment}_{i,j,t} = \alpha_i + \lambda_t + \beta \times \mathit{Up\ CIP}_{j,t} + \gamma \times \mathit{Own\ CIP}_{j,t} + \delta \times \mathit{Down\ CIP}_{j,t} + \theta' \mathit{Controls}_{i,j,t-1} + \varepsilon_{i,j,t}, \tag{17}$$

using *Up CIPO*$_{j,t}$, *Own CIPO*$_{j,t}$, and *Down CIPO*$_{j,t}$ to instrument *Up CIP*$_{j,t}$, *Own CIP*$_{j,t}$, and *Down CIP*$_{j,t}$. *Investment*$_{i,j,t}$ is capital expenditures scaled by beginning of year total assets. α_i and λ_t are firm and year fixed effects. *Controls*$_{i,j,t-1}$ are *Ln(Assets)*, *Tobin's Q*, *Cash/Assets*, *Debt/Assets*, *EBITDA/Assets*, *Sales Growth*, *Excess Return*, *Excess Volatility*, *Industry Sales Growth*, and *Industry Concentration*. The sample period is 1991 to 2011 as in Acemoglu et al. (2016).

Table 10 shows the results. In all odd-numbered columns, we only control for firm and year fixed effects. In all even-numbered columns, we also include the firm- and industry-level control variables. All standard errors are clustered by industry. Columns (1) to (6) show the coefficient estimates and *t*-statistics from the first stage and reveal a significant correlation between Chinese import penetration in the US and other developed countries, consistent with prior literature.

Columns (7) and (8) show the results from the second stage. The estimated coefficient on *Up CIP* in column (7) is 0.385 (*t*-statistic 2.62) and 0.276 (*t*-statistic 2.71) in column (8). That is, downstream firms' investment exceeds the sample average in years when upstream import penetration from China exceeds the average. Over the entire sample period, since Chinese import penetration has been steadily increasing, this translates into a larger total increase in investment for those firms whose upstream industries experienced larger increases in import competition from China. Specifically, in terms of economic magnitude, the estimates suggest that the increase in Chinese import penetration over the twenty-year period from 1991 to 2011 entailed an increase in downstream investment by 12% to 16%, relative to the 1991-level of investment, over the same period.[18] The results of this second analysis are thus broadly consistent with our tariff-related findings and the interpretation that lower import tariffs can foster competition from foreign rivals to which downstream firms may respond by increasing investment. The estimated magnitudes of the two effects, however, are not directly comparable because one is an estimate of the impact of tariff reductions around multinational trade agreements whereas the other is an estimate of the impact of import penetration from China. That is, while we would predict that both estimates have the same sign (as we find), we do not necessarily expect that they have the same magnitude.

5 Conclusion

Protectionist trade policies have recently gained in popularity. Such policies may help some domestic industries by sheltering them from foreign competition, yet they can hurt others by increasing the price of imported inputs needed for production. Studying the impact of upstream tariff reductions on US manufacturing firms' investments, we estimate that a hypothetical decrease of all tariffs by 10% would translate into an increase in downstream investment by 4% to 6%. Cross-sectional tests suggest the importance of the share of input costs in total costs, input differentiation and R&D-intensity, industry concentration, and financial constraints for the extent to which tariff cuts propagate downstream. Ancillary tests suggest that lower tariffs also entail higher downstream profitability, productivity, output, and employment. We leave it for future research to study

[18]From 1991 to 2011, the average import penetration from China in upstream manufacturing industries rose by $\Delta \mathit{Up\ CIP} = 0.025$. Column (7) suggests an associated increase in *Investment* by $0.025 \times 0.385 = 0.0096$, corresponding to 16% of the average 1991-level of *Investment* (0.059). Column (8) suggests an increase by 12%.

the consequences of trade barriers other than tariffs, such as legal and regulatory requirements.

Our findings are important for several reasons. First, they contribute to a more comprehensive understanding of the effects that tariffs can have through firms' supply chains. Second, while theory generally predicts that freer trade is net-beneficial, empirical evidence of the possible benefits is harder to come by, in particular, for highly industrialized economies like the US. Indeed, recent work on the impact of freer trade in the US focuses on the negative consequences such as higher unemployment and lower wages. These papers highlight that trade liberalization entails substantial short-run adjustment costs. We, instead, provide evidence of potential benefits in the long run: higher investment in downstream industries, which goes hand in hand with higher profitability, productivity, employment, and output. The possibility that some of these new investments could reflect inefficient over-investment cannot be ruled out entirely, yet our empirical evidence does not point in this direction. Third, our findings can help inform the ongoing debate about protectionist versus free trade policies and what type of transfer programs are needed to redistribute the gains from any given policy. In particular, our findings suggest that high import tariffs may be most detrimental if imposed in those industries that are "very upstream" in the overall production chain because, in that case, the tariffs may entail negative consequences for the entire sequence of downstream industries. Our results further indicate that the gains from freer upstream trade may not be realized uniformly but vary across firms and industries. Transfer programs to redistribute the surplus from trade liberalizations should thus take such possible heterogeneities into account.

Appendix: Variable Definitions

Variable	Definition
Capex/Assets (Firm-Level)	Capital expenditures (capx) divided by book value of total assets (at) at the end of the previous year. Source: Compustat.
Capex/Capital (Industry-Level)	Total capital expenditures (in real terms) at the industry-level divided by total capital (in real terms) at the end of the previous year. Source: NBER-CES Database.
Cash/Assets	Cash holdings (che) divided by book value of total assets (at). Source: Compustat.
CIP	Amount of imports from China to the US, scaled by the industry's initial absorbtion measured as output plus total imports minus exports in 1991. Source: UN Comtrade Database.
CIPO	Amount of imports from China to other countries (Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain, and Switzerland), scaled by the industry's initial absorbtion measured as output plus total imports minus exports in 1991. Source: UN Comtrade Database.
Debt/Assets	Book value of total long-term and short-term debt (dllt + dlc) divided by book value of total assets (at). Source: Compustat.
Down CIP	Weighted average CIP in all downstream industries. The weight of each downstream industry is the dollar value of the gross flow of goods from the upstream industry to the downstream industry divided by the dollar value of the total gross flow of goods from the upstream industry. Following Acemoglu et al. (2016), we use the 1992 BEA input-output table, and we aggregate industries to the level of four-digit SIC codes. Source: BEA input-output tables, UN Comtrade Database.
Down CIPO	Weighted average CIPO in all downstream industries. The weight of each downstream industry is the dollar value of the gross flow of goods from the upstream industry to the downstream industry divided by the dollar value of the total gross flow of goods from the upstream industry. Following Acemoglu et al. (2016), we use the 1992 BEA input-output table, and we aggregate industries to the level of four-digit SIC codes. Source: BEA input-output tables, UN Comtrade Database.
Down Tariff	Weighted average import tariff rate in all downstream industries. The weight of each downstream industry is the dollar value of the gross flow of goods from the upstream industry to the downstream industry divided by the dollar value of the total gross flow of goods from the upstream industry. We aggregate industries to the level of four-digit SIC codes. Source: Center for International Data at UC Davis, BEA input-output tables.
ΔDown Tariff	Downstream tariff in year $t = -1$ minus downstream tariff in year $t = 3$. To ensure that ΔDown Tariff is not confounded by changes in the amounts of imports from different countries of origin, we use the import values as of year $t = -1$ to construct the weights used in computing Down Tariff. Similarly, to ensure that changes in the gross-flows of goods between industries do not confound the results, we use the 1972 BEA input-output table when computing the tariff changes between 1975 and 1979, the 1977 BEA input-output table when computing the tariff changes from 1979 to 1983, and the 1992 BEA input-output table when computing the tariff changes from 1993 to 1997. Source: Center for International Data at UC Davis, BEA input-output tables.
EBITDA/Assets	EBITDA (ebitda) divided by book value of total assets (at). Source: Compustat.
Excess Return	Stock return ([$prcc\_f_t$ / $prcc\_f_{t-1}$] – 1) minus market return ([$usdval_t$ / $usdval_{t-1}$] – 1). Source: Compustat, CRSP.
Excess Volatility	Standard deviation of daily returns during the year minus standard deviation of daily

Variable	Definition
	market returns during the year. Source: CRSP.
Gross Profit/Assets (Firm-Level)	Sales (sale) minus cost of goods sold (cogs), divided by book value of total assets (at). Source: Compustat.
Gross Profit/Output (Industry-Level)	Value of shipments (vship) – material costs (matcost) – energy costs (energy) – employee compensation (pay), divided by value of shipments (vship). Source: NBER-CES Database.
Imp	Indicator equal to one in years $t = 0, 1, 2$, where $t = -1$ denotes the last year before the implementation of the tariff revisions.
Import Tariff	Import tariff rate computed as the value of import duties divided by the customs value of imports. Source: Center for International Data at UC Davis.
Industry Concentration (HHI)	Herfindahl-Hirschman Index (HHI) of sales in a given industry and year. Source: Compustat.
Industry Sales Growth	Growth rate of aggregate sales in a given industry and year. Source: Compustat.
Input Price	Material price index at the industry-level. Source: NBER-CES Database.
Institutional Ownership	Number of shares held by institutional investors in the fourth quarter divided by the number of shares outstanding in December. Source: Thomson/Refinitiv, CRSP.
Ln(Assets)	Natural logarithm of the book value of total assets (at). Source: Compustat.
Ln(Employment)	Natural logarithm of the number of employees (in 1,000s). Source: NBER-CES Database.
Ln(Real Input)	Natural logarithm of material costs divided by material price index. Source: NBER-CES Database.
Ln(Real Output)	Natural logarithm of sales divided by output price index. Source: NBER-CES Database.
Ln(TFP) (Firm-Level)	Natural logarithm of firm-level total factor productivity, estimated based on Giupponi and Landais (2022): $TFP_{it} = [sale_{it} - cogs_{it}] / [(emp_{it})^{\alpha_{jt}} (ppent_{it})^{1-\alpha_{jt}}]$, where i, j, and t index firms, (SIC4-)industries, and years. α_{jt} is the industry-level labor share, computed using the NBER-CES data as total employee compensation divided by value-added. Source: Compustat, NBER-CES Database.
Ln(TFP) (Industry-Level)	Natural logarithm of 5-factor total factor productivity (index 1987 = 1) at the industry-level. Source: NBER-CES Database.
Own CIP	CIP in the industry itself. Source: UN Comtrade Database.
Own CIPO	CIPO in the industry itself. Source: UN Comtrade Database.
Own Tariff	Import tariff rate in the industry itself. Source: Center for International Data at UC Davis.
ΔOwn Tariff	Own tariff in year $t = -1$ minus own tariff in year $t = 3$. To ensure that ΔOwn Tariff is not confounded by changes in the amounts of imports from different countries of origin, we use the import values as of year $t = -1$ to construct the weights used in computing Own Tariff. Source: Center for International Data at UC Davis.

Variable	Definition
Post	Indicator equal to one in years $t = 3, 4, \ldots, 7$, where $t = -1$ is the last year before the implementation of the tariff revisions.
Production Workers/Employment	Ratio of the number of production workers to total employment at the industry-level. Source: NBER-CES Database.
R&D/Sales	Research & development expenses (xrd) divided by sales (sale). Zero if no R&D expenses are reported. Source: Compustat.
Sales Growth (Firm-Level)	Sales (sale) divided by sales in the previous year – 1. Source: Compustat.
Tobin's Q	[Book value of total assets (at) – book value of equity (ceq) + market value of equity (csho*prcc_f)] / book value of total assets (at). Source: Compustat.
Top4Share	Percentage of aggregate industry sales accounted for by the four firms with the largest sales volume. Source: Compustat.
ΔUncertainty	Excess volatility in year $t = -1$ minus excess volatility in year $t = 3$. Source: CRSP.
Up CIP	Weighted average CIP in all upstream industries. The weight of each upstream industry is the dollar value of the gross flow of goods from the upstream to the downstream industry divided by the value of the total gross flow of goods to the downstream industry. Following Acemoglu et al. (2016), we use the 1992 BEA input-output table, and we aggregate industries to the level of four-digit SIC codes. Source: BEA input-output tables, UN Comtrade Database.
Up CIPO	Weighted average CIPO in all upstream industries. The weight of each upstream industry is the dollar value of the gross flow of goods from the upstream to the downstream industry divided by the value of the total gross flow of goods to the downstream industry. Following Acemoglu et al. (2016), we use the 1992 BEA input-output table, and we aggregate industries to the level of four-digit SIC codes. Source: BEA input-output tables, UN Comtrade Database.
Up Tariff	Weighted average import tariff rate in all upstream industries. The weight of each upstream industry is the dollar value of the gross flow of goods from the upstream to the downstream industry divided by the value of the total gross flow of goods to the downstream industry. We aggregate industries to the level of four-digit SIC codes. Source: Center for International Data at UC Davis, BEA input-output tables.
ΔUp Tariff	Upstream tariff in year $t = -1$ minus upstream tariff in year $t = 3$. To ensure that ΔUp Tariff is not confounded by changes in the amounts of imports from different countries of origin, we use the import values as of year $t = -1$ to construct the weights used in computing Up Tariff. Similarly, to ensure that changes in the gross-flows of goods between industries do not confound the results, we use the 1972 BEA input-output table when computing the tariff changes between 1975 and 1979, the 1977 BEA input-output table when computing the tariff changes from 1979 to 1983, and the 1992 BEA input-output table when computing the tariff changes from 1993 to 1997. Source: Center for International Data at UC Davis, BEA input-output tables.
Whited-Wu (WW) Index	$-0.091 \times$ [ibc/at] $- 0.044 \times$ ln(at) $+ 0.102 \times$ industry sales growth $- 0.035 \times$ sales growth $- 0.062 \times$ dividendpayer $+ 0.021 \times$ [dltt/at]. Formula based on Whited and Wu (2006). Source: Compustat.

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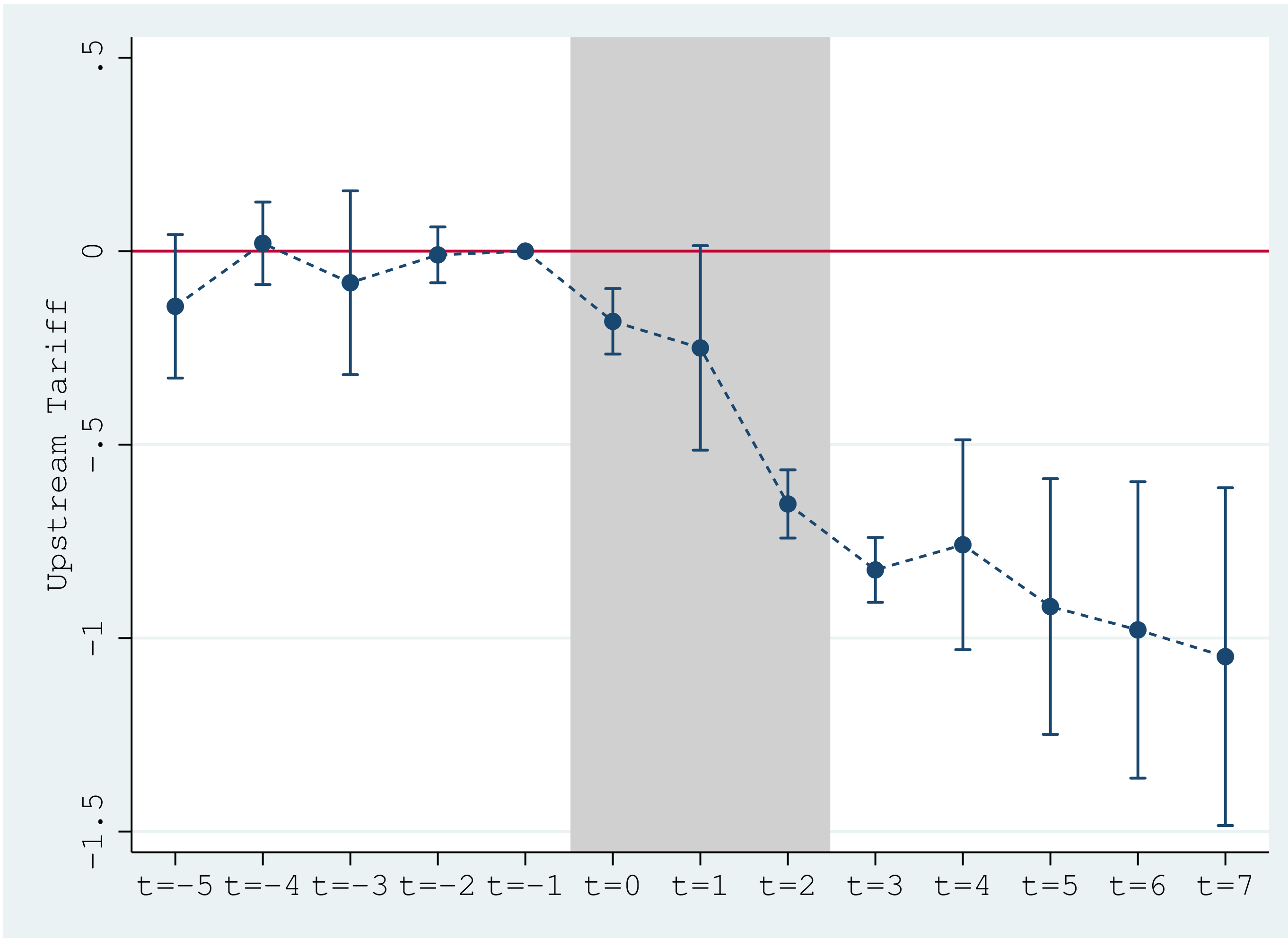
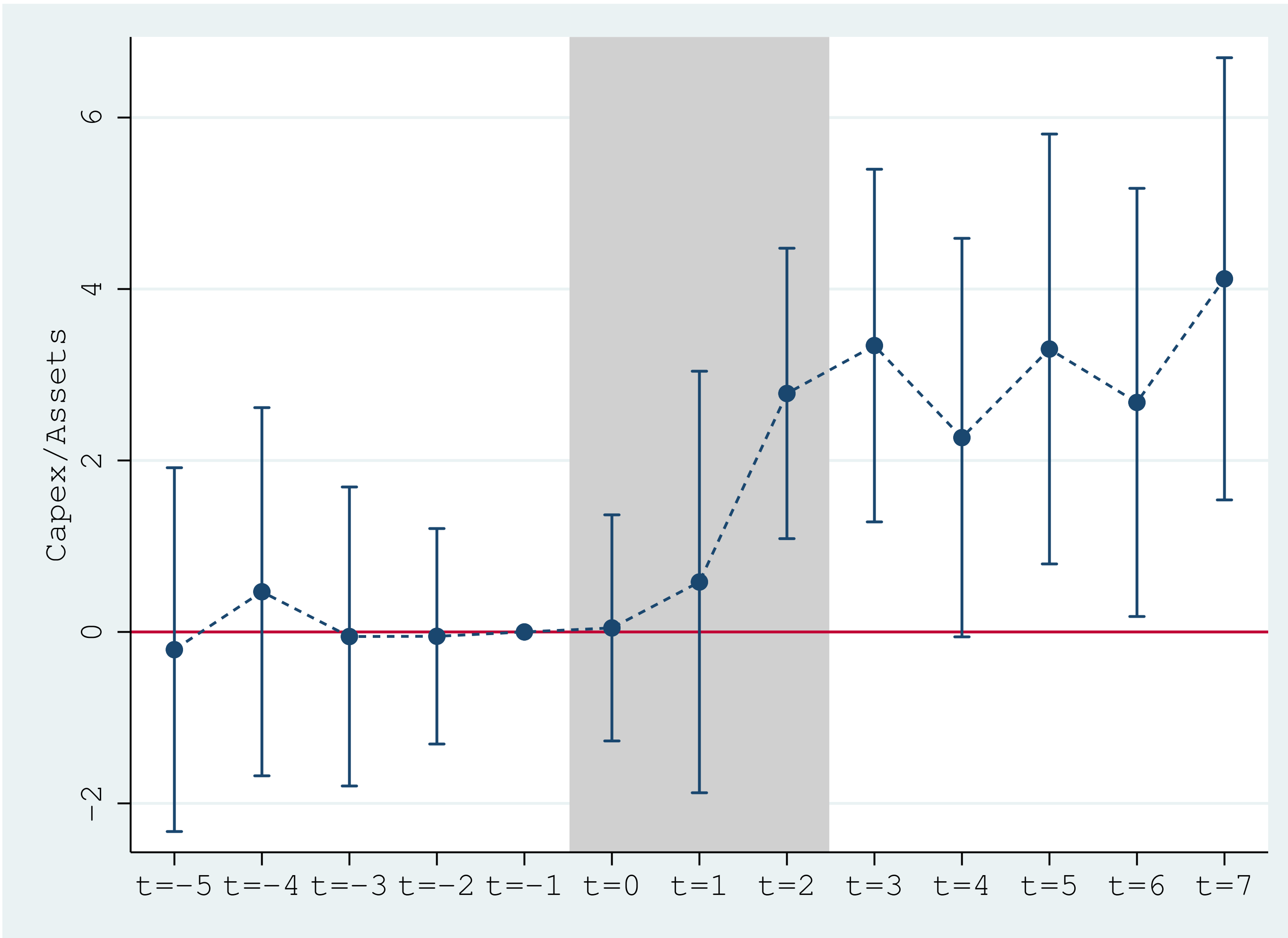
Figure 1: Import Tariffs in Upstream Industries Before and After Multinational Trade Agreements



This figure shows the decline in average upstream import tariffs following multinational trade agreements (GSP, 7th GATT round, and NAFTA/8th GATT round). Specifically, the figure shows the estimated β_τ coefficients and 95% confidence intervals from the following regression:
$\mathit{Up\ Tariff}_{k,i,j,t} = \sum_{\tau=-5}^{7} \left(\beta_\tau \Delta \mathit{Up\ Tariff}_{k,j} + \gamma_\tau \Delta \mathit{Own\ Tariff}_{k,j} + \delta_\tau \Delta \mathit{Down\ Tariff}_{k,j} + \theta_\tau' \mathit{Controls}_{k,i,j}\right) \mathbb{1}\left\{t = \tau\right\} + \alpha_{k,i} + \lambda_{k,t} + \rho_j \times t + \varepsilon_{k,i,j,t}$.
Trade agreements are indexed by k, and firms, (SIC4-)industries, and years by i, j, and t. We use the last year before the tariff revisions as the reference year and thus omit $\mathbb{1}\left\{t = -1\right\}$. The standard errors are clustered by (SIC4-)industry.

Figure 2: Investment in Downstream Industries Before and After Multinational Trade Agreements



This figure shows estimates of the sensitivity of downstream firms' investment (*Capex/Assets*) to upstream tariff reductions (Δ*Up Tariff*) obtained from a difference-in-differences analysis around multinational trade agreements (GSP, 7th GATT round, and NAFTA/8th GATT round). Specifically, the figure shows the estimated β_τ coefficients and 95% confidence intervals from the following regression:

$$\textit{Investment}_{k,i,j,t} = \sum_{\tau=-5}^{7} \left(\beta_\tau \Delta \textit{Up Tariff}_{k,j} + \gamma_\tau \Delta \textit{Own Tariff}_{k,j} + \delta_\tau \Delta \textit{Down Tariff}_{k,j} + \theta'_\tau \textit{Controls}_{k,i,j}\right) \mathbb{1}\left\{t=\tau\right\} + \alpha_{k,i} + \lambda_{k,t} + \rho_j \times t + \varepsilon_{k,i,j,t}.$$

Trade agreements are indexed by k, and firms, (SIC4-)industries, and years by i, j, and t. We use the last year before the tariff revisions as the reference year and thus omit $\mathbb{1}\left\{t=-1\right\}$. The standard errors are clustered by (SIC4-)industry.

Table 1: Summary Statistics

	(1)	(2)	(3)	(4)	(5)	(6)
Variable:	Observations	Mean	SD	*p*1	*p*50	*p*99
Up Tariff (in percentage points)	3,660	1.264	0.968	0.120	1.074	6.518
ΔUp Tariff (in percentage points)	3,660	0.234	0.176	-0.021	0.203	0.761
Own Tariff (in percentage points)	3,660	5.023	3.624	0.000	4.732	21.711
ΔOwn Tariff (in percentage points)	3,660	1.216	1.656	-1.960	0.979	5.700
Down Tariff (in percentage points)	3,660	1.177	1.731	0.012	0.527	10.686
ΔDown Tariff (in percentage points)	3,660	0.216	0.302	-0.491	0.114	1.136
Capex/Assets	3,660	0.074	0.068	0.002	0.055	0.390
Ln(Assets) (in USD million)	3,660	4.354	1.914	0.859	4.127	9.465
Tobin's Q	3,660	1.585	1.387	0.543	1.134	7.959
Cash/Assets	3,660	0.127	0.165	0.001	0.063	0.801
Debt/Assets	3,660	0.220	0.170	0.000	0.205	0.735
EBITDA/Assets	3,660	0.111	0.179	-0.671	0.141	0.397
Sales Growth	3,660	0.138	0.377	-0.633	0.095	2.019
Excess Return	3,660	0.112	0.648	-0.824	-0.036	2.891
Excess Volatility	3,660	0.029	0.021	0.003	0.024	0.102
Industry Sales Growth	3,660	0.104	0.162	-0.348	0.092	0.852
Industry Concentration (HHI)	3,660	0.237	0.162	0.042	0.192	0.789

This table presents summary statistics for the pre-treatment values of the variables used in the analysis. All variables are measured as of year $t = -1$, the last year before the implementation of the tariff revisions following the multinational trade agreements that we exploit in the difference-in-differences analysis: the implementation of the GSP (from 1976 onwards), tariff revisions agreed upon during the 7th GATT round (from 1980 onwards), and tariff revisions due to NAFTA and the 8th GATT round (from 1994 and 1995 onwards). When computing the summary statistics, we use only one observation for each combination of a trade agreement and downstream firm.

Table 2: Balance on Observables and Absence of Pre-Treatment Trends

	(1)	(2)	(3)
Dependent Variable:	Coefficient	t-statistic	Observations
Ln(Assets)$_{t=-1}$	-1.457	-1.61	3,660
Tobin's Q$_{t=-1}$	-0.133	-0.31	3,660
Cash/Assets$_{t=-1}$	0.022	0.33	3,660
Debt/Assets$_{t=-1}$	-0.007	-0.17	3,660
EBITDA/Assets$_{t=-1}$	-0.045	-0.76	3,660
Sales Growth$_{t=-1}$	-0.002	-0.02	3,660
Excess Return$_{t=-1}$	0.096	0.77	3,660
Excess Volatility$_{t=-1}$	0.009	1.63	3,660
Industry Sales Growth$_{t=-1}$	0.018	0.35	3,660
Industry Concentration (HHI)$_{t=-1}$	0.002	0.03	3,660
ΔLn(Assets)$_{t=-5,t=-1}$	-0.016	-0.12	2,836
ΔTobin's Q$_{t=-5,t=-1}$	-0.052	-0.27	2,778
ΔCash/Assets$_{t=-5,t=-1}$	0.011	0.75	2,835
ΔDebt/Assets$_{t=-5,t=-1}$	-0.009	-0.37	2,835
ΔEBITDA/Assets$_{t=-5,t=-1}$	-0.007	-0.34	2,834
ΔSales Growth$_{t=-5,t=-1}$	-0.045	-0.68	2,716
ΔExcess Return$_{t=-5,t=-1}$	0.003	0.02	2,669
ΔExcess Volatility$_{t=-5,t=-1}$	0.002	0.84	2,742
ΔIndustry Sales Growth$_{t=-5,t=-1}$	0.058	0.79	2,838
ΔIndustry Concentration$_{t=-5,t=-1}$	-0.007	-0.31	2,838

This table shows the coefficient estimates and corresponding t-statistics as well as the number of observations from regressions of the following form: $Y_{k,i,j} = \alpha_k + \beta \times \Delta \textit{Up Tariff}_{k,j} + \varepsilon_{k,i,j}$. Trade agreements (GSP, 7th GATT round, and NAFTA/8th GATT round) are indexed by k, firms by i, and industries by j. $Y_{k,i,j}$ is the dependent variable of interest for firm i in industry j and for trade agreement k, measured as of year $t = -1$ (the last year before the implementation of the tariff revisions). $\Delta Y_{t=-5,t=-1}$ is the change in $Y_{k,i,j}$ between $t = -5$ and $t = -1$. $\Delta \textit{Up Tariff}_{k,j}$ is the reduction in upstream import tariffs for industry j around trade agreement k. The standard errors are clustered by (SIC4-)industry. Statistical significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

Table 3: Difference-in-Differences Estimation Around Multinational Trade Agreements

	(1)	(2)	(3)	(4)
Dependent Variable:	Capex/Assets	Capex/Assets	Capex/Assets	Capex/Assets
(a) ΔUp Tariff $\times$ Post	2.606***	2.963***	2.307***	3.282***
	(3.69)	(3.72)	(2.88)	(2.79)
(b) ΔUp Tariff $\times$ Imp	0.594	0.738	0.398	0.909
	(0.61)	(0.74)	(0.56)	(0.99)
(c) ΔOwn Tariff $\times$ Post		-0.132	-0.122	-0.136
		(-1.55)	(-1.53)	(-1.44)
(d) ΔOwn Tariff $\times$ Imp		-0.208**	-0.175***	-0.183**
		(-2.47)	(-2.62)	(-2.50)
(e) ΔDown Tariff $\times$ Post		-0.869*	-0.922**	-0.030
		(-1.91)	(-2.21)	(-0.07)
(f) ΔDown Tariff $\times$ Imp		0.466	0.418	0.834**
		(0.92)	(1.19)	(2.35)
Trade Agreement$\times$Firm Fixed Effects	Yes	Yes	Yes	Yes
Trade Agreement$\times$Year Fixed Effects	Yes	Yes	Yes	Yes
Pre-Treatment Controls (Interacted)	No	No	Yes	Yes
SIC4-Level Time Trends	No	No	No	Yes
Adjusted R^2	0.393	0.394	0.406	0.409
Observations	38,445	38,445	38,445	38,445
p-value of test of H_0: (a) = (b)	0.023	0.011	0.008	0.002
p-value of test of H_0: (c) = (d)	–	0.304	0.471	0.536
p-value of test of H_0: (e) = (f)	–	0.002	0.000	0.026
p-value of test of H_0: (a) + (b) = 0	0.030	0.021	0.045	0.036
p-value of test of H_0: (c) + (d) = 0	–	0.028	0.021	0.036
p-value of test of H_0: (e) + (f) = 0	–	0.641	0.459	0.254

This table presents estimates of the sensitivity of downstream firms' investment (*Capex/Assets*) to upstream tariff reductions (Δ*Up Tariff*) obtained from a difference-in-differences analysis around multinational trade agreements (GSP, 7th GATT round, and NAFTA/8th GATT round). *Post* is an indicator equal to one in years $t = 3, 4, \ldots, 7$, where $t = -1$ denotes the last year before the implementation of the tariff revisions. *Imp* is an indicator for the implementation phase and equal to one in years $t = 0, 1, 2$. All coefficient estimates are multiplied by 100 to improve readability. The standard errors are clustered by (SIC4-)industry. t-statistics are reported in parentheses. Statistical significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

Table 4: Difference-in-Differences Dynamics

	(1)	(2)	(3)	(4)
Dependent Variable:	Capex/Assets	Capex/Assets	Capex/Assets	Capex/Assets
(a) ΔUp Tariff $\times$ $\mathbb{1}\{t=-5\}$	-0.357	-0.021	0.300	-0.206
	(-0.37)	(-0.02)	(0.32)	(-0.19)
(b) ΔUp Tariff $\times$ $\mathbb{1}\{t=-4\}$	0.449	0.694	0.848	0.469
	(0.46)	(0.71)	(0.85)	(0.43)
(c) ΔUp Tariff $\times$ $\mathbb{1}\{t=-3\}$	0.042	0.019	0.225	-0.053
	(0.05)	(0.02)	(0.26)	(-0.06)
(d) ΔUp Tariff $\times$ $\mathbb{1}\{t=-2\}$	-0.413	-0.414	0.083	-0.050
	(-0.66)	(-0.67)	(0.13)	(-0.08)
(e) ΔUp Tariff $\times$ $\mathbb{1}\{t=0\}$	-0.296	-0.250	-0.151	0.047
	(-0.36)	(-0.35)	(-0.25)	(0.07)
(f) ΔUp Tariff $\times$ $\mathbb{1}\{t=1\}$	-0.106	0.440	0.263	0.583
	(-0.08)	(0.38)	(0.24)	(0.47)
(g) ΔUp Tariff $\times$ $\mathbb{1}\{t=2\}$	2.052**	2.630***	2.329***	2.782***
	(2.15)	(3.65)	(3.22)	(3.25)
(h) ΔUp Tariff $\times$ $\mathbb{1}\{t=3\}$	2.704***	3.079***	2.779***	3.340***
	(3.12)	(3.77)	(3.08)	(3.21)
(i) ΔUp Tariff $\times$ $\mathbb{1}\{t=4\}$	1.649*	1.822**	1.558*	2.267*
	(1.72)	(2.03)	(1.67)	(1.93)
(j) ΔUp Tariff $\times$ $\mathbb{1}\{t=5\}$	2.620**	2.782***	2.412**	3.300**
	(2.48)	(3.16)	(2.55)	(2.60)
(k) ΔUp Tariff $\times$ $\mathbb{1}\{t=6\}$	2.528**	2.910***	1.703*	2.677**
	(2.46)	(2.99)	(1.85)	(2.12)
(l) ΔUp Tariff $\times$ $\mathbb{1}\{t=7\}$	3.469***	3.690***	3.084***	4.119***
	(3.53)	(3.50)	(2.88)	(3.16)
Trade Agreement×Firm Fixed Effects	Yes	Yes	Yes	Yes
Trade Agreement×Year Fixed Effects	Yes	Yes	Yes	Yes
ΔOwn Tariff (Interacted)	No	Yes	Yes	Yes
ΔDown Tariff (Interacted)	No	Yes	Yes	Yes
Pre-Treatment Controls (Interacted)	No	No	Yes	Yes
SIC4-Level Time Trends	No	No	No	Yes
Adjusted R^2	0.393	0.396	0.422	0.425
Observations	38,445	38,445	38,445	38,445
p-value of test of H_0: (a) = (b) = (c) = (d) = 0	0.647	0.632	0.892	0.880

This table presents estimates of the sensitivity of downstream firms' investment (*Capex/Assets*) to upstream tariff reductions (Δ*Up Tariff*) obtained from a difference-in-differences analysis around multinational trade agreements (GSP, 7th GATT round, and NAFTA/8th GATT round) using the following regression: $\textit{Investment}_{k,i,j,t} = \sum_{\tau=-5}^{7} \left(\beta_\tau \Delta \textit{Up Tariff}_{k,j} + \gamma_\tau \Delta \textit{Own Tariff}_{k,j} + \delta_\tau \Delta \textit{Down Tariff}_{k,j} + \theta'_\tau \textit{Controls}_{k,i,j}\right) \mathbb{1}\{t=\tau\} + \alpha_{k,i} + \lambda_{k,t} + \rho_j \times t + \varepsilon_{k,i,j,t}$. Trade agreements are indexed by k, and firms, (SIC4-)industries, and years by i, j, and t. We use the last year before the tariff revisions as the reference year and thus omit $\mathbb{1}\{t=-1\}$. All coefficient estimates are multiplied by 100 to improve readability. The standard errors are clustered by (SIC4-)industry. *t*-statistics are reported in parentheses. Statistical significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

Table 5: Efficient Investment vs. Over-Investment

Panel A: Sensitivity of Downstream Profitability and Productivity at the Firm- and Industry-Level to Upstream Tariff Reductions

	(1)	(2)	(3)	(4)
Dependent Variable:	Firm-Level Gross Profit/Assets	Firm-Level Ln(TFP)	Industry-Level Gross Profit/Output	Industry-Level Ln(TFP)
ΔUp Tariff × Post	6.877***	3.968	6.474***	4.264**
	(3.71)	(0.38)	(3.27)	(2.15)
ΔUp Tariff × Imp	3.840***	1.765	2.868***	4.297***
	(2.96)	(0.21)	(3.00)	(3.48)
Adjusted R^2	0.781	0.706	0.919	0.831
Observations	38,445	37,820	13,183	13,183

Panel B: Sensitivity of Downstream Investment to Upstream Tariff Reductions in Different Sub-Samples (Splits Based on Firm-Level Variables)

	(1)	(2)	(3)	(4)	(5)	(6)
Sub-Sample:	High Increase in Gross Profit/Assets	Low Increase in Gross Profit/Assets	High Increase in Ln(TFP)	Low Increase in Ln(TFP)	High Inst. Ownership	Low Inst. Ownership
Dependent Variable:	Capex/Assets	Capex/Assets	Capex/Assets	Capex/Assets	Capex/Assets	Capex/Assets
(a) ΔUp Tariff × Post	4.440***	0.816	4.170***	1.565	3.390**	1.943
	(3.24)	(0.45)	(3.76)	(0.80)	(2.48)	(1.19)
(b) ΔUp Tariff × Imp	2.658***	-0.738	2.221***	-0.513	0.705	0.930
	(3.44)	(-0.36)	(3.05)	(-0.26)	(0.49)	(1.19)
Adjusted R^2	0.396	0.426	0.428	0.398	0.491	0.326
Observations	13,387	13,407	13,027	13,039	18,350	18,573
p-value of test of H_0: (a) in (1) = (a) in (2)		0.114				
p-value of test of H_0: (b) in (1) = (b) in (2)		0.143				
p-value of test of H_0: (a) in (3) = (a) in (4)				0.193		
p-value of test of H_0: (b) in (3) = (b) in (4)				0.180		
p-value of test of H_0: (a) in (5) = (a) in (6)						0.423
p-value of test of H_0: (b) in (5) = (b) in (6)						0.888

This table presents estimates of the sensitivity of downstream profitability and productivity at the firm- and industry-level to upstream tariff reductions in Panel A and estimates of the sensitivity of downstream firms' investment to upstream tariff reductions in various sub-samples in Panel B. All specifications control for Trade Agreement×Firm Fixed Effects (Trade Agreement×Industry Fixed Effects in Columns (3) and (4) of Panel A), Trade Agreement×Year Fixed Effects, ΔOwn Tariff (Interacted), ΔDown Tariff (Interacted), Pre-Treatment Controls (Interacted), and SIC4-Level Time Trends. All coefficient estimates are multiplied by 100 to improve readability. The standard errors are clustered by (SIC4-)industry. t-statistics are reported in parentheses. Statistical significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

Table 6: Controlling for Changes in Uncertainty

	(1)	(2)	(3)	(4)
Dependent Variable:	Capex/Assets	Capex/Assets	Capex/Assets	Capex/Assets
ΔUp Tariff $\times$ Post	2.485***	2.817***	2.305***	3.271***
	(3.53)	(3.53)	(2.86)	(2.74)
ΔUp Tariff $\times$ Imp	0.462	0.667	0.410	0.909
	(0.45)	(0.64)	(0.52)	(0.92)
ΔUncertainty $\times$ Post	0.498***	0.491***	0.414***	0.390***
	(7.36)	(7.12)	(6.14)	(5.70)
ΔUncertainty $\times$ Imp	0.349***	0.350***	0.256***	0.241***
	(6.24)	(6.23)	(4.38)	(4.11)
ΔOwn Tariff $\times$ Post		-0.130	-0.122	-0.150
		(-1.55)	(-1.54)	(-1.54)
ΔOwn Tariff $\times$ Imp		-0.250***	-0.220***	-0.236***
		(-3.00)	(-3.21)	(-3.21)
ΔDown Tariff $\times$ Post		-0.805*	-0.899**	0.055
		(-1.72)	(-2.08)	(0.12)
ΔDown Tariff $\times$ Imp		0.413	0.343	0.809**
		(0.75)	(0.87)	(2.03)
Trade Agreement$\times$Firm Fixed Effects	Yes	Yes	Yes	Yes
Trade Agreement$\times$Year Fixed Effects	Yes	Yes	Yes	Yes
Pre-Treatment Controls (Interacted)	No	No	Yes	Yes
SIC4-Level Time Trends	No	No	No	Yes
Adjusted R^2	0.391	0.392	0.404	0.407
Observations	34,205	34,205	34,205	34,205

This table presents estimates of the sensitivity of downstream firms' investment (*Capex/Assets*) to upstream tariff reductions (Δ*Up Tariff*) when controlling for the impact of changes in uncertainty (ΔUncertainty). All estimates are obtained from a difference-in-differences analysis around multinational trade agreements (GSP, 7th GATT round, and NAFTA/8th GATT round). *Post* is an indicator equal to one in years $t = 3, 4, \ldots, 7$, where $t = -1$ denotes the last year before the implementation of the tariff revisions. *Imp* is an indicator for the implementation phase and equal to one in years $t = 0, 1, 2$. All coefficient estimates are multiplied by 100 to improve readability. The standard errors are clustered by (SIC4-)industry. *t*-statistics are reported in parentheses. Statistical significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

Table 7: Cross-Sectional Variation

Panel A: Downstream Firms with High vs. Low Material Costs

	(1)	(2)
Sub-Sample:	High Material Costs	Low Material Costs
Dependent Variable:	Capex/Assets	Capex/Assets
(a) ΔUp Tariff $\times$ Post	6.029***	0.210
	(5.13)	(0.20)
(b) ΔUp Tariff $\times$ Imp	2.666***	-1.260
	(3.96)	(-1.03)
Adjusted R^2	0.411	0.413
Observations	18,302	20,143
p-value of test of H_0: (a) in (1) = (a) in (2)	0.000	
p-value of test of H_0: (b) in (1) = (b) in (2)	0.005	

Panel B: Tariff Reductions on Homogeneous (Low-R&D) vs. Differentiated (High-R&D) Goods

	(1)	(2)
Dependent Variable:	Capex/Assets	Capex/Assets
(a) ΔUp Tariff for Homogeneous Goods $\times$ Post	5.380**	
	(2.29)	
(b) ΔUp Tariff for Differentiated Goods $\times$ Post	-0.315	
	(-0.22)	
(c) ΔUp Tariff for Homogeneous Goods $\times$ Imp	1.411	
	(1.06)	
(d) ΔUp Tariff for Differentiated Goods $\times$ Imp	-0.910	
	(-0.84)	
(a) ΔUp Tariff for Low-R&D Goods $\times$ Post		6.586***
		(3.55)
(b) ΔUp Tariff for High-R&D Goods $\times$ Post		-1.462
		(-0.77)
(c) ΔUp Tariff for Low-R&D Goods $\times$ Imp		2.096*
		(1.74)
(d) ΔUp Tariff for High-R&D Goods $\times$ Imp		-1.312
		(-1.07)
Adjusted R^2	0.408	0.409
Observations	38,445	38,445
p-value of test of $H_0 : (a) = (b)$	0.031	0.003
p-value of test of $H_0 : (c) = (d)$	0.100	0.016

Panel C: Concentrated vs. Dispersed Downstream Industries

	(1)	(2)	(3)	(4)
Sub-Sample:	Concentrated (High HHI)	Dispersed (Low HHI)	Concentrated (High Top4Share)	Dispersed (Low Top4Share)
Dependent Variable:	Capex/Assets	Capex/Assets	Capex/Assets	Capex/Assets
(a) ΔUp Tariff $\times$ Post	4.800***	0.582	4.680***	1.197
	(2.94)	(0.35)	(2.91)	(0.68)
(b) ΔUp Tariff $\times$ Imp	2.388***	-1.124	2.836***	-1.578
	(2.97)	(-0.97)	(3.57)	(-1.17)
Adjusted R^2	0.416	0.404	0.425	0.396
Observations	18,798	19,647	18,752	19,693
p-value of test of H_0: (a) in (1) = (a) in (2)		0.081		
p-value of test of H_0: (b) in (1) = (b) in (2)		0.009		
p-value of test of H_0: (a) in (3) = (a) in (4)				0.168
p-value of test of H_0: (b) in (3) = (b) in (4)				0.007

Panel D: Financially Unconstrained vs. Constrained Downstream Firms

	(1)	(2)	(3)	(4)	(5)	(6)
Sub-Sample:	Unconstrained (High Assets)	Constrained (Low Assets)	Unconstrained (Dividend)	Constrained (No Dividend)	Unconstrained (Low WW-Ind.)	Constrained (High WW-Ind.)
Dependent Variable:	Capex/Assets	Capex/Assets	Capex/Assets	Capex/Assets	Capex/Assets	Capex/Assets
(a) ΔUp Tariff $\times$ Post	4.703***	0.651	4.833***	-1.078	5.248***	-0.250
	(3.76)	(0.36)	(4.41)	(-0.66)	(4.54)	(-0.13)
(b) ΔUp Tariff $\times$ Imp	0.668	1.128	1.240*	0.104	1.158	0.553
	(0.52)	(1.36)	(1.74)	(0.06)	(1.04)	(0.48)
Adjusted R^2	0.482	0.356	0.426	0.398	0.487	0.361
Observations	19,121	19,324	22,724	15,566	19,013	19,160
p-value of test of H_0: (a) in (1) = (a) in (2)		0.032				
p-value of test of H_0: (b) in (1) = (b) in (2)		0.728				
p-value of test of H_0: (a) in (3) = (a) in (4)				0.002		
p-value of test of H_0: (b) in (3) = (b) in (4)				0.501		
p-value of test of H_0: (a) in (5) = (a) in (6)						0.009
p-value of test of H_0: (b) in (5) = (b) in (6)						0.646

This table presents results from cross-sectional tests. Panel A shows estimates of the sensitivity of downstream firms' investment (*Capex/Assets*) to upstream tariff reductions (Δ*Up Tariff*) in the sub-sample of downstream firms with high material costs and in the sub-sample of downstream firms with low material costs. Panel B shows estimates of the sensitivity to upstream tariff reductions for homogeneous goods (Δ*Up Tariff for Homogeneous Goods*) and differentiated goods (Δ*Up Tariff for Differentiated Goods*) as well as for goods with low R&D-intensity (Δ*Up Tariff for Low-R&D Goods*) and high R&D-intensity (Δ*Up Tariff for High-R&D Goods*). Panel C shows estimates of the sensitivity in the sub-sample of downstream firms in concentrated industries and in the sub-sample of downstream firms in dispersed industries. Panel D shows estimates of the sensitivity in the sub-sample of downstream firms that are more likely to be financially constrained and in the sub-sample of downstream firms that are less likely to be financially constrained. All specifications control for Trade Agreement$\times$Firm Fixed Effects, Trade Agreement$\times$Year Fixed Effects, ΔOwn Tariff (Interacted), ΔDown Tariff (Interacted), Pre-Treatment Controls (Interacted), and SIC4-Level Time Trends. All coefficient estimates are multiplied by 100 to improve readability. The standard errors are clustered by (SIC4-)industry. t-statistics are reported in parentheses. Statistical significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

Table 8: Summary Statistics at the Industry-Level

	(1)	(2)	(3)	(4)	(5)	(6)
Variable:	Observations	Mean	SD	*p*1	*p*50	*p*99
Up Tariff (in percentage points)	1,016	1.758	1.828	0.100	1.284	9.910
ΔUp Tariff (in percentage points)	1,016	0.259	0.243	-0.071	0.215	1.039
Own Tariff (in percentage points)	1,016	6.792	5.775	0.000	5.333	28.273
ΔOwn Tariff (in percentage points)	1,016	1.168	1.806	-2.617	0.972	7.512
Down Tariff (in percentage points)	1,016	1.730	2.450	0.004	0.830	13.538
ΔDown Tariff (in percentage points)	1,016	0.279	0.385	-0.157	0.115	1.429
Capex/Capital	1,016	0.075	0.052	0.019	0.068	0.182
Input Price	1,016	2.760	0.975	1.293	2.560	5.340
Ln(Input)	1,016	7.264	1.238	4.321	7.260	10.748
Ln(Output)	1,016	7.966	1.195	5.328	7.950	11.110
Ln(Employment)	1,016	3.265	1.075	0.693	3.201	5.935
Ln(TFP)	1,016	-0.035	0.185	-0.486	-0.023	0.406
Sales Growth	1,016	0.061	0.108	-0.237	0.060	0.335
Production Workers/Employment	1,016	0.732	0.116	0.380	0.755	0.909

This table presents summary statistics for the pre-treatment values of the variables used in the industry-level analysis. All variables are measured as of year $t = -1$, the last year before the implementation of the tariff revisions following the multinational trade agreements that we exploit in the difference-in-differences analysis: the implementation of the GSP (from 1976 onwards), tariff revisions agreed upon during the 7th GATT round (from 1980 onwards), and tariff revisions due to NAFTA and the 8th GATT round (from 1994 and 1995 onwards).

Table 9: Outcomes at the Industry-Level

	(1)	(2)	(3)	(4)	(5)
Dependent Variable:	Capex/Capital	Input Price	Ln(Real Input)	Ln(Real Output)	Ln(Employment)
ΔUp Tariff $\times$ Post	1.381**	-14.088***	19.102***	17.569***	18.984***
	(2.02)	(-2.75)	(2.93)	(2.86)	(3.70)
ΔUp Tariff $\times$ Imp	0.092	-16.934***	6.062*	7.775***	6.953***
	(0.18)	(-4.67)	(1.87)	(2.76)	(2.89)
Trade Agreement$\times$SIC4 Fixed Effects	Yes	Yes	Yes	Yes	Yes
Trade Agreement$\times$Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
ΔOwn Tariff (Interacted)	Yes	Yes	Yes	Yes	Yes
ΔDown Tariff (Interacted)	Yes	Yes	Yes	Yes	Yes
Pre-Treatment Controls (Interacted)	Yes	Yes	Yes	Yes	Yes
SIC4-Level Time Trends	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.420	0.974	0.987	0.988	0.989
Observations	13,188	13,183	13,183	13,183	13,183

This table presents estimates of the sensitivity of different (downstream-)industry-level variables to upstream tariff reductions (Δ*Up Tariff*) obtained from a difference-in-differences analysis around multinational trade agreements (GSP, 7th GATT round, and NAFTA/8th GATT round). *Post* is an indicator equal to one in years $t = 3, 4, \ldots, 7$, where $t = -1$ denotes the last year before the implementation of the tariff revisions. *Imp* is an indicator for the implementation phase and equal to one in years $t = 0, 1, 2$. All coefficient estimates are multiplied by 100 to improve readability. The standard errors are clustered by (SIC4-)industry. *t*-statistics are reported in parentheses. Statistical significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

Table 10: 2SLS IV Estimation Exploiting Variation in Import Competition from China

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Up CIP	Up CIP	Own CIP	Own CIP	Down CIP	Down CIP	Capex/Assets	Capex/Assets
Up CIPO	1.141***	1.137***	2.476***	2.433***	0.179***	0.176***		
	(22.11)	(23.30)	(3.10)	(3.24)	(3.34)	(3.36)		
Own CIPO	0.001	0.001	1.105***	1.106***	-0.014**	-0.014***		
	(0.11)	(0.16)	(7.41)	(7.49)	(-2.57)	(-2.62)		
Down CIPO	-0.067***	-0.069***	-1.243***	-1.268***	1.313***	1.313***		
	(-3.14)	(-3.32)	(-2.75)	(-2.83)	(53.30)	(55.54)		
Up CIP (instrumented)							0.385***	0.276***
							(2.62)	(2.71)
Own CIP (instrumented)							-0.032***	-0.023***
							(-2.99)	(-2.91)
Down CIP (instrumented)							-0.210***	-0.213***
							(-2.69)	(-3.58)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes	No	Yes
F-statistic on Instruments	418	426	40	40	1,435	1,630	–	–
Adjusted R^2	0.979	0.979	0.927	0.928	0.989	0.989	0.002	0.074
Observations	29,328	29,328	29,328	29,328	29,328	29,328	29,328	29,328

This table presents estimates of the sensitivity of downstream firms' investment (*Capex/Assets*) to upstream import penetration from China (*Up CIP*) obtained from 2SLS IV regressions using the import penetration in other developed countries as instruments for Chinese import penetration in the US. The standard errors are clustered by (SIC4-)industry. *t*-statistics are reported in parentheses. Statistical significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

Internet Appendix to

The Downstream Impact of Upstream Tariffs: Evidence from Investment Decisions in Supply Chains

*** Not for Publication ***

Theoretical Framework

Baseline Model (Prediction 1)

We consider a firm that invests in productive capacity. If the firm invests $i \in \mathbb{R}_+$ at cost $c(i)$, it can produce $f(i)$ units of output. For example, $f(i)$ could be the capacity of a factory built at cost $c(i)$.[1] The firm can produce each unit of output at cost k and sell it at price p, so the profit per unit of output is $\pi = p - k$. The firm thus chooses its investment i to maximize

$$\Pi = \pi f(i) - c(i). \tag{A1}$$

We assume $f'(i) > 0$ and $c'(i) > 0$ as well as $f''(i) \leq 0$ and $c''(i) \geq 0$, where at least one inequality is strict. We further assume $\lim_{i \to 0} \pi f'(i) > \lim_{i \to 0} c'(i)$ to guarantee that an interior optimum level of investment exists. This optimum, i^*, is given by the first order condition

$$\pi f'(i^*) = c'(i^*), \tag{A2}$$

i.e., the marginal benefit is equal to the marginal cost. Applying the implicit function theorem to (A2) shows that the optimal investment is increasing in the profit per unit of output:

$$\frac{di^*}{d\pi} = -\frac{f'(i^*)}{\pi f''(i^*) - c''(i^*)} > 0. \tag{A3}$$

Intuitively, a higher profit per unit of output increases the incentives to invest in productive capacity.

[1] In the simplest case, the cost of investment could just be the investment itself, i.e., $c(i) = i$. In general, however, the total cost $c(i)$ could exceed the amount i of the investment, for example, if the firm must raise external funds, which could be costly due to agency problems, asymmetric information, or an increase in the expected cost of financial distress, or if investing i necessitates foregoing alternative investment opportunities.

To assess the relation between upstream tariffs and downstream investment, we now assume that the profit π per unit of output is decreasing in the import tariff τ on some input supplied by an upstream industry and needed to produce the downstream output, i.e.,

$$\pi = \pi(\tau) \;\text{ with }\; \pi'(\tau) < 0. \tag{A4}$$

The negative relation between the profit per unit of output and the tariff could operate through multiple, non mutually exclusive channels. A lower upstream tariff could reduce the price at which the downstream firm can purchase its input from upstream suppliers and thereby lower the cost of producing its output (e.g., De Loecker et al. 2016; Blaum et al. 2018).[2] Further, a lower tariff could increase the quality and variety of the available input (e.g., Goldberg et al. 2010) and thereby increase the price at which the downstream firm can sell its output.

Using $\pi'(\tau) < 0$, we obtain

$$\frac{di^*}{d\tau} = \pi'(\tau)\frac{di^*}{d\pi} = -\frac{\pi'(\tau)f'(i^*)}{\pi(\tau)f''(i^*) - c''(i^*)} < 0, \tag{A5}$$

i.e., the optimal amount of investment is decreasing in the upstream tariff rate.

Share of Input Costs in Overall Production Costs (Prediction 2)

Suppose that producing one unit of downstream output requires $n > 0$ units of an input procured from upstream suppliers at unit-cost $y(\tau)$, with $y'(\tau) > 0$, and $m \geq 0$ units of other resources

[2] For example, a lower tariff reduces the cost at which the input can be imported. A lower tariff can also increase import competition, which can in turn lead to an increase in supplier productivity and thus a decrease in the marginal cost of producing the input (Melitz and Trefler 2012). Further, a lower tariff can reduce the markup that upstream suppliers charge. Consider, for instance, the case of monopolistic competition so that the markup is decreasing in the number of suppliers. A lower tariff that leads to an increase in the number of foreign suppliers that compete on the domestic market can then lead to a reduction in the markup.

(e.g., labor) with unit-cost z. Upstream tariff reductions thus reduce the cost of the input procured from the upstream suppliers but not the cost of the other resources.[3]

The downstream firm's profit per unit of output is now

$$\pi(\tau) = p - k = p - n \times y(\tau) - m \times z, \tag{A6}$$

and the relation between the optimal amount of investment and the upstream tariff rate becomes

$$\frac{di^*}{d\tau} = \frac{n \times y'(\tau) f'(i^*)}{\pi(\tau) f''(i^*) - c''(i^*)} < 0. \tag{A7}$$

For a given unit-cost of production $k = \bar{k}$, a firm's investment response to upstream tariff changes is thus more pronounced if its input costs are relatively more important. Specifically, using $\lambda = n \times y(\tau)/\bar{k}$ to denote the share of input costs in the overall production cost, we obtain

$$\frac{\partial \frac{di^*}{d\tau}}{\partial \lambda} = \frac{y'(\tau)}{y(\tau)} \times \frac{\bar{k} f'(i^*)}{\pi(\tau) f''(i^*) - c''(i^*)} < 0. \tag{A8}$$

Differentiated vs. Homogeneous Inputs (Prediction 3)

Suppose that the upstream supplier from whom the downstream firm plans to procure its input (after having invested in productive capacity) succumbs to foreign competition with probability $\phi(\tau) \in (0, 1)$, where $\phi'(\tau) < 0$. That is, a higher import tariff protects the supplier, and a lower tariff makes it more likely that the supplier goes out of business. If the supplier survives, then the downstream firm's payoff (gross of the investment expense) is $\pi(\tau) f(i)$, with $\pi'(\tau) < 0$, as before. If the supplier goes out of business, however, then the downstream firm's payoff is $\delta \times \pi(\tau) f(i)$. We assume $\delta = 1$ if the supplier produced a homogeneous input (e.g., cement) and can easily be replaced with another supplier. In that case, a supply chain disruption does not

[3] Potential increases in the input's quality (or variety) can be interpreted here as decreases in its quality-adjusted cost.

affect the downstream firm's payoff. If, instead, the supplier produced a differentiated input (e.g., industrial machinery), we assume $0 \leq \delta < 1$. The idea is that the use of differentiated inputs requires relationship-specific investments and therefore makes it costly to switch suppliers.[4] In this case, a supply chain disruption reduces the downstream firm's payoff.

In the former case, with homogeneous inputs, the downstream firm thus maximizes

$$E\left[\Pi\right] = \left[1-\phi(\tau)\right]\pi(\tau)f(i) + \phi(\tau)\pi(\tau)f(i) - c(i) = \pi(\tau)f(i) - c(i), \tag{A9}$$

as before, and the optimal amount of investment is given by

$$\pi(\tau)f'(i^*) = c'(i^*) \ \text{ with } \ \frac{di^*}{d\tau} = -\frac{\pi'(\tau)f'(i^*)}{\pi(\tau)f''(i^*) - c''(i^*)} < 0. \tag{A10}$$

In the latter case, with differentiated inputs, the downstream firm instead maximizes

$$E\left[\Pi\right] = \left[1-\phi(\tau)\right]\pi(\tau)f(i) + \phi(\tau)\delta\pi(\tau)f(i) - c(i) = \left[1-(1-\delta)\,\phi(\tau)\right]\pi(\tau)f(i) - c(i), \tag{A11}$$

and the optimal amount of investment (assuming an interior optimum exists) is given by

$$\left[1-(1-\delta)\,\phi(\tau)\right]\pi(\tau)f'(i^*) = c'(i^*) \tag{A12}$$

with

$$\frac{di^*}{d\tau} = \frac{\left\{(1-\delta)\,\phi'(\tau)\pi(\tau) - \pi'(\tau)\left[1-(1-\delta)\,\phi(\tau)\right]\right\}f'(i^*)}{\left[1-(1-\delta)\,\phi(\tau)\right]\pi(\tau)f''(i^*) - c''(i^*)}. \tag{A13}$$

We thus obtain $di^*/d\tau < 0$ if and only if

$$\frac{\pi'(\tau)}{\phi'(\tau)} > \frac{(1-\delta)\,\pi(\tau)}{1-(1-\delta)\,\phi(\tau)} \ \Leftrightarrow \ \delta > \frac{\pi(\tau) - \left[1-\phi(\tau)\right]\frac{\pi'(\tau)}{\phi'(\tau)}}{\pi(\tau) + \phi(\tau)\frac{\pi'(\tau)}{\phi'(\tau)}}. \tag{A14}$$

That is, in the case of differentiated inputs, an upstream tariff reduction leads to an increase in the downstream firm's investment only if the increase in the profit per unit of output is sufficiently

[4] Note that the need for relationship-specific investments is a common assumption in the literature on international sourcing decisions (e.g., Antràs 2003; Antràs and Helpman 2004; Antràs and Chor 2013; Alfaro et al. 2019).

large, relative to the increase in the probability that the upstream supplier goes out of business, or, equivalently, if the cost of a supply chain disruption is sufficiently small (i.e., δ sufficiently large).

Comparing the investment responses in the two cases, we further obtain

$$-\frac{\pi'(\tau)f'(i^*)}{\pi(\tau)f''(i^*)-c''(i^*)} < \frac{\{(1-\delta)\,\phi'(\tau)\pi(\tau)-\pi'(\tau)\,[1-(1-\delta)\,\phi(\tau)]\}\,f'(i^*)}{[1-(1-\delta)\,\phi(\tau)]\,\pi(\tau)f''(i^*)-c''(i^*)} \tag{A15}$$

if and only if

$$\pi'(\tau)\phi(\tau)c''(i^*)-\phi'(\tau)\pi(\tau)\,[\pi(\tau)f''(i^*)-c''(i^*)]<0, \tag{A16}$$

which is satisfied, all else equal, given the assumptions on π, ϕ, c, and f. That is, the investment response is more pronounced in the case of homogeneous, rather than differentiated, inputs.[5]

Bargaining Power (Prediction 4)

Let Σ denote the total gains from trade between an upstream supplier, the downstream firm, and its customer. That is, Σ is the total surplus that can be achieved if the supplier supplies the input, the downstream firm produces the output, and the customer buys the output. Assume further that $\Sigma = \Sigma(\tau)$ with $\Sigma'(\tau) < 0$. That is, reducing the import tariff on the input increases the total surplus that can be achieved. As argued above, this could be the case because tariff reductions decrease the cost at which the input can be imported or increase the quality or variety of the input.

Assume further that, whatever the process through which the prices for the input and output are set, the final outcome is efficient in the sense that the upstream supplier, the downstream firm, and

[5]This result also holds if we assume that tariff reductions for differentiated goods have a smaller effect on the downstream firm's input costs – and, hence, marginal profit – than for homogeneous goods (e.g., because product differentiation could help to protect suppliers from price competition). Specifically, if we assume $0 > \hat{\pi}'(\tau) > \pi'(\tau)$, where $\hat{\pi}'(\tau)$ is the effect for differentiated goods, then inequality (A16) becomes $\hat{\pi}'(\tau)\phi(\tau)c''(i^*) - \phi'(\tau)\pi(\tau)\,[\pi(\tau)f''(i^*)-c''(i^*)] < 0 < [\pi'(\tau)-\hat{\pi}'(\tau)]\,\frac{[1-(1-\delta)\phi(\tau)]\pi(\tau)f''(i^*)-c''(i^*)}{1-\delta}$.

the customer split the total surplus as follows: The supplier receives $\alpha\Sigma(\tau)$, the downstream firm $\beta\Sigma(\tau)$, and the customer $\gamma\Sigma(\tau)$, with $(\alpha, \beta, \gamma) \in [0, 1]^3$ and $\alpha + \beta + \gamma = 1$. That is, α, β, and γ can be interpreted as the supplier's, the downstream firm's, and the customer's bargaining power.

The price k at which the downstream firm buys the input from the supplier and the price p at which it sells its output to the customer (and hence the profit π per unit of output) must thus satisfy

$$p - k = \beta\Sigma(\tau) = \pi(\tau). \tag{A17}$$

All else equal, the downstream firm's investment response to a change in the upstream tariff,

$$\frac{di^*}{d\tau} = \pi'(\tau)\frac{di^*}{d\pi} = -\beta\Sigma'(\tau)\frac{f'(i^*)}{\pi(\tau)f''(i^*) - c''(i^*)} < 0, \tag{A18}$$

is therefore more pronounced if the downstream firm's bargaining power (β) is higher.

Financial Constraints (Prediction 5)

Suppose that the downstream firm chooses its investment $i \in \mathbb{R}_+$ to maximize

$$\Pi = \pi(\tau)f(i) - c(i) \tag{A19}$$

with π, f, and c, as before, but now also subject to the following financial constraint:

$$i \leq \lambda(\tau) \;\text{ with }\; 0 \leq \lambda(\tau_n) \leq \lambda(\tau_m) \;\text{ for any tariffs } \tau_m \text{ and } \tau_n \text{ such that } 0 \leq \tau_m \leq \tau_n. \tag{A20}$$

That is, upstream tariff reductions not only increase the downstream firm's profit per unit of output but may also relax the firm's financial constraint. This could be the case, for example, because lower upstream tariffs decrease the firm's input costs and thereby increase the profit per unit of output, which in turn translates into higher cash flows from existing operations.[6] It follows that the firm invests $i = \lambda(\tau)$ if the financial constraint is binding and otherwise invests $i = i^*$ given by

$$\pi(\tau)f'(i^*) = c'(i^*) \text{ with } \frac{di^*}{d\tau} < 0. \tag{A21}$$

Consider now two tariffs levels, τ_1 and $\tau_2 < \tau_1$, the corresponding investments, $i_1 \in \{\lambda(\tau_1), i_1^*\}$ and $i_2 \in \{\lambda(\tau_2), i_2^*\}$, and their differences $\Delta = i_2 - i_1$. There are four cases:

(a) The financial constraint is neither binding at τ_1 nor at τ_2: $\Delta_{(a)} = i_2^* - i_1^* > 0$.

(b) The financial constraint is not binding at τ_1 but is binding at τ_2: $\Delta_{(b)} = \lambda(\tau_2) - i_1^* > 0$.

(c) The financial constraint is binding at τ_1 but not at τ_2: $\Delta_{(c)} = i_2^* - \lambda(\tau_1) > 0$.

(d) The financial constraint is binding at τ_1 and at τ_2: $\Delta_{(d)} = \lambda(\tau_2) - \lambda(\tau_1) \geq 0$.

A tariff reduction thus implies an increase in investment – unless the tariff reduction does not relax the firm's binding financial constraint, in which case its investment does not change. Further, if the tariff reduction does not relax the constraint – i.e., if $\lambda(\tau_2) = \lambda(\tau_1)$, which in turn rules out case (c) and implies $\Delta_{(d)} = 0$ – then the increase in investment is largest for a firm that is unconstrained both before and after the tariff reduction: $\Delta_{(a)} > \Delta_{(b)} > \Delta_{(d)} = 0$. However, if the tariff reduction relaxes the constraint – i.e., if $\lambda(\tau_2) > \lambda(\tau_1)$ – then it is possible that the increase in investment for a firm that was initially constrained is larger than for an unconstrained firm: For example, $\Delta_{(c)} > \Delta_{(a)}$.[7] Hence, whether the presence of financial constraints reduces or increases the investment response, relative to the unconstrained case, is a priori an empirical question.

[6] Note, however, that a relaxation of the financial constraint is not a foregone conclusion: If the reason for the constraint is the limited pledgeability of the firms' income – e.g., due to moral hazard or adverse selection problems (Tirole 2006) – then an upstream tariff reduction is unlikely to substantially relax the constraint.

[7] Note that it is also possible that $\Delta_{(d)} > \Delta_{(a)}$ in that case.

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Supplemental Analyses and Robustness Tests

Table A.1: Summary Statistics for Industries' Most Important Customers and Suppliers

	(1)	(2)	(3)	(4)	(5)	(6)
	Obs.	Mean	SD	*p*1	*p*50	*p*99
Max Customer Weight (based on 1972 BEA Table)	121	0.068	0.088	0.000	0.031	0.462
Max Customer Weight (based on 1977 BEA Table)	119	0.070	0.090	0.000	0.036	0.486
Max Customer Weight (based on 1992 BEA Table)	128	0.067	0.087	0.000	0.042	0.436
Max Supplier Weight (based on 1972 BEA Table)	121	0.088	0.076	0.004	0.065	0.371
Max Supplier Weight (based on 1977 BEA Table)	119	0.094	0.084	0.005	0.064	0.360
Max Supplier Weight (based on 1992 BEA Table)	128	0.077	0.072	0.009	0.060	0.303

This table presents summary statistics for the fraction of an industry's total sales accounted for by the most important downstream (i.e., customer) industry in terms of sales volume (*Max Customer Weight*) as well as for the fraction of an industry's total purchases accounted for by the most important upstream (i.e., supplier) industry in terms of purchase volume (*Max Supplier Weight*).

Table A.2: Sensitivity of Downstream Investment to Upstream Tariffs

	(1)	(2)	(3)	(4)
Dependent Variable:	Capex/Assets	Capex/Assets	Capex/Assets	Capex/Assets
Up Tariff	-1.216***	-1.269***	-1.155***	-1.782***
	(-3.47)	(-3.02)	(-3.02)	(-2.78)
Own Tariff		0.035	0.015	0.012
		(0.87)	(0.56)	(0.53)
Down Tariff		0.005	0.141	0.052
		(0.02)	(0.62)	(0.13)
Firm Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Controls	No	No	Yes	Yes
SIC4-Level Time Trends	No	No	No	Yes
Adjusted R^2	0.350	0.351	0.423	0.431
Observations	31,789	31,789	31,789	31,789

This table presents estimates from a panel regression of downstream firms' investment (*Capex/Assets*) on upstream import tariffs (*Up Tariff*), tariffs in the firms' own industries (*Own Tariff*), and downstream tariffs (*Down Tariff*): $\textit{Investment}_{i,j,t} = \beta \times \textit{Up Tariff}_{j,t} + \gamma \times \textit{Own Tariff}_{j,t} + \delta \times \textit{Down Tariff}_{j,t} + \theta' \textit{Controls}_{i,j,t-1} + \alpha_i + \lambda_t + \rho_j \times t + \varepsilon_{i,j,t}$. Firms, (SIC4-)industries, and years are indexed by i, j, and t. *Investment* is capital expenditures scaled by beginning of year assets. *Up Tariff*, *Own Tariff*, and *Down Tariff* are the tariffs in upstream, own, and downstream industries. To compute the import-value-weighted average tariff, $\textit{Import Tariff}_{j,t}$, we fix each country's weight at the 1972 import value, and to construct $\textit{Up Tariff}_{j,t}$ ($\textit{Down Tariff}_{j,t}$), we use the 1972 BEA input-output table to compute the industry-weights $\omega_{s,j}$ and $\nu_{j,s}$. Using weights from 1977 or 1992 yields very similar results. *Controls* are *Ln(Assets)*, *Tobin's Q*, *Cash/Assets*, *Debt/Assets*, *EBITDA/Assets*, *Sales Growth*, *Excess Return*, *Excess Volatility*, *Industry Sales Growth*, and *Industry Concentration*. α_i and λ_t are firm and year fixed effects. $\rho_j \times t$ is an industry specific time trend. The sample period is 1974 to 2001. All coefficient estimates are multiplied by 100 to improve readability. The standard errors are clustered by (SIC4-)industry. *t*-statistics are reported in parentheses. Statistical significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

Table A.3: Using Alternative Horizons to Compute Tariff Reductions

	(1)	(2)	(3)	(4)
Dependent Variable:	Capex/Assets	Capex/Assets	Capex/Assets	Capex/Assets
ΔUp Tariff from $t = -2$ to $t = 3$ × Post	2.327***	2.620***	2.003***	2.762***
	(3.88)	(3.94)	(2.99)	(2.78)
ΔUp Tariff from $t = -2$ to $t = 3$ × Imp	0.600	0.666	0.392	0.797
	(0.75)	(0.77)	(0.63)	(1.01)
Adjusted R^2	0.393	0.394	0.406	0.409
Observations	38,396	38,396	38,396	38,396
ΔUp Tariff from $t = -2$ to $t = 2$ × Post	2.569***	2.747***	2.140***	2.607***
	(3.82)	(3.81)	(2.97)	(2.63)
ΔUp Tariff from $t = -2$ to $t = 2$ × Imp	0.772	0.892	0.616	0.909
	(0.98)	(1.05)	(0.98)	(1.15)
Adjusted R^2	0.393	0.394	0.406	0.408
Observations	38,396	38,396	38,396	38,396
ΔUp Tariff from $t = -1$ to $t = 2$ × Post	3.494***	3.810***	3.148***	4.212***
	(3.81)	(3.83)	(3.20)	(3.11)
ΔUp Tariff from $t = -1$ to $t = 2$ × Imp	0.911	1.155	0.851	1.424
	(0.85)	(1.02)	(1.06)	(1.37)
Adjusted R^2	0.393	0.393	0.406	0.408
Observations	36,783	36,783	36,783	36,783
ΔUp Tariff from $t = -1$ to $t = 1$ × Post	2.289***	2.590***	2.120**	1.543
	(3.18)	(3.38)	(2.58)	(1.61)
ΔUp Tariff from $t = -1$ to $t = 1$ × Imp	0.911	0.903	0.994*	0.741
	(1.36)	(1.31)	(1.96)	(1.33)
Adjusted R^2	0.378	0.379	0.391	0.394
Observations	35,471	35,471	35,471	35,471
Trade Agreement×Firm Fixed Effects	Yes	Yes	Yes	Yes
Trade Agreement×Year Fixed Effects	Yes	Yes	Yes	Yes
ΔOwn Tariff (Interacted)	No	Yes	Yes	Yes
ΔDown Tariff (Interacted)	No	Yes	Yes	Yes
Pre-Treatment Controls (Interacted)	No	No	Yes	Yes
SIC4-Level Time Trends	No	No	No	Yes

This table presents estimates of the sensitivity of downstream firms' investment (*Capex/Assets*) to upstream tariff reductions (Δ*Up Tariff*) obtained from a difference-in-differences analysis around multinational trade agreements (GSP, 7th GATT round, and NAFTA/8th GATT round). The regressions are specified as in Table 3 (in the paper), except that the magnitude of the tariff reductions is computed over alternative horizons. All coefficient estimates are multiplied by 100 to improve readability. The standard errors are clustered by (SIC4-)industry. t-statistics are reported in parentheses. Statistical significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

Table A.4: Dropping Firms with Large Upstream Tariff Reductions in Prior Trade Agreements

	(1)	(2)	(3)	(4)
Dependent Variable:	Capex/Assets	Capex/Assets	Capex/Assets	Capex/Assets
(a) ΔUp Tariff $\times$ Post	2.719***	3.256***	2.603***	4.443***
	(3.14)	(3.40)	(2.75)	(3.41)
(b) ΔUp Tariff $\times$ Imp	0.986	1.319	0.534	1.419
	(1.00)	(1.35)	(0.70)	(1.48)
(c) ΔOwn Tariff $\times$ Post		-0.182*	-0.177*	-0.191*
		(-1.96)	(-1.90)	(-1.69)
(d) ΔOwn Tariff $\times$ Imp		-0.243***	-0.194***	-0.204***
		(-2.77)	(-2.74)	(-2.64)
(e) ΔDown Tariff $\times$ Post		-1.048**	-1.076**	-0.345
		(-2.33)	(-2.50)	(-0.64)
(f) ΔDown Tariff $\times$ Imp		0.476	0.470	0.814**
		(1.07)	(1.32)	(2.14)
Trade Agreement$\times$Firm Fixed Effects	Yes	Yes	Yes	Yes
Trade Agreement$\times$Year Fixed Effects	Yes	Yes	Yes	Yes
Pre-Treatment Controls (Interacted)	No	No	Yes	Yes
SIC4-Level Time Trends	No	No	No	Yes
Adjusted R^2	0.394	0.395	0.406	0.409
Observations	31,073	31,073	31,073	31,073
p-value of test of H_0: (a) = (b)	0.081	0.045	0.016	0.001
p-value of test of H_0: (c) = (d)	–	0.452	0.837	0.881
p-value of test of H_0: (e) = (f)	–	0.004	0.001	0.023
p-value of test of H_0: (a) + (b) = 0	0.020	0.007	0.038	0.006
p-value of test of H_0: (c) + (d) = 0	–	0.010	0.011	0.023
p-value of test of H_0: (e) + (f) = 0	–	0.435	0.346	0.552

This table presents estimates of the sensitivity of downstream firms' investment (*Capex/Assets*) to upstream tariff reductions (Δ*Up Tariff*) obtained from a difference-in-differences analysis around multinational trade agreements (GSP, 7th GATT round, and NAFTA/8th GATT round). The regressions are specified as in Table 3 (in the paper). The only difference is that, when constructing the regression sample by stacking the observations from the three panels that we create around the trade agreements, we first drop from each panel all observations pertaining to firms that experienced large upstream tariff reductions in prior trade agreements. Specifically, for each $k = 1, 2, 3$ and $h = 1, 2$ and $j = 1, 2, \ldots, J$, we drop from the panel around trade agreement k all observations pertaining to firms in industry j for which Δ*Up Tariff*$_{h,j} \geq 0.1$ for any $h < k$. All coefficient estimates are multiplied by 100 to improve readability. The standard errors are clustered by (SIC4-)industry. t-statistics are reported in parentheses. Statistical significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

Table A.5: DiD Analysis using Indicators for Upstream Tariff Reductions of Different Magnitudes

	(1)	(2)	(3)	(4)
Dependent Variable:	Capex/Assets	Capex/Assets	Capex/Assets	Capex/Assets
$\mathbb{1}\{0.5 \leq \Delta$Up Tariff $< \infty\} \times$ Post	2.462**	2.651***	2.344**	4.266***
	(2.46)	(2.68)	(2.36)	(4.16)
$\mathbb{1}\{0.3 \leq \Delta$Up Tariff $< 0.5\} \times$ Post	1.607*	1.814**	1.237	1.640*
	(1.72)	(2.03)	(1.37)	(1.85)
$\mathbb{1}\{0.1 \leq \Delta$Up Tariff $< 0.3\} \times$ Post	0.841	0.996	0.766	1.042
	(1.02)	(1.27)	(0.98)	(1.32)
$\mathbb{1}\{0.0 \leq \Delta$Up Tariff $< 0.1\} \times$ Post	0.442	0.460	0.341	0.967
	(0.52)	(0.57)	(0.42)	(1.21)
$\mathbb{1}\{0.5 \leq \Delta$Up Tariff $< \infty\} \times$ Imp	2.026***	2.178***	2.057***	3.068***
	(3.20)	(3.38)	(3.44)	(4.37)
$\mathbb{1}\{0.3 \leq \Delta$Up Tariff $< 0.5\} \times$ Imp	1.258**	1.311**	0.931*	1.182**
	(2.26)	(2.35)	(1.87)	(2.07)
$\mathbb{1}\{0.1 \leq \Delta$Up Tariff $< 0.3\} \times$ Imp	1.042**	1.138**	1.049**	1.226**
	(2.32)	(2.56)	(2.51)	(2.48)
$\mathbb{1}\{0.0 \leq \Delta$Up Tariff $< 0.1\} \times$ Imp	0.839*	0.804*	0.887**	1.243**
	(1.95)	(1.85)	(2.22)	(2.57)
Trade Agreement×Firm Fixed Effects	Yes	Yes	Yes	Yes
Trade Agreement×Year Fixed Effects	Yes	Yes	Yes	Yes
ΔOwn Tariff (Interacted)	No	Yes	Yes	Yes
ΔDown Tariff (Interacted)	No	Yes	Yes	Yes
Pre-Treatment Controls (Interacted)	No	No	Yes	Yes
SIC4-Level Time Trends	No	No	No	Yes
Adjusted R^2	0.393	0.394	0.406	0.409
Observations	38,445	38,445	38,445	38,445

This table presents estimates of the sensitivity of downstream firms' investment (*Capex/Assets*) to upstream tariff reductions in various size-based categories obtained from a difference-in-differences analysis around multinational trade agreements (GSP, 7th GATT round, and NAFTA/8th GATT round) using the following regression:

$$\begin{aligned} \textit{Investment}_{k,i,j,t} \quad = \quad & (\beta_{11}\mathbb{1}\{0.5 \leq \Delta\text{Up Tariff} < \infty\} + \beta_{12}\mathbb{1}\{0.3 \leq \Delta\text{Up Tariff} < 0.5\} \\ & + \beta_{13}\mathbb{1}\{0.1 \leq \Delta\text{Up Tariff} < 0.3\} + \beta_{14}\mathbb{1}\{0.0 \leq \Delta\text{Up Tariff} < 0.1\}) \times \textit{Imp}_{k,t} \\ & + (\beta_{21}\mathbb{1}\{0.5 \leq \Delta\text{Up Tariff} < \infty\} + \beta_{22}\mathbb{1}\{0.3 \leq \Delta\text{Up Tariff} < 0.5\} \\ & + \beta_{23}\mathbb{1}\{0.1 \leq \Delta\text{Up Tariff} < 0.3\} + \beta_{24}\mathbb{1}\{0.0 \leq \Delta\text{Up Tariff} < 0.1\}) \times \textit{Post}_{k,t} \\ & + \left(\gamma_1\Delta\textit{Own Tariff}_{k,j} + \delta_1\Delta\textit{Down Tariff}_{k,j} + \theta_1'\textit{Controls}_{k,i,j}\right) \times \textit{Imp}_{k,t} \\ & + \left(\gamma_2\Delta\textit{Own Tariff}_{k,j} + \delta_2\Delta\textit{Down Tariff}_{k,j} + \theta_2'\textit{Controls}_{k,i,j}\right) \times \textit{Post}_{k,t} \\ & + \alpha_{k,i} + \lambda_{k,t} + \rho_j \times t + \varepsilon_{k,i,j,t} \end{aligned}$$

The smallest tariff reductions (including increases) serve as the reference category, so we omit $\mathbb{1}\{\Delta\text{Up Tariff} < 0.0\}$. Trade agreements are indexed by k, and firms, (SIC4-)industries, and years by i, j, and t. All coefficient estimates are multiplied by 100 to improve readability. The standard errors are clustered by (SIC4-)industry. t-statistics are reported in parentheses. Statistical significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

Table A.6: Measuring Investment with Ln(Capex)

	(1)	(2)
Dependent Variable:	Ln(Capex)	Ln(Capex)
ΔUp Tariff $\times$ Post	55.935**	
	(2.24)	
ΔUp Tariff $\times$ Imp	20.707*	
	(1.74)	
ΔUp Tariff $\times \mathbb{1}\{t=-5\}$		-16.306
		(-1.14)
ΔUp Tariff $\times \mathbb{1}\{t=-4\}$		-5.572
		(-0.38)
ΔUp Tariff $\times \mathbb{1}\{t=-3\}$		-2.749
		(-0.22)
ΔUp Tariff $\times \mathbb{1}\{t=-2\}$		-2.535
		(-0.32)
ΔUp Tariff $\times \mathbb{1}\{t=0\}$		1.354
		(0.17)
ΔUp Tariff $\times \mathbb{1}\{t=1\}$		11.364
		(0.85)
ΔUp Tariff $\times \mathbb{1}\{t=2\}$		41.125**
		(2.55)
ΔUp Tariff $\times \mathbb{1}\{t=3\}$		59.303***
		(3.18)
ΔUp Tariff $\times \mathbb{1}\{t=4\}$		39.200*
		(1.78)
ΔUp Tariff $\times \mathbb{1}\{t=5\}$		56.672**
		(2.30)
ΔUp Tariff $\times \mathbb{1}\{t=6\}$		52.971*
		(1.85)
ΔUp Tariff $\times \mathbb{1}\{t=7\}$		57.001*
		(1.96)
Trade Agreement$\times$Firm Fixed Effects	Yes	Yes
Trade Agreement$\times$Year Fixed Effects	Yes	Yes
ΔOwn Tariff (Interacted)	Yes	Yes
ΔDown Tariff (Interacted)	Yes	Yes
Pre-Treatment Controls (Interacted)	Yes	Yes
SIC4-Level Time Trends	Yes	Yes
Adjusted R^2	0.906	0.909
Observations	38,337	38,337

This table presents estimates of the sensitivity of downstream firms' investment to upstream tariff reductions (Δ*Up Tariff*) obtained from a difference-in-differences analysis around multinational trade agreements (GSP, 7th GATT round, and NAFTA/8th GATT round). Column (1) corresponds to column (4) of Table 3 (in the paper), and column (2) corresponds to column (4) of Table 4 (in the paper), except that we use *Ln(Capex)* instead of capital expenditures scaled by the book value of total assets as the dependent variable. All coefficient estimates are multiplied by 100 to improve readability. The standard errors are clustered by (SIC4-)industry. *t*-statistics are reported in parentheses. Statistical significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

Table A.7: Controlling for SIC3×Year Fixed Effects

	(1)
Dependent Variable:	Capex/Assets
ΔUp Tariff × Post	2.590***
	(2.91)
ΔUp Tariff × Imp	2.169*
	(1.83)
ΔOwn Tariff × Post	-0.100
	(-0.77)
ΔOwn Tariff × Imp	-0.202
	(-1.45)
ΔDown Tariff × Post	-0.708
	(-1.03)
ΔDown Tariff × Imp	0.099
	(0.11)
Trade Agreement×Firm Fixed Effects	Yes
Trade Agreement×Year×SIC3 Fixed Effects	Yes
Pre-Treatment Controls (Interacted)	Yes
Adjusted R^2	0.417
Observations	38,261

This table presents estimates of the sensitivity of downstream firms' investment (*Capex/Assets*) to upstream tariff reductions (Δ*Up Tariff*) obtained from a difference-in-differences analysis around multinational trade agreements (GSP, 7th GATT round, and NAFTA/8th GATT round). The regression is specified as in column (4) of Table 3 (in the paper), except that we include Trade Agreement×Year×SIC3 Fixed Effects instead of Trade Agreement×Year Fixed Effects. All coefficient estimates are multiplied by 100 to improve readability. The standard errors are clustered by (SIC4-)industry. *t*-statistics are reported in parentheses. Statistical significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

Table A.8: Placebo Difference-in-Differences Using Only Observations in Pre-Treatment Periods

	(1)	(2)	(3)	(4)
Dependent Variable:	Capex/Assets	Capex/Assets	Capex/Assets	Capex/Assets
ΔUp Tariff $\times$ Placebo-Post	-0.539	-0.678	-0.679	-0.278
	(-0.86)	(-1.16)	(-1.17)	(-0.33)
Trade Agreement$\times$Firm Fixed Effects	Yes	Yes	Yes	Yes
Trade Agreement$\times$Year Fixed Effects	Yes	Yes	Yes	Yes
ΔOwn Tariff (Interacted)	No	Yes	Yes	Yes
ΔDown Tariff (Interacted)	No	Yes	Yes	Yes
Pre-Treatment Controls (Interacted)	No	No	Yes	Yes
SIC4-Level Time Trends	No	No	No	Yes
Adjusted R^2	0.476	0.477	0.479	0.481
Observations	15,619	15,619	15,619	15,619

This table presents estimates of the sensitivity of downstream firms' investment (*Capex/Assets*) to upstream tariff reductions (Δ*Up Tariff*) obtained from a placebo difference-in-differences analysis using only observations in the pre-treatment periods of the multinational trade agreements (GSP, 7th GATT round, and NAFTA/8th GATT round). The regressions are specified as in Table 3 (in the paper). However, before constructing the regression sample by stacking the observations from the three panels that we create around the trade agreements, for each $k = 1, 2, 3$, we drop from the panel around trade agreement k all observations pertaining to years $t = 0$ to $t = 7$ (and thus retain only observations pertaining to years $t = -5$ to $t = -1$), where $t = -1$ is the last year before the implementation of the trade agreement. We then estimate the following regression:

$$\begin{aligned} \textit{Investment}_{k,i,j,t} \quad = \quad & \left(\beta \Delta \textit{Up Tariff}_{k,j} + \gamma \Delta \textit{Own Tariff}_{k,j} + \delta \Delta \textit{Down Tariff}_{k,j}\right) \times \textit{Placebo-Post}_{k,t} \\ & + \theta' \textit{Controls}_{k,i,j} \times \textit{Placebo-Post}_{k,t} + \alpha_{k,i} + \lambda_{k,t} + \rho_j \times t + \varepsilon_{k,i,j,t}. \end{aligned}$$

Placebo-Post is an indicator equal to one in year t if $t \geq -3$ (i.e., in the later part of the pre-period before a trade agreement). Setting *Placebo-Post* equal to one if $t \geq -2$ yields similar results. All coefficient estimates are multiplied by 100 to improve readability. The standard errors are clustered by (SIC4-)industry. *t*-statistics are reported in parentheses. Statistical significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

Table A.9: Tariff Dynamics

	(1)
Dependent Variable:	Up Tariff
ΔUp Tariff $\times\ \mathbb{1}\{t=-5\}$	-0.143
	(-1.52)
ΔUp Tariff $\times\ \mathbb{1}\{t=-4\}$	0.020
	(0.38)
ΔUp Tariff $\times\ \mathbb{1}\{t=-3\}$	-0.082
	(-0.68)
ΔUp Tariff $\times\ \mathbb{1}\{t=-2\}$	-0.010
	(-0.26)
ΔUp Tariff $\times\ \mathbb{1}\{t=0\}$	-0.181***
	(-4.24)
ΔUp Tariff $\times\ \mathbb{1}\{t=1\}$	-0.250*
	(-1.87)
ΔUp Tariff $\times\ \mathbb{1}\{t=2\}$	-0.653***
	(-14.68)
ΔUp Tariff $\times\ \mathbb{1}\{t=3\}$	-0.824***
	(-19.44)
ΔUp Tariff $\times\ \mathbb{1}\{t=4\}$	-0.759***
	(-5.54)
ΔUp Tariff $\times\ \mathbb{1}\{t=5\}$	-0.919***
	(-5.50)
ΔUp Tariff $\times\ \mathbb{1}\{t=6\}$	-0.979***
	(-5.06)
ΔUp Tariff $\times\ \mathbb{1}\{t=7\}$	-1.048***
	(-4.75)
Trade Agreement×Firm Fixed Effects	Yes
Trade Agreement×Year Fixed Effects	Yes
ΔOwn Tariff (Interacted)	Yes
ΔDown Tariff (Interacted)	Yes
Pre-Treatment Controls (Interacted)	Yes
SIC4-Level Time Trends	Yes
Adjusted R^2	0,990
Observations	38,445

This table shows the decline in average upstream import tariffs following multinational trade agreements (GSP, 7th GATT round, and NAFTA/8th GATT round). Specifically, the table shows the estimated β_τ coefficients from the following regression:
$\textit{Up Tariff}_{k,i,j,t} = \sum_{\tau=-5}^{7}\left(\beta_\tau \Delta \textit{Up Tariff}_{k,j} + \gamma_\tau \Delta \textit{Own Tariff}_{k,j} + \delta_\tau \Delta \textit{Down Tariff}_{k,j} + \theta'_\tau \textit{Controls}_{k,i,j}\right) \mathbb{1}\{t=\tau\}$ $+\alpha_{k,i} + \lambda_{k,t} + \rho_j \times t + \varepsilon_{k,i,j,t}$. Trade agreements are indexed by k, and firms, (SIC4-)industries, and years by i, j, and t. We use the last year before the tariff revisions as the reference year and thus omit $\mathbb{1}\{t=-1\}$. The standard errors are clustered by (SIC4-)industry. t-statistics are reported in parentheses. Statistical significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.