The Economic Effects of Trade Policy Uncertainty*

Dario Caldara Matteo Iacoviello Patrick Molligo
Andrea Prestipino Andrea Raffo

April 8, 2019

PRELIMINARY AND INCOMPLETE

Abstract

This paper takes a comprehensive approach to study the link between uncertainty about trade policy and the U.S. economy. It does so by developing measures of trade risk both at the firm and at the aggregate level, by estimating the effects of these measures on investment, and by interpreting these results through the lens of of a general equilibrium, open economy macro model. In the data, as in the model, higher uncertainty about trade policy deters investment and economic activity.

KEYWORDS: Trade Policy Uncertainty; Tariffs; Investment.

JEL CLASSIFICATION: C1. D22. D80. E12. E32. F13. H32.

*All errors and omissions are our own responsibility. The views expressed in this paper are solely the responsibility of the authors and should not be interpreted as reflecting the views of the Board of Governors of the Federal Reserve System or of anyone else associated with the Federal Reserve System. At the time of writing, all authors worked at the Federal Reserve Board. Corresponding author: Matteo Iacoviello (matteo.iacoviello@frb.gov)

1 Introduction

Trade negotiations and proposals for a new approach to trade policy have become the focus of increased attention among investors, politicians, and market participants. These developments have resulted in an increase in uncertainty about the outlook for foreign trade. Measures of trade policy uncertainty based on media counts, or extracted from surveys of firms and managers, have gone up substantially in recent years, as shown in Figure 1. For example, in January 2019, the Federal Reserve's Beige Book, a document that compiles anecdotal description of economic conditions in the twelve Federal Reserve districts, contained multiple references—based on surveys of manufacturers, business contacts, and industry representatives—to uncertainty about the outlook for trade policy.

For decades prior to these trade developments, there was limited volatility in trade policy, and thus limited study of the impact of uncertainty regarding trade policy on the U.S. economy. This paper takes a comprehensive approach to fill that gap—developing measures of uncertainty at both the firm and aggregate level, estimating the effects of these measures on investment, and then interpreting these effects through the lens of a general equilibrium, open economy macro model.[1]

In the first part of the paper, we empirically measure trade uncertainty and its effects. First, we build a firm-level measure of trade policy uncertainty and link it to Compustat firm-level investment data. We show that increases in trade uncertainty predict lower capital accumulation after one year. Second, we use an aggregate approach and construct two indicators of trade policy uncertainty for the U.S. economy. We include these indicators into a standard VAR model and find that, historically, periods of elevated trade uncertainty have been followed by lower output and investment.

The results from the two approaches predict roughly similar effects of trade policy uncertainty on investment. Specifically, we find that a shock that is sized to capture the rise in trade policy uncertainty between 2017 and 2018, predicts a decline in the level of aggregate investment of between 1 and 2 percent. Moreover, such predictions are in line with recent survey evidence that directly asks firms how they reassessed capital expenditure plans in response to higher trade uncertainty.[2]

In the second part of the paper we use a two-country new-Keynesian DSGE model to understand the channels by which trade policy risk affects investment and economic activity. We study two experiments that capture how trade tensions are transmitted to the real economy. In the first experiment, we model trade tensions as downside risk, and study the effect on an increase in the probability of higher tariffs in the future. In the second, we model trade tensions as a mean-preserving increase in the variance of tariffs. We show that a calibrated version of the model can generate an investment decline in response to shocks to trade policy risk that is roughly in line with our empirical estimates. Moreover we find that anticipation and uncertainty effects are equally

[1] There are important exceptions, of course, mostly focusing on other episodes of trade uncertainty. For instance, Handley and Limão (2017) estimate and quantify the impact of trade policy on China's export boom to the United States following its 2001 WTO accession, as do Crowley, Meng, and Song (2018). Steinberg (2019) studies Brexit trade uncertainty.

[2] See the Survey of Business Uncertainty run by the Federal Reserve Bank of Atalanta (Altig et al., 2019).

important in accounting for the investment decline.

Section 2 measures trade policy uncertainty. Section 3 looks at the empirical effects of trade policy uncertainty. Section 4 contains the model, and Section 5 looks at the model experiments.

2 Measuring Trade Policy Uncertainty

2.1 Overview

In this section, we empirically measure the effects of elevated trade uncertainty. We first describe the construction of our firm-level trade policy uncertainty (TPU) measure. We then discuss two complementary measures of aggregate TPU, one based on newspaper coverage of TPU news, and the other based on the estimation of a stochastic volatility model for U.S. tariffs.

2.2 Firm-Level Trade Policy Uncertainty

We construct a time-varying, firm-level measure of TPU based on text analysis of transcripts of quarterly earnings conference calls of publicly listed companies. Our approach is inspired by the analysis of firm-level political risk in Hassan et al. (2017).[3] Quarterly earnings conference calls follow a common format: the CEO or the CFO of the company opens with an overview of the particular firm's performance in the preceding quarter, and then transitions into a Q&A session with investors and analysts. The nature of the Q&A portion of the call is inherently more forward-looking, and it often covers uncertainty and risks faced by the firm. We run text searches of approximately 160,000 transcripts for 7,526 firms, collected from 2005 through the end of 2018.

Our methodology involves two main steps. In the first step, we search each transcript for terms related to trade policy, such as *tariff*, *import duty*, *import barrier*, and *(anti-)dumping*.[4] We construct the indicator TP that counts, for each transcript, the frequency of these words. The indicator TP proxies for the intensity of trade policy related discussions, irrespective of whether they center on risk and uncertainty.

[3] Hassan et al. (2017) use earnings calls from 2002 through 2016 to study the effects of firm-specific policy uncertainty on current firm-specific investment. One of the political topics is trade uncertainty, which is constructed at the firm level using trade-specific terms in combination with uncertainty terms. There are three important differences between our approach and theirs. First, we focus specifically on trade policy uncertainty. Second, regarding the choice of words, our search places more emphasis on "tariffs" than "trade" since a preliminary audit of earnings calls covering the 2017-2018 period indicated that "trade" terms such as "all trade" or "trade relations" contained far more false positives than "tariff" words. Third, we emphasize the dynamic effect of trade uncertainty on capital accumulation. Figure A.1 in the Appendix compares our aggregate TPU based on firms' earnings calls with the analogous measure constructed by Hassan et al. (2017). Their measure spikes in 2008Q4, a period of higher economic uncertainty, while our measure does not.

[4] The full list of trade policy terms is: *tariff**, *import dut**, *import barrier**, *anti-dumping*, *trade treat**, *trade agreement**, *trade polic**, *trade act**, *trade relationship**, *GATT*, *World Trade Organization/WTO*, and *free trade*. We also search for *import**, *export**, and *border** within three words of either *ban**, *tax**, or *subsid**. An asterisk indicates a search wild card.

In the second step, we isolate discussions about trade policy uncertainty by further examining the pool of transcripts returning positive values for TP. We conduct an initial human audit of these transcripts to devise a list of terms indicating uncertainty, such as *risk*, *threat*, *uncertainty*, *worry*, *concern*, *volatile*, and *tension*.[5] We require the uncertainty-related words to be within ten words of one or more of the initial trade policy-related terms. The frequency of the joint instances of trade policy and uncertainty term combinations in each transcript gives us the indicator TPU of the overall uncertainty around trade policy perceived by a firm. As for the latter we conduct an audit of our firm-level TPU measure to refine our set of uncertainty terms and minimize instances of false positives. The final TPU indicator reliably captures information about companies' uncertain sentiment surrounding developments in trade policy, while excluding those that do not discuss risks and uncertainty.

Figures 1 and 2 highlight the large degree of variation in trade policy uncertainty over time and across industries. For each firm, we construct a variable $TPUDUMMY$ that takes value 1 if the transcripts mention trade policy uncertainty ($TPU \geq 0$), and 0 otherwise. Figure 1 shows how companies and media's perceptions of trade uncertainty are remarkably well-aligned: in particular, the aggregated firm-level trade uncertainty tracks very closely the aggregate TPU index constructed from newspaper searches—discussed in the next subsection—.

Figure 2 offers additional detail, showing for selected quarters the share of firms discussing TPU within an industry, the latter defined using the Fama-French 12 industry classification.[6] Our measure has evolved along two dimensions during the sample period. First, the number of firms concerned with TPU has increased over time across nearly all industries. In the first quarter of 2010, less than 2% of firms discussed TPU in all industries but one. In the last quarter of 2018, about 20% of the firms' earnings calls contained discussions related to TPU. Second, stronger sectoral variation in TPU is apparent in the data beginning in 2015, especially in the cross section of firms, which motivates the sample choice for the firm-level empirical analysis.

2.3 Aggregate Trade Policy Uncertainty

We complement the firm-level indicator of TPU with aggregate level data. In particular, we construct two indicators of economy-wide TPU.

The first indicator is based on searches of newspaper articles that discuss trade policy uncertainty. We run—starting in 1960—automated text searches of the electronic archives of seven newspapers: Boston Globe, Chicago Tribune, Guardian, Los Angeles Times, New York Times, Wall Street Journal, and Washington Post.

In constructing the aggregate index we closely follow the approach employed for the construction

[5] The full list of uncertainty terms is: *risk**, *threat**, *cautio**, *uncertain**, *propos**, *future*, *worr**, *concern**, *volatil**, *tension**, *likel**, *probabil**, *possibil**, *chance**, *danger**, *fear**, *expect**, *potential**, *rumor**, and *prospect**.

[6] See http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/det_12_ind_port.html

of the firm-level indicator, except for minor modifications of the search terms to better capture changes in vernacular. For instance, the news-based measure includes mentions of *import surcharges*, which were a defining feature of President Nixon's protectionist trade policies of the early 1970s. As before, we require that the trade policy terms appear along with uncertainty terms in the same article.[7] The final aggregate measure represents the monthly share of articles discussing trade policy uncertainty. We index the resulting series to equal 100 for an article share of 1 percent.[8]

The second indicator of trade uncertainty is estimated using a stochastic volatility model for import tariff rates. Following Mendoza, Razin, and Tesar (1994) and Fernandez-Villaverde et al. (2015), we construct a quarterly measure of tariff rates, computed as $\tau_t = CD_t/(M_t - CD_t)$, where CD denotes customs duties and M denotes imports of goods. The sample runs from 1960Q1 through 2018Q3. We focus on tariffs because data are readily available and have a natural counterpart in our DSGE models discussed later. Nonetheless, this approach does not capture uncertainty originating from other trade policy actions such as antidumping procedures or (re)negotiations of major trade agreements.[9]

We posit that tariffs (τ_t) evolve according to:

$$\tau_t = (1-\rho_\tau)\,\mu_\tau + \rho_\tau \tau_{t-1} + \exp(\sigma_t)\,\varepsilon_t, \quad \varepsilon_t \sim N(0,1), \tag{1}$$

$$\sigma_t = (1-\rho_\sigma)\,\sigma + \rho_\sigma \sigma_{t-1} + \eta u_t, \quad u_t \sim N(0,1) \tag{2}$$

where equation (1) is a fiscal rule for the level of tariffs that follows an autoregressive process with stochastic volatility, and equation (2) models stochastic volatility as an autoregressive process.[10]

Our formulation for the tariff rule incorporates two independent innovations to tariffs. The first innovation (ε_t) affects the tariff itself and, like a typical fiscal shock, captures commercial

[7] The full set of trade policy words is: *foreign competition*, *protectionism*, *tariff**, *import dut**, *import barrier**, *trade treat**, *trade polic**, *trade act**, *import fee**, *tax** (within 10 words of *foreign good**, *foreign oil*, or *import**), *import** (within 10 words of *surtax** or *surcharge**), and *trade agreement** (Not including *NAFTA* or *North American Free Trade Agreement*). We also exclude *GATT*, *WTO*, and *World Trade Organization*. The set of uncertainty words is: *concern**, *fear**, *pressure**, *confusion*, *turmoil*, *challenge**, *uncertain**, *risk**, *dubious*, *unclear*, *dispute**, *issue**, *potential**, *probabl**, *predict**, and *danger**

[8] Baker, Bloom, and Davis (2016) also construct an indicator, available from 1985, of trade policy uncertainty available at `http://www.policyuncertainty.com/categorical_epu.html`. There are three differences between their index and ours. First, our index adds an additional 25 years of data, extending back to 1960. Second, the search terms differ slightly: we keep ours as close as possible to the ones used to construct the firm-level TPU. Third, unlike the Baker, Bloom, and Davis (2016) measure, our index is much higher in 2017 and 2018 than during the negotiations that led to signing of North American Free Trade Agreement. Figure A.2 in the Appendix compares our news-based index with Baker et al.'s index.

[9] See, for instance, Barattieri, Cacciatore, and Ghironi (2018) for an empirical analysis on the effects of antidumping measures in Canada and Turkey.

[10] We also experimented with a level equation that includes feedback from the state of the economy (measured as the cyclical component of output) and the level of debt (as a ratio of GDP). Overall, our parameter estimates were not much different but the sample size shrank. Hence, we decided to have the simpler rule as our benchmark specification. The White (1980) and Breusch and Pagan (1979) tests indicate that the null hypothesis of homoskedastic shocks to tariffs is rejected at the 1% level.

policy actions not explained by past values of tariffs. The second innovation (u_t) affects the spread of values for tariffs and acts like a volatility shock: A value σ_t higher than usual, for instance, indicates increased uncertainty about future tariff rates. The parameters of interest are the average log standard deviation of an innovation to fiscal shocks (σ), the unconditional standard deviation of the fiscal volatility shock (η), and the persistence of the two processes (ρ_τ and ρ_σ). We estimate the model using Bayesian techniques. In particular, we use the algorithm of Born and Pfeifer (2014b) that employs a particle filter to estimate the unobserved stochastic volatility process. We take 60,000 draws from the posterior distribution of the parameters, discarding the first 10,000 draws.

Columns 2 to 4 in Table 2 report the median and 95 percent credible sets of the posterior distribution of the model parameters. Our estimates indicate that both the tariff rule and the tariff volatility process are very persistent. Innovations to the level of tariffs (ε_t) have an average standard deviation of $100 \times exp(-6.14) = 0.22$ percentage points. A one-standard deviation innovation to the volatility of tariffs (u_t) increases the standard deviation of innovations to tariff shocks to about $100 \times exp[-6.14 + 0.37] = 0.31$ percentage points.[11]

We also re-estimate the model on data from 1960 through 1984, the sample we use in the macro analysis discussed in Section 3. Compared to the full sample the average standard deviation of the level of tariffs is about 50 percent larger, 0.31 percentage points. Similarly, a one standard deviation volatility shock increases tariff volatility to 0.5 percentage points, an increase nearly 70 percent as large as in the full sample.

An Historical Overview of Movements in Aggregate TPU.

Figure 3 plots the news-based index of TPU, while Figure 4 shows the tariff volatility series. For the latter, we plot the median and the 90 percent posterior probability interval.[12] The resulting series can be interpreted as the percentage point increase in tariff that would have resulted from a one-standard deviation innovation to the tariff shock at different points in time.

These two figures allow us to build an historical account of uncertainty about trade policy. The news-based TPU and the tariff volatility series share two major spikes in the early 1970s, namely 1971Q4 and 1975Q1-1976Q1. The first spike coincides with what historians often refer to as the "Nixon shock," that is, a unique, unanticipated policy shift in which the U.S. Administration imposed an across-the-board tariff on dutiable imports—the first general tariff increase since the Smoot-Hawley tariff of 1930 (Irwin, 2013).[13] Notably, this event is relatively short lived and the import tariffs were eventually removed in late December of the same year.

The second spike begins with the January 1975 State of the Union address of President Ford

[11] Fernandez-Villaverde et al. (2015) use a similar approach to estimate uncertainty about capital taxes and find that the average standard deviation of such taxes is 0.75 percentage point, consistent with the conventional view that uncertainty over tariff policy in the past decades has been low compared to other fiscal policy instruments.

[12] We transform the shocks to express them into the level of tariffs, $(100 \times \exp \sigma_t)$.

[13] The surcharge applied to about half of U.S. imports.

in which he announced measures to address the energy crisis by, among other things, reducing oil imports. The interesting aspect of President Ford's actions is that they were implemented just weeks after Congress had voted on the 1974 Trade Act, which contained a strong push towards opening markets and granting more powers to the President to liberalize trade. Thus, the Ford Administration's use of trade policy instruments to deal with rising oil prices represented a surprising shift in the scope and use of trade policy.

The news-based TPU index captures additional episodes of TPU that did not coincide with tariff volatility. The most notable one is the increase in trade uncertainty that took place in 2017 and intensified in 2018. Such episodes occurred against the backdrop of only a modest increase in tariff volatility. Two smaller spikes in the news-based index take place at the beginning of Kennedy's presidency—when he proposed a rethinking of America's trade policies—and around the negotiation of the North American Free Trade Agreement in the in the early 1990s.[14]

More broadly, the contemporaneous correlation between the two series is 0.26, with the news-based index leading the estimated tariff volatility measure by two quarters. Given the methodological differences underlying the construction of these uncertainty measures and the observation that the TPU includes uncertainty about a broader set of trade policy actions than just tariffs, it is striking (and reassuring) that we find this positive correlation.

3 The Effects of Trade Policy Uncertainty

3.1 Overview

We now use the measures described in the previous section to get a quantitative sense of the macroeconomic effects of trade policy uncertainty. We proceed in two steps. First, we use firm-specific trade uncertainty to estimate the effects on investment of the recent spike in TPU. Second, we complement these results using historical relationships and by estimating a vector autoregressive (VAR) model of the U.S. economy.

3.2 Firm-level Responses to Trade Policy Uncertainty

We start by estimating the dynamic effects of changes in TPU on firm-level investment. Disaggregated data allow us to exploit the wide range of variation in actual and perceived trade policy uncertainty across firms and over time. To this end, we combine the firm-level TPU measure with quarterly data from Compustat, which contain balance-sheet variables for the near-universe of publicly listed firms. Our strategy is to regress investment at various horizons against contemporaneous values of firm-level TPU. This strategy mimics the local projections approach developed by Jorda

[14] See Table A.1 for further discussion of these episodes.

(2005), with the notable difference that we exploit firm-level variation both in the time-series and in the cross-section on the dependent and independent variables. More precisely, we estimate the following regression:

$$\log k_{i,t+h} - \log k_{i,t-1} = \alpha_i + \alpha_{s,t} + \beta_h \, TPU_{i,t} + \mathbf{\Gamma}'\mathbf{X}_{i,t} + \varepsilon_{i,t} \tag{3}$$

where $h \geq 0$ indexes current and future quarters, and β_h measures the semi-elasticity of investment of trade policy uncertainty. Our investment measure is $\log k_{i,t+h} - \log k_{i,t-1}$, where $k_{i,t}$ is the capital stock of firm i at the start of period t, following Ottonello and Winberry (2018) and CLEMENTI and PALAZZO (2019). α_i and $\alpha_{s,t}$ denote firm and sector-by-quarter fixed effects, respectively. $\mathbf{X}_{i,t}$ are firm-level control variables: Tobin's Q, cash flows, openness, one lag of the growth rate of the capital stock, and one lag of the trade policy uncertainty measure. We also control for $TPX_{i,t}$, mentions of trade policy, $TP_{i,t}$, excluding those related to trade policy uncertainty. The goal is to estimate β_h, the dynamic effect on investment of variations in trade uncertainty at the firm level. Trade uncertainty is $TPU_{i,t}$, that is, the number of mentions of trade uncertainty words divided by the total number of words in the firms' earnings calls.

Our variables are constructed as follows. We measure capital as net property, plant, and equipment (PPENTQ) except in the first period where we initialize the firm's capital stock using the gross level (PPEGTQ). This approach provides a stable estimate of quarterly capital growth over the sample. We measure Tobin's Q as the market value of equity plus the book value of assets minus book value of equity, all divided by the book value of assets (Gulen and Ion, 2015). Cash flows are calculated as cash and short-term investments (CHEQ) scaled by beginning-of-period property, plant, and equipment. Both Tobin's Q and cash flows are winsorized at the 1st and 99th percentiles. Finally, openness is the ratio of exports to usage—where usage is gross output plus imports less exports—at the industry level.[15] These industries account for roughly half of total capital expenditures among Compustat firms.

Our measure of firm-level TPU runs from 2005Q1 through 2018Q4 and covers the near-universe of listed firms. However, we restrict our sample in two dimensions. First, we focus our analysis on the 2015Q1-2018Q4 period. As discussed in Section 2, in the years up to 2015, there has been little movement in aggregate and idiosyncratic TPU: only 1.3 percent of firm-quarter observations mention TPU (i.e., $TPUDUMMY = 1$) for the years 2005-2018, while mentions jump to 5.1 percent from 2016 through 2018. Second, we include firms in the traded sectors of agriculture, mining, and manufacturing, thus leaving out wholesale and service sectors. Agriculture, mining, and manufacturing account for about one half of the firms in our sample and are the only sectors with data available to construct our openness measure. Between 2015 and 2018, firms in these sectors

[15] Gross output by industry is from the Industry Economic Accounts Data published by the Bureau of Economic Analysis. Exports and imports data are from the U.S. Census Bureau U.S. International Trade and Goods and Services report.

also mention trade uncertainty more frequently (4.7 vs 1.7 percent) than in remaining sectors. All told, our baseline specification includes a total of 9,835 observations on 1,292 firms.[16]

We estimate equation (3) at horizons $h = 0, 1, 2, 3, 4$. Figure 5 shows the response of firms' capital after an increase in TPU from 0 to 0.035. The latter is the median value of TPU among firms with positive TPU. Accordingly, the figure traces out the differential impact on capital between a firm that is concerned about TPU and another one that is not concerned. Four quarters after the increase in TPU, the capital stock of firms that are worried is 2.5 percent lower.

Table A.2 reports quotes from the transcripts associated with some of the most influential observations in our sample that feature a large negative contribution of trade uncertainty to investment one quarter ahead. While some mentions of trade uncertainty refer to an aggregate component, most of the discussions refer to sector-specific policies, to country-specific policies that affect firms doing business in particular region, or to a combination of the two.

Figure 6 summarizes results for alternative specifications of our econometric framework. Panel 1 shows the response of investment after dropping $\mathbf{X}_{i,t}$ from the baseline specification, while still controlling for lagged investment and lagged TPU. Our results hold irrespective of whether we control for any contemporaneous correlation between TPU and other variables capturing firms' investment opportunities, thus allaying the reverse-causation concern that firms mention TPU as an excuse when business is not doing well.

Panel 2 shows that there is something special about investment and concerns about trade policy, rather than investment and trade policy per se. We replace in equation (3) TPU with TP, the indicator based on the count of words mentioning trade policy, irrespective of whether uncertainty words are included or not. As the panel shows, unlike for TPU, higher TP predicts, if anything, higher investment.

In our baseline specification, the average effect of aggregate trade uncertainty shocks is absorbed by the sector-by-quarter fixed effects ($\alpha_{s,t}$). Panel 3 relaxes this restriction by dropping $\alpha_{s,t}$. Under this specification, the effects of an increase in trade policy uncertainty are slightly attenuated. One possible interpretation is that general equilibrium effects, such as counter-cyclical policy responses, tend to mitigate the negative consequences of heightened trade uncertainty.

From Firm-level to Aggregate Effects

Are the estimated effects small or large? To boot, our specification does not directly answer the question of how aggregate trade uncertainty affects aggregate investment, since the empirical approach "differences out" any aggregate general equilibrium effect. However, it is possible to make some predictions about aggregate effects by holding fixed any common general equilibrium effects

[16] A detailed description of the variables construction can be found in the Appendix. We further refine our sample by excluding observations for which (i) total assets (ATQ) are less than $1 million, (ii) capital expenditures (CAPXY) are negative, and (iii) acquisitions (AQCY) larger than 5 percent percent of assets.

such as endogenous policy responses, or spillovers across firms. Between 2017 and 2018, the share of firms in our sample that mentioned trade policy uncertainty in the earnings calls went from 2.8 to 12.9 percent, a 10.1 percentage point increase. Multiplying 10.1 by the 2.53 percent response—after one year—of capital for a firm that is worried about TPU, yields an aggregate decline of capital of 0.26 percent. Since agriculture, mining, and manufacturing account for 43 percent of total assets (ATQ) in 2018, the decline in total capital for all listed firms can be estimated to be $0.101 \times 2.53 \times 0.43 = 0.11$ percent. Multiplying this number by the net stock of private nonresidential fixed assets, \$24 trillion, gives a dollar effect of \$26.4 billion.[17] This drop amounts to about a 1 percent decline in private nonresidential fixed investment.

Trade Uncertainty, Actual Tariffs, and Industry Investment in 2018

We conclude the firm-level analysis by zooming in on the industry effects of TPU for the year 2018, the year in our sample witnessing the largest increase in TPU. Our goal is to complement the local projection above with a simple analysis of the differential industry effects of heightened trade tensions in 2018. We construct industry-level changes in capital growth between 2017 and 2018, grouping firms according to the FamaFrench 49 industry classifications. By the same token, we construct the change in industry TPU between 2017 and 2018. The first column of Table 1 reports the results of the cross-sectional regression:

$$\Delta \log k_{j,2018} - \Delta \log k_{j,2017} = \alpha + \beta \Delta TPU_j + u_j.$$

where $\Delta \log k_j$ denotes the log change in the capital stock for industry j.[18] The estimated value of β is -1.57. To interpret this number, consider an industry that experienced a two-standard deviation change in TPU in 2018. This industry is predicted to have reduced its capital growth by about 3.2 percent. Figure 7 offers a visual representation of the strong negative correlation between industry TPU and industry investment in 2018.

In 2018 certain tariffs themselves increased, beckoning the question whether this instance of high TPU simply captures the negative effects of higher tariffs. For each industry, we calculate the share of costs subject to new tariffs in 2018. [19] Column 2 controls for new tariffs in 2018, reporting the results of the following regression:

$$\Delta \log k_{j,2018} - \Delta \log k_{j,2017} = \alpha + \beta \Delta TPU_j + \gamma NEWTARIFFS_j + u_j.$$

[17] This series is available in line 3 of Table 1.1 of the Fixed Assets Accounts Tables produced by the Bureau of Economic Analysis.

[18] Specifically, we denote $\log k_{i,2018}$ as a firm's capital stock at the end of 2018. The change in the capital stock for industry j at the end of year t is constructed as the weighted average of the change in the capital stock of the firms in the industry, $\Delta \log k_t = \sum_i \omega_i \Delta \log k_{it}$, where ω_i denotes the sectoral capital share of firm i in industry j.

[19] We thank our colleague Aaron Flaaen for constructing and sharing this measure with us. The share is constructed combining input-output tables with the product list subject to new tariffs published by the U.S. Trade Representative.

The coefficient on new tariffs is statistically insignificant. In other words, the industry regression indicates that the impact of tariffs on industry investment has been small, while firms more worried about the escalation of trade tensions have reduced their investment.

3.3 Macroeconomic Effects of Trade Policy Uncertainty

There are two important challenges for our firm-level approach. First, how do we interpret firm-specific trade policy uncertainty when there is a large common component? One interpretation is that firm-specific trade uncertainty captures idiosyncratic exposure to a trade policy "shock" that has a strong aggregate component, but whose microeconomic ramifications affect firms and industries differently at different points in time. For instance, two firms in the same industry may buy inputs from suppliers in countries subject to differential trade policy shocks. Another interpretation is that firm-specific uncertainty may capture differential risk aversion and expectations of the managers regarding the same aggregate phenomenon. Under both interpretations, our cross-sectional evidence provides robust support to the notion that trade uncertainty may deter investment, even though the aggregate response is absorbed by the time effects.

Second, how do we convert firm-level responses into aggregate responses when the common component is important? In the previous section, we have provided an estimate of such aggregate effect by implicitly assuming an equivalence between micro and macro effects, and by ruling out any complex general equilibrium effects.

An alternative approach to identify the effects of aggregate trade policy uncertainty relies on the time-honored tradition of estimating a quarterly VAR in the tradition of Christiano, Eichenbaum, and Evans (2005). Our baseline specification includes the following variables: (1) tariff volatility shocks; (2) real GDP per capita; (3) real business fixed investment per capita; (4) the ratio of net exports to GDP; (5) markups, defined as the inverse of the labor share in the business sector; and (6) the federal funds rate.[20]

We estimate the VAR over the sample 1960Q1-1984Q4, rather than over the entire 1960-2018 sample. There are two reasons for this choice. First, as discussed earlier, the period until the 1980s includes several episodes of spikes in trade policy uncertainty. Second, there is evidence about the instability of parameter estimates in the pre- and post-1984 periods (see e.g. Great Moderation). In our benchmark specification, we apply a recursive identification scheme where we order tariff volatility first, reflecting our view that our series of tariff volatility is exogenous to the macroeconomy. For robustness, we apply an alternative identification that orders tariff volatility last.

[20] The model includes two lags of the endogenous variables and a constant. We use the median of the filtered, instead of the smoothed, tariff volatility series estimated using the stochastic volatility model described in the previous section, so that we can condition on information at time t. All per capita variables are constructed using the quarterly civilian non-institutional population. We detrend data prior to estimation using a linear trend; results under a VAR specification that includes a linear trend are nearly identical to those reported in the paper.

The solid lines in Figure 8 show the median impulse responses of the six endogenous variables to a two-standard-deviation shock to tariff volatility, while the shaded bands represent the corresponding 70 percent point-wise credible sets. Such a shock corresponds to an increase in tariff volatility from its mean of 0.3 to a higher value of 0.9 percentage points. This is about half the size of the Nixon and Ford shocks shown in Figure 4, and is comparable to an out-of-sample estimate of the rise in volatility that would follow a gradual increase in average tariffs from 2 to 8 percent.[21] The tariff volatility shock gradually reduces output and investment: in the first year after the shock, GDP drops by about 0.3 percent, whereas private investment declines between 1 and 2 percent.[22] Higher trade policy uncertainty leads to an improvement in the trade balance, with the ratio of net exports to GDP rising by 0.1 percentage points. Markups increase two years after the shock. Finally, monetary policy accommodates its stance, with the federal funds rate dropping by 0.6 percentage points.

Our results are robust to two alternative specifications of the VAR model. Figure 9 shows that the results obtained by ordering tariff volatility last in the system are nearly identical to those under the baseline identification. Figure 10 presents the estimates of the baseline VAR where we replace our tariff volatility series with the news-based TPU index. Our main findings are robust to the adopted measure of trade policy uncertainty. However, the timing of the effects is different: a shock to the news-based TPU index leads to an immediate decline in real activity compared to the tariff volatility measure. A possible explanation is that the news-based TPU index is a more timely indicator of uncertainty, an hypothesis corroborated by the fact that it leads tariff volatility by about two quarters. Additionally, news-based TPU captures uncertainty about additional dimensions of trade policy, such as export restrictions and anti-dumping measures, that might have more immediate effects on activity compared to tariffs.

Validation of Tariff Volatility Shocks

We conducted the VAR analysis on historical data from 1960 through 1984. These years were characterized by increased macroeconomic volatility due a variety of factors—such as oil shocks and monetary policy shocks—that are well-documented in the literature. While we attempt to control in the VAR for some of these alternative drivers of the business cycle, it is possible that our tariff volatility shocks are contaminated by other sources of macroeconomic instability.

To attenuate these concerns, we run two exercises. First, we look at the correlation between the tariff volatility shocks and other traditional macroeconomic shocks, which are external to our VAR

[21] Tariff uncertainty as measured by our stochastic volatility model does not substantially rise in 2017 and 2018, mostly because the model infers changes in volatility from changes in actual tariffs, which have been modest in 2017 and 2018. However, assuming a gradual increase in tariff rates over two years from an average level of 2 percent to 8 percent, our real-time estimate of tariff volatility would rise roughly by two standard deviations, as in the experiment of Figure 8.

[22] For comparison, these effects are of similar magnitude to those documented by Fernandez-Villaverde et al. (2015) in their analysis of shocks to capital tax volatility.

model. Second, we look at whether these external shocks Granger-cause the tariff volatility shocks.

We look at four sources of macroeconomic fluctuations that could be relevant for the sample at hand: oil shocks, monetary policy shocks, technology shocks, and (non-tariff) fiscal shocks. The oil shocks are from Hamilton (2003) and are based on a nonlinear transformation of the nominal price of crude oil. The monetary policy shocks are from Romer and Romer (2004) where we take the quarterly sum of their monthly variable. Technology shocks are the residual from an AR(1) model of the utilization-adjusted total factor productivity (TFP) (Fernald, 2012). To proxy for changes in non-tariff fiscal instruments, we use three indicators: the surprise tax policy changes from Mertens and Ravn (2011); the news shocks about military spending from Ramey (2011); and the capital tax volatility series of Fernandez-Villaverde et al. (2015).

Table 3 reports the pairwise correlations between these external shocks and our identified tariff volatility shocks, as well as results from the Granger causality tests. These results robustly support the lack of systematic contemporaneous and lagged association between the identified tariff volatility shocks and other types of macroeconomic shocks. All correlations and Granger tests are statistically different from zero and small in economic terms.

3.4 Taking Stock from the Empirical Evidence

We have presented a variety of methods to measure the empirical effects of movements in trade policy uncertainty. Our firm-level approach finds that firm-level variation in trade policy uncertainty, sized to reflect the developments in 2017-18, can account for an overall decline in investment of about 1 percent. Our estimated VAR, which is informed by the historical experience of the 1960s and 1970s, also predicts a negative effect of trade uncertainty on investment. When the VAR shock is sized to reflect the trade tensions of 2017 and 2018, the predicted drag on investment is a bit larger, between 1 and 2 percent.

4 The Model

In this section, we present a DSGE model that we build to investigate how trade policy uncertainty transmits to the economy. The model is an open economy version of Christiano, Eichenbaum, and Evans (2005) and Smets and Wouters (2007) that features stochastic volatility in the rule for import tariff rates.

The economy consists of a home (H) country and a foreign (F) country that are isomorphic in structure. We denote foreign variables with an asterisk. Agents in each economy include households, retailers, wholesale firms, producers of intermediate goods, financial intermediaries, and the government. The next sections describe the optimization problems solved by each type of agent.

4.1 Households

Households in the home country choose final good consumption $\left(C_t^h\right)$, differentiated labor supply and wages for their members ($l_{j,t}$ and $w_{j,t}$ for $j \in H$), bank deposits D_t, and a portfolio of assets $\{A_t(s)\}_{s\in S}$ to maximize expected lifetime utility

$$E_s \sum_{t\geq s} \beta^{t-s} U\left(C_t^h, \{l_{j,t}\}_{j\in H}\right), \tag{4}$$

subject to the budget constraint

$$C_t^h + \sum_{s\in S} A_t(s) + D_t + \int AC_{j,t}^w dj \leq \int l_{j,t} w_{j,t} dj + \sum_{s\in S} A_{t-1}(s) R_t^A(s) + D_{t-1} R_t^d + T_t, \tag{5}$$

where $AC_{j,t}^w$ is the resource cost for household member j of adjusting its wage, $R_t^A(s)$ is the return on asset $A_{t-1}(s)$, R_t^d is the return on deposits D_{t-1}, and T_t is a lump-sum transfer from the government. We assume that the wage adjustment cost function is increasing in the aggregate level of employment (L_t) and is quadratic in the desired wage change

$$AC_{j,t}^w = \frac{\rho_w}{2}\left(\frac{w_{jt}}{w_{jt-1}} - 1\right)^2 L_t. \tag{6}$$

In setting its wage, household member j takes as given intermediate good producers' labor demand

$$l_{j,t} = \left(\frac{w_{jt}}{W_t}\right)^{-\varepsilon_w} L_t, \tag{7}$$

where ε_w governs the elasticity of substitution across differentiated labor inputs.

Optimality requires the following saving conditions:

$$1 = \beta E_t\left[\Lambda_{t,t+1} R_{t+1}^A(s)\right] \text{ for } s \in S \tag{8}$$

$$1 = \beta E_t\left[\Lambda_{t,t+1} R_{t+1}^d(s)\right] \tag{9}$$

where $\Lambda_{t,t+1} = \frac{U_c(t+1)}{U_c(t)}$ is the real stochastic discount factor for the household in the home country. In a symmetric equilibrium, this expression reduces to the wage Phillips curve

$$\left(\pi_t^w - 1\right)\pi_t^w = \frac{\varepsilon_w}{\rho_w}\left[-\frac{U_{l_j}(t)}{U_c(t)} - \frac{(\varepsilon_w - 1)}{\varepsilon_w} W_t\right] + \beta E_t \frac{U_c(t+1)}{U_c(t)}\left(\pi_{t+1}^w - 1\right)\pi_{t+1}^w \frac{L_{t+1}}{L_t}. \tag{10}$$

4.2 Retailers

Competitive consumption retailers in the home country combine a composite traded consumption good ($C_{T,t}$) and a non-traded good ($C_{N,t}$) to produce the final consumption good (C_t) according to the constant-elasticity-of-substitution (CES) aggregator

$$C_t = \left[\gamma_c^{\frac{1}{\varphi_c}} C_{T,t}^{\frac{\varphi_c - 1}{\varphi_c}} + (1-\gamma_c)^{\frac{1}{\varphi_c}} C_{N,t}^{\frac{\varphi_c - 1}{\varphi_c}} \right]^{\frac{\varphi_c}{\varphi_c - 1}}, \tag{11}$$

where $\varphi_c \geqslant 0$ determines the elasticity of substitution between the composite traded good and the non-traded good and γ_c governs the relative share of these consumption goods. Profits for the consumption retailers are

$$\Pi_{C,t}^{R} = P_t C_t - P_{Tt} C_{Tt} + P_{Nt} C_{Nt}, \tag{12}$$

where P_{Tt} and P_{Nt} are, respectively, the price indexes of the composite traded consumption good and the non-traded consumption good in the home country.

Given the CES structure of the aggregator, the associated demand schedules are characterized by

$$C_{T,t} = \gamma_c \left(\frac{P_{Tt}}{P_t} \right)^{-\varphi_c} C_t, \tag{13}$$

$$C_{N,t} = (1-\gamma_c) \left(\frac{P_{Nt}}{P_t} \right)^{-\varphi_c} C_t. \tag{14}$$

The zero profit condition for consumption retailers gives the consumption price index

$$P_t^{1-\varphi_c} = \gamma_c P_{Tt}^{1-\varphi_c} + (1-\gamma_c) P_{Nt}^{1-\varphi_c}. \tag{15}$$

Similarly, competitive investment retailers in the home country combine a composite traded investment good ($I_{T,t}$) and a non-traded investment good ($I_{N,t}$) to produce the final investment good (I_t) according to the CES aggregator

$$I_t = \left[\gamma_i^{\frac{1}{\varphi_i}} I_{T,t}^{\frac{\varphi_i - 1}{\varphi_i}} + (1-\gamma_i)^{\frac{1}{\varphi_i}} I_{N,t}^{\frac{\varphi_i - 1}{\varphi_i}} \right]^{\frac{\varphi_i}{\varphi_i - 1}}, \tag{16}$$

where $\varphi_i \geqslant 0$ determines the elasticity of substitution between the composite traded investment good and the non-traded investment good and γ_i governs the relative share of these investment goods. Profits for the investment retailers are

$$\Pi_{I,t}^{R} = P_t^I I_t - P_{Tt}^I I_{Tt} + P_{Nt}^I I_{Nt}, \tag{17}$$

where P_{Tt}^I and P_{Nt}^I are, respectively, the price indexes of the composite traded investment good and the non-traded investment good in the home country.

Given the CES structure of the aggregator, the associated demand schedules are characterized by

$$I_{T,t} = \gamma_i \left(\frac{P^I_{Tt}}{P^I_t} \right)^{-\varphi_i} I_t, \tag{18}$$

$$I_{N,t} = (1 - \gamma_i) \left(\frac{P^I_{Nt}}{P^I_t} \right)^{-\varphi i} I_t. \tag{19}$$

The zero profit condition for investment retailers gives the investment price index

$$\left(P^I_t\right)^{1-\varphi_i} = \gamma_i \left(P^I_{Tt}\right)^{1-\varphi_i} + (1 - \gamma_i) \left(P^I_{Nt}\right)^{1-\varphi_i}. \tag{20}$$

4.3 Wholesale Firms

Competitive wholesale consumption firms combine a domestic traded consumption good ($C_{H,t}$) and a foreign traded consumption good ($C_{F,t}$) to produce the composite traded consumption good ($C_{T,t}$) according to the CES aggregator

$$C_{T,t} = \left[\omega_c^{\frac{1}{\theta_c}} C_{Ht}^{\frac{\theta_c - 1}{\theta_c}} + (1 - \omega_c)^{\frac{1}{\theta_c}} C_{Ft}^{\frac{\theta_c - 1}{\theta_c}} \right]^{\frac{\theta_c}{\theta_c - 1}}, \tag{21}$$

where $\theta_c \geqslant 0$ determines the elasticity of substitution between domestic and foreign traded consumption goods and ω_c governs home bias. Profits for the home wholesale firms are

$$\Pi^W_{C,t} = P_{Tt} C_{Tt} - P_{Ht} C_{Ht} + \left(1 + \tau^m_{C,t}\right) P_{Ft} C_{Ft}, \tag{22}$$

where P_{Ht} and P_{Ft} are, respectively, the price indexes of the domestic and foreign traded consumption goods. Imported consumption goods are subject to the tariff $\tau^m_{C,t}$. Given the CES structure, the associated demand schedules are characterized by

$$C_{Ht} = \omega_c \left(\frac{P_{H,t}}{P_{Tt}} \right)^{-\theta_c} C_{T,t}, \tag{23}$$

$$C_{Ft} = (1 - \omega_c) \left[\frac{P_{F,t} \left(1 + \tau^m_{C,t}\right)}{P_{Tt}} \right]^{-\theta_c} C_{T,t}, \tag{24}$$

and the price index for the composite traded consumption good is

$$(P_{Tt})^{1-\theta_c} = \omega_c P_{H,t}^{1-\theta_c} + (1 - \omega_c) \left[P_{F,t} \left(1 + \tau^m_t\right)\right]^{1-\theta_c}. \tag{25}$$

Similarly, we assume that competitive wholesale investment firms combine a domestic traded investment good ($I_{H,t}$) and foreign traded investment good ($I_{F,t}$) to produce the composite traded investment good ($I_{T,t}$) according to the CES aggregator

$$I_{T,t} = \left[\omega_i^{\frac{1}{\theta_i}} I_{H,t}^{\frac{\theta_i - 1}{\theta_i}} + (1 - \omega_i)^{\frac{1}{\theta_i}} I_{F,t}^{\frac{\theta_i - 1}{\theta_i}} \right]^{\frac{\theta_i}{\theta_i - 1}}, \tag{26}$$

where $\theta_i \geqslant 0$ determines the elasticity of substitution between domestic and foreign traded investment goods and ω_c governs home bias.

Profits for the home wholesale firms are

$$\Pi_{I,t}^{W} = P_{Tt}^{I} C_{Tt} - P_{Ht}^{I} C_{Ht} + \left(1 + \tau_{C,t}^{m}\right) P_{Ft}^{I} C_{Ft}, \tag{27}$$

where P_{Ht}^{I} and P_{Ft}^{I} are, respectively, the price indexes of the domestic and foreign traded investment goods. Imported investment goods are subject to the tariff $\tau_{I,t}^{m}$.

Given the CES structure, the associated demand schedules are characterized by

$$I_{Ht} = \omega_i \left(\frac{P_{H,t}^{I}}{P_{Tt}^{I}} \right)^{-\theta_i} I_{T,t}, \tag{28}$$

$$I_{Ft} = (1 - \omega_i) \left[\frac{P_{F,t}^{I} \left(1 + \tau_{I,t}^{m}\right)}{P_{Tt}^{I}} \right]^{-\theta_i} I_{T,t}, \tag{29}$$

and the price index for the composite traded consumption good is

$$\left(P_{Tt}^{I}\right)^{1-\theta_i} = \omega_c \left(P_{H,t}^{I}\right)^{1-\theta_i} + (1 - \omega_c) \left[P_{F,t}^{I} \left(1 + \tau_t^{m}\right)\right]^{1-\theta_i}. \tag{30}$$

4.4 Distributors

We assume that there are competitive distributors that specialize in the production of composite traded domestic consumption goods ($C_{H,t}$), composite traded foreign consumption goods ($C_{F,t}$), composite non-traded domestic consumption goods ($C_{N,t}$), composite traded domestic investment goods ($I_{H,t}$), composite traded foreign investment goods ($I_{F,t}$), and composite non-traded domestic investment goods ($I_{N,t}$), using domestic and foreign varieties that are aggregated by mean of the following CES technologies

$$C_{d,t} = \left[\int C_{d,t}(j)^{\frac{\varepsilon - 1}{\varepsilon}} dj \right]^{\frac{\varepsilon}{\varepsilon - 1}}, \quad for\ d = H, F, N, \tag{31}$$

$$I_{d,t} = \left[\int I_{d,t}(j)^{\frac{\varepsilon - 1}{\varepsilon}} dj \right]^{\frac{\varepsilon}{\varepsilon - 1}}, \quad for\ d = H, F, N. \tag{32}$$

The associated demand schedules are

$$C_{d,t}\left(j\right)=\left[\frac{P_{d,t}\left(j\right)}{P_{d,t}}\right]^{-\varepsilon}C_{H,t},\quad for\ d=H,F,N, \tag{33}$$

$$I_{d,t}\left(j\right)=\left[\frac{P_{d,t}\left(j\right)}{P_{d,t}}\right]^{-\varepsilon}I_{F,t},\quad for\ d=H,F,N, \tag{34}$$

and the price indexes are

$$P_{d,t}=\left[\int P_{d,t}\left(j\right)^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}},\quad for\ d=H,F,N, \tag{35}$$

$$P^{I}_{d,t}=\left[\int P^{I}_{I,t}\left(j\right)^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}},\quad for\ d=H,F,N. \tag{36}$$

4.5 Producers

Each country features a continuum $m\in[0,1]$ and $n\in[0,1]$ of monopolistically competitive firms that produce different varieties of intermediate goods in the tradable and non-tradable sectors, respectively, by accessing a competitive market for capital and labor inputs. Both factors of production can be costlessly reallocated between tradable and non-tradable production. Producers in the two sectors use the technology

$$Y_{Tt}\left(m\right)+Y^{*}_{Tt}\left(m\right)=Z_{t}K^{\alpha_T}_{Tt}\left(m\right)L^{1-\alpha_T}_{Tt}\left(m\right), \tag{37}$$

$$Y_{N,t}\left(n\right)=Z_{t}K^{\alpha_N}_{Nt}\left(n\right)L^{1-\alpha_N}_{Nt}\left(n\right), \tag{38}$$

where, for firm m, $Y_{T,t}\left(m\right)$ are domestic sales in the tradable sector, $Y^{*}_{T,t}\left(m\right)$ are foreign sales in the tradable sector, $Y_{N,t}\left(n\right)$ are sales in the non-tradable sector. Z_t denotes the aggregate level of technology, and (α_T,α_N) control the share of inputs in production.

Let W_t and r^k_t denote (consumption) real wages and rental rate of capital. Given the Cobb-Douglas technology functions, cost minimization yields the usual expression for marginal costs

$$MC^{T}_{t}=\left[\frac{r^k_t}{\alpha_T}\right]^{\alpha_T}\left[\frac{w_t}{(1-\alpha_T)}\right]^{1-\alpha_T}, \tag{39}$$

$$MC^{N}_{t}=\left[\frac{r^k_t}{\alpha_N}\right]^{\alpha_N}\left[\frac{w_t}{(1-\alpha_N)}\right]^{1-\alpha_N}. \tag{40}$$

Producers face costs of adjusting prices that are increasing in total sales and quadratic in the change of desired prices (more details below). Consider first the producers of tradable varieties. Define the relative prices p_{Ht}, $p_{Ht}(j)$, p^{*}_{Ht}, $p^{*}_{Ht}(j)$ as follows

$$p_{Ht} = \frac{P_{Ht}}{P_t};\ p_{Ht}(j) = \frac{P_{Ht}(j)}{P_t};\ \ p^*_{Ht} = \frac{P^*_{Ht}}{P^*_t};\ p^*_{Ht}(j) = \frac{P^*_{Ht}(j)}{P^*_t}, \tag{41}$$

and let the real exchange rate be

$$Q_t = \varepsilon_t \frac{P^*_t}{P_t}. \tag{42}$$

In our benchmark specification, we assume local currency pricing (LCP), that is, tradable producers set prices in domestic currency in the domestic market, and in foreign currency in the foreign market. Producers also pay different costs to adjust prices in the two markets. Hence, profits for an individual firm m are

$$\Pi^P_t(m) = p_{Ht}(m) Y_{Ht}(m) + Q_t p^*_{Ht}(m) Y^*_{Ht}(m) - MC_t (Y_{Ht}(m) + Y^*_{Ht}(m)) - AC^p_t(m) - AC^{p^*}_t(m),$$

where

$$AC^p_t(m) = \frac{\rho_p}{2}\left[\frac{p_{H,t}(m)}{p_{H,t-1}(m)}\pi_t - 1\right]^2 Y_{H,t}, \tag{43}$$

$$AC^p_t(m) = \frac{\rho_p}{2}\left[\frac{p^*_{H,t}(m)}{p^*_{H,t-1}(m)}\pi^*_t - 1\right]^2 Y^*_{H,t}. \tag{44}$$

In a symmetric equilibrium where we denote

$$\pi_{Ht} = \frac{P_{Ht}}{P_{Ht-1}} = \frac{p_{H,t}}{p_{H,t-1}}\pi_t, \tag{45}$$

the Phillips curves for the domestic and the foreign markets are

$$(\pi_{Ht} - 1)\pi_{Ht} = \frac{\varepsilon}{\rho_p}\left(MC^T_t - \frac{\varepsilon - 1}{\varepsilon}p_{H,t}\right) + \beta E_t \Lambda_{t,t+1}(\pi_{Ht+1} - 1)\pi_{Ht+1}\frac{Y_{H,t+1}}{Y_{Ht}}, \tag{46}$$

$$(\pi^*_{Ht} - 1)\pi^*_{Ht} = \frac{\varepsilon}{\rho_p}\left(MC^T_t - \frac{\varepsilon - 1}{\varepsilon}Q_t p^*_{H,t}\right) + \beta E_t \Lambda_{t,t+1}\left(\pi^*_{Ht+1} - 1\right)\pi^*_{Ht+1}\frac{Y^*_{H,t+1}}{Y^*_{Ht}}. \tag{47}$$

Similar steps for the non-tradable sector yield

$$(\pi_{Nt} - 1)\pi_{Nt} = \frac{\varepsilon}{\rho_p}\left(MC^N_t - \frac{\varepsilon - 1}{\varepsilon}p_{N,t}\right) + \beta E_t \Lambda_{t,t+1}(\pi_{Nt+1} - 1)\pi_{Nt+1}\frac{Y_{N,t+1}}{Y_{Nt}}. \tag{48}$$

4.6 Financial Intermediation

Financial intermediaries collect deposits from households and provide sources of funding to firms. A bank with net worth N_t

$$N_t = \left[r^k_t + (1-\delta)p^K_t\right] K_t - D_{t-1}R_t, \tag{49}$$

buys assets at time t by using N_t and deposits

$$p_t^K K_t = N_t + D_t. \tag{50}$$

Letting the leverage multiple be $\phi_t = \frac{p_t^K K_t}{N_t}$, and the return on capital $R_t^k = \frac{r_t^k + (1-\delta) p_t^K}{p_{t-1}^K}$, we can use (49) and (50) to write the evolution of net worth as

$$N_{t+1} = N_t \left[\phi_t \left(R_{t+1}^k - R_t\right) + R_t\right]. \tag{51}$$

With probability σ a banker survives, and with probability $(1-\sigma)$ a banker exits and gives net worth back to the family. We then have that the optimal value of being a banker with net worth N_t is

$$V_t\left(N_t\right) = \psi_t N_t = \max_{\phi_t} \beta E_t \Lambda_{t,t+1} \left[1 - \sigma + \sigma \psi_{t+1}\right] N_t \left[\phi_t \left(R_{t+1}^k - R_t\right) + R_t\right], \tag{52}$$

s.t.

$$\beta E_t \Lambda_{t,t+1} \left[1 - \sigma + \sigma \psi_{t+1}\right] \left[\phi_t \left(R_{t+1}^k - R_t\right) + R_t\right] \geq \theta \phi_t. \tag{53}$$

The solution with binding constraint is

$$\theta \phi_t = \psi_t, \tag{54}$$

$$\psi_t = \beta E_t \Lambda_{t,t+1} \left[1 - \sigma + \sigma \psi_{t+1}\right] \left[\phi_t \left(R_{t+1}^k - R_t\right) + R_t\right]. \tag{55}$$

Aggregate net worth evolves according to

$$N_t = \sigma N_{t-1} \left[\phi_t \left(R_{t+1}^k - R_t\right) + R_t\right] (1 + e_b) \tag{56}$$

where $e_b \sigma N_{t-1} \left[\phi_t \left(R_{t+1}^k - R_t\right) + R_t\right]$ is a transfer from the family to new bankers.

4.7 Capital Goods Producers

Let the increase in the aggregate capital stock be given by

$$I_t^k = K_t - (1-\delta) K_{t-1}. \tag{57}$$

Capital good producers use consumption goods and investment goods in order to produce final capital goods I_t^k. In particular they use one unit of investment goods I_t for each unit of I_t^k and they also face quadratic adjustment cost whenever they change the overall amount of I_t^k given by $\frac{\kappa}{2}\left(\frac{I_t^k}{I_{t-1}^k} - 1\right)^2$. Their problem is then to choose I_t^k to solve:

$$\max E_s \sum_{t \geq s} \beta^{t-s} \Lambda_{t,s} \left(p_t^K I_t^k - I_t^k \left[p_t^I + \frac{\kappa}{2}\left(\frac{I_t^k}{I_{t-1}^k} - 1\right)\right]\right), \tag{58}$$

$$p_t^K = p_t^I + \frac{\kappa}{\eta}\left(\frac{I_t^k}{I_{t-1}^k} - 1\right)^{\eta} + \frac{\kappa}{\eta}\left(\frac{I_t^k}{I_{t-1}^k} - 1\right)^{\eta-1}\frac{I_t^k}{I_{t-1}^k} - E_t\beta\Lambda_{t,st+1}\frac{\kappa}{\eta}\left(\frac{I_t^k}{I_{t-1}^k} - 1\right)^{\eta-1}\frac{I_t^k}{I_{t-1}^k}. \tag{59}$$

4.8 Government Policy and Equilibrium

To close the model we specify a rule for monetary, fiscal and trade policy.

The monetary authority follows a standard Taylor rule. The government balances its budget period by period.

Given stochastic processes for tariffs, taxes, and technology and demand shocks, an equilibrium is defined in the usual fashion.[23]

4.9 Solution and Calibration

Given our interest in quantifying the macroeconomic effects on trade policy uncertainty, we solve the model using a third-order perturbation method. As discussed in Fernandez-Villaverde, Guerron-Quintana, and Rubio-Ramirez (2010), innovations to volatility shocks have direct effects only through third-order terms.

We calibrate the model using standard values from the literature— following closely the parameters used by Fernandez-Villaverde et al. (2015) —as well as drawing from the VAR evidence described above to discipline the stochastic process for tariffs. The calibration is described in Table (4) for the deep parameters of the model, and in Table (5) for the exogenous processes and selected steady state values.

Starting with the calibration of the preference paremeters in Table 4, we assume a utility function that is separable in consumption and labor. We assume a discount factor β of 0.995, consistent with an annual real rate of 2 percent. We set risk aversion γ_R to 2, a habit formation γ_H to 0.75. We calibrate the inverse of the Frisch elasticity γ_F to 1. Turning to the calibration of the nominal rigidities, we set the wage and price stickiness parameters ρ_w and ρ_p, respectively, to a value that would replicate, in a linearized setup, the slope of the wage and price Phillips curve derived using Calvo stickiness with an average duration of wages and prices of six years. Following Fernandez-Villaverde et al. (2015), we fix the elasticity of labor and goods demand ε_w and ε at 21.

In our baseline, we set the share of traded consumption and investment goods γ_c and γ_i to 1. In the production function for wholesale firms, we set the trade elasticities of consumption and investment goods, θ_c and θ_i, to 1.5. We assume that the home bias in the production of consumption goods (ω_c) is 0.9, while the home bias in the production of investment goods (ω_i) is 0.5. We set the capital share of traded goods (α_T) is 0.36. We set the parameter governing investment adjustment costs (κ) to 0.5. With regards to financial frictions, we fix the share of networth of new e_b bankers to half a percent and set the survival probability of bankers (σ) to 0.962, and the diversion rate θ

[23] For details, see derivations in the Appendix.

to 0.433. These values imply a leverage of 4 percent and and annual excess returns of 2 percent, in line with Gertler and Karadi (2011).

We assume that the behaviour of monetary policy is described by a Taylor rule. The coefficient on infliation (γ_π) is 1.25, the coefficient on deviation of output from steady state (γ_y) is 0.25, and the inertia coefficient (γ_r) is 0.7.

Turning to the calibration of the exogenous processes in Table 4, we set the parameters describing the process for the tariff rate to the median estimates reported in Table 2. The parameters governing the remaining exogenous processes are from Fernandez-Villaverde et al. (2015).

5 Model Experiments

We use our model to describe how trade policy developments are transmitted to the macroeconomy. Trade policy developments are captured in our model by the stochastic process for import tariffs on consumption and investment goods. As shown by equations (24) and (29), tariffs drive a wedge between the unit revenue of intermediate good producers on the exported goods, and the price paid by their foreign customers. We model trade tensions as an increase in both the expectation of, and in the uncertainty about, future tariffs. In particular, we conduct two experiments that isolate anticipation effects and pure uncertainty effects of trade policy risk.

5.1 Downside Risks: Increase in the Probability of Higher Tariffs

In this first experiment, we solve a first order approximation of our model that allows for regime switches in tariffs and beliefs about tariffs. We assume that tariffs at home and abroad can take two possible values, τ^{SS} and τ^{HIGH}.[24]

We assume that, in period 1, agents learn that trade negotiations have begun, with a deadline set after $N = 8$ periods. No change in tariffs is possible until period N. Upon reaching the deadline, three outcomes are possible, each with probability equal to one-third: (i) no new tariffs are imposed, so that tariffs remain at their steady-state level τ^{SS}, and risk is resolved once and for all; (ii) tariffs rise to a higher value τ^{HIGH}, and remain there with probability equal to ρ_τ; (iii) trade negotiations restart, i.e. the exogenous process for the regime returns back to period 1.[25] We set $\tau^{SS} = 0.02$—the current average tariff rate on U.S. imports—and we set $\tau^{HIGH} = 0.08$.[26]

Figure 11 shows the evolution of the economy starting in period 1 under two possible outcomes of the negotiations. The blue solid lines describe outcome (i), when no new tariffs are imposed. The

[24] Additionally, we assume that the foreign economy immediately retaliates to any increase in domestic tariffs, and that tariffs on investment and consumption goods are equal, i.e. $\tau^m_{C,t} = \tau^{m*}_{C,t} = \tau^{m*}_{I,t} = \tau^m_{I,t} = \tau^m_t$.

[25] The third outcome adds realism to the experiment, but has little bearing for our quantitative results.

[26] Our experiment is inspired by the work of Steinberg (2019), who uses a dynamic trade model to assess the macroeconomic impact of uncertainty about Brexit on the U.K. economy.

red dashed lines describe outcome (ii), when negotiations fail and new tariffs are imposed, rising to their higher value at period 9 and remaining there throughout the experiment. The response of the economy up to period 8—which is common across all outcomes—is indicative of the effects of heightened downside risk.[27] In period 8, investment is 0.4 percent and consumption is 0.02 percent below steady state. The drop in domestic absorption more than offsets the modest rise in net exports, causing GDP to decline. If no new tariffs are imposed after the end of negotiations, the economy reverts back to its steady state. By contrast, if negotiations fail and tariffs increase at period 9, there is a sizable drop in output of about 0.7 percent three years after the imposition of tariffs. The contraction in GDP is mostly driven by a persistent drop in investment. This persistent decline in investment demand is also associated with a large drop in asset prices and a tightening of financial conditions reflected in higher spreads.

The investment decline during the first 8 periods is due to the downside risk on asset prices induced by the trade negotiations. When negotiations start, forecasts of future asset prices decline, causing an immediate contraction in investment demand. The drop in investment is further amplified by a rise in excess returns through the familiar financial accelerator mechanism.[28]

5.2 Second Moment Shocks: Increased Uncertainty about Tariffs

We now turn to the pure uncertainty effects of trade policy announcements. We assume that the process for tariffs is determined by the stochastic volatility process described in equations (1) and (2), with the parameters set to the values estimated in Section 2. As before, we assume that the foreign economy retaliates immediately to any domestic tariff change. To capture the effects of an increase in uncertainty, we approximate our policy functions to the third order, following Andreasen, Fernandez-Villaverde, and Rubio-Ramirez (2017).

Figure 12 shows the response of the economy to an increase in σ_t. We choose the size of the shock to roughly mimic the increase in uncertainty associated with the last period of negotiations in the experiment described in the previous subsection. Specifically, the standard deviation of tariffs, $\exp(\sigma_t)$, rises from its estimated average of 0.2 to 3 percentage points. The blue solid lines depict the impact of heightened uncertainty in the baseline economy, while the red dashed line shows the effects in an economy with flexible prices.

In our baseline economy, the rise in uncertainty results in a decline in both domestic consumption and investment. The fall in domestic absorption is only partially offset by a rise in net exports,

[27] In this experiment, we use a first-order perturbation of the policy functions around deterministic steady states consistent with the assumed path of tariffs. Hence, we do not fully capture the uncertainty associated with the start of negotiations. We tackle this issue in the next experiment.

[28] There is also an intertemporal substitution force that tends to boost aggregate demand in anticipation of future shocks that make consumption and investment more expensive. The relevance of this offsetting channel to aggregate demand depends critically on the monetary policy response to both the announcement of negotiations and the realization of tariffs.

resulting in a slight decline in output. Firms respond to the rise in uncertainty by increasing prices and markups. This rise in markups is key in determining the contraction in economic activity. In the flex-price economy, firms keep markups at their desired level, inducing a smaller and less persistent decline in domestic absorption.

Markups are central to the transmission of tariff uncertainty shocks. When different varieties are close substitutes, the firm's cost of charging a lower price than its competitors is much larger than the cost of charging a higher price. Since uncertainty about future tariffs increases the variance of future desired prices, firms raise prices to avoid having a relatively low price in the future. This is the same mechanism described in Fernandez-Villaverde et al. (2015), who study the macroeconomic effects of uncertainty about capital taxes in a closed-economy model.[29]

In our model, firms set two different prices in the domestic and foreign markets. As shown in the last two panels of Figure 12, the precautionary increase in prices is much stronger in the foreign market. This result occurs because changes in tariffs induce large changes in foreign demand that are highly correlated with firms' marginal costs: higher (lower) tariffs lead to a decline (increase) in both domestic exports and marginal costs. The positive covariance between foreign demand and marginal costs amplifies the precautionary increase in prices in the export market, resulting in larger markups.

Intuitively, tariff volatility induces large fluctuations in foreign demand. Moreover, when demand is very elastic, firms want to avoid having relatively low prices in periods in which demand is high and marginal costs are high. Such a mechanism induces firms to increase prices in response to higher uncertainty.

6 Conclusion

We take a comprehensive approach at studying the economic effects of trade policy uncertainty, using firm-level data, a VAR analysis, and a DSGE model. We find that high uncertainty about tariffs deters investment.

[29] The incentive to increase prices when uncertainty is high is at the maximum in the limiting case of an elasticity of substitution going to infinity. See also Born and Pfeifer (2014a) for a discussion. Price adjustment costs make the firms' marginal profit function convex, as firms have to satisfy the demand at a given price. Firms stuck with a price that is too low will sell more goods at a lower profit, while firms stuck with a price that is too high will sell fewer goods, but at a higher per unit profit. In response to higher uncertainty firms will raise prices and markups as self-insurance against being stuck with a price that is too low.

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Table 1: Industry TPU and Industry Investment in 2018

	(1) $\Delta log K_{2018} - \Delta log K_{2017}$	(2) $\Delta log K_{2018} - \Delta log K_{2017}$
ΔTPU_{2018} (standardized)	-1.565**	-2.336**
	(0.737)	(0.983)
New Tariffs in 2018		1.305
		(1.029)
Observations	46	40
R-squared	0.093	0.135

NOTE: Standard errors in parenthesis. * and ** denote significance at the 10 and 5 percent level, respectively. Columns (1) to (2) regress change in industry investment (2018 vs 2017) against change in industry TPU in 2018. Industries are grouped according to Fama and French 49-industries classification. We drop utilities, banks and financial institutions, as well as industries where we do not have data on new tariffs.

Table 2: Tariff Rule: Parameter Estimates

	Full Sample			1960-1984		
Parameter	Median	5-th ptile	95-th ptile	Median	5-th ptile	95-th ptile
ρ_τ	0.99	0.99	0.99	0.99	0.99	0.99
σ	-6.14	-6.73	-5.47	-5.77	-6.59	-4.44
ρ_σ	0.96	0.87	0.99	0.96	0.70	0.99
η	0.37	0.29	0.47	0.48	0.37	0.62

NOTE: The entries in the table denote the median, 5-th and 95-th percentiles of the posterior distribution of the parameters of the stochastic volatility model described in equations (1) and (2).

Table 3: Orthogonality Between Tariff Volatility Shocks and Other External Shocks

External Shocks	Correlation	(p-value)	Granger F-test	(p-value)
Oil shocks[a]	-0.08	(0.45)	0.65	(0.52)
Monetary policy shocks[b]	-0.05	(0.70)	0.78	(0.46)
TFP growth shocks[c]	-0.01	(0.91)	0.07	(0.94)
Unanticipated tax shocks[d]	-0.00	(0.99)	0.19	(0.83)
Defense spending shocks[e]	0.06	(0.53)	0.95	(0.39)
Capital tax vol. shocks[f]	0.14	(0.28)	1.04	(0.36)

NOTE: The entries in the table denote the pairwise correlations and Granger-causality tests between the tariff volatility shock identified under the baseline VAR specification and a set of external instruments. The regressions underlying the pairwise Granger causality tests include a constant and two lags of each external instrument. Sample period for the volatility shocks is 1960:Q3 to 1984:Q4.

[a] Crude oil supply shock from Hamilton (2003).

[b] Monetary policy shocks from Romer and Romer (2004); (1969:Q1–1984:Q4).

[c] Residuals from a first-order autoregressive model of the log-difference in the utilization-adjusted total factor productivity; see Fernald (2012).

[d] Unanticipated tax shocks from Mertens and Ravn (2011).

[e] Defense spending news shocks from Ramey (2011).

[f] Capital tax volatility shocks from Fernandez-Villaverde et al. (2015).

Table 4: Calibration – Deep Parameters

Parameter	Symbol	Value
(a) Preferences		
Discount Factor	β	0.995
Risk Aversion	γ_R	2
Habit	γ_H	0.75
Inverse Frisch Elasticity	γ_F	1
(b) Rigidities		
Cost of wage adjustment	ρ_w	3317
Cost of price adjustment	ρ_p	771
Elasticity of labor demand	ε_w	21
Elasticity of goods demand	ε	21
(c) Technology – Retailers		
Elasticity of substitution between tradable and non-tradable consumption	ϕ_c	2
Share of traded consumption goods	γ_c	1
Elasticity of substitution between tradable and non-tradable investment	ϕ_i	2
Share of traded investment goods in prod.	γ_i	1
(d) Technology – Wholesale Firms		
Trade elasticity consumption goods	θ_c	1.5
Home bias for consumption goods	ω_c	0.9
Trade elasticity investment goods	θ_i	1.5
Home bias for investment goods	ω_i	0.5
(e) Technology – Producers		
Capital share, non-traded goods production	α_N	0.1
Capital share, traded goods production	α_T	0.36
(f) Technology – Capital Goods Producers		
Investment adjustment	κ	0.5
(g) Financial Intermediation		
Bankers' survival probability	σ	0.962
Share of new entrants	e_b	0.005
Diversion rate	θ	0.433
(h) Policy Parameters		
Coefficient on inflation	γ_π	1.25
Coefficient on output	γ_y	0.25
Inertia coefficient	γ_r	0.7

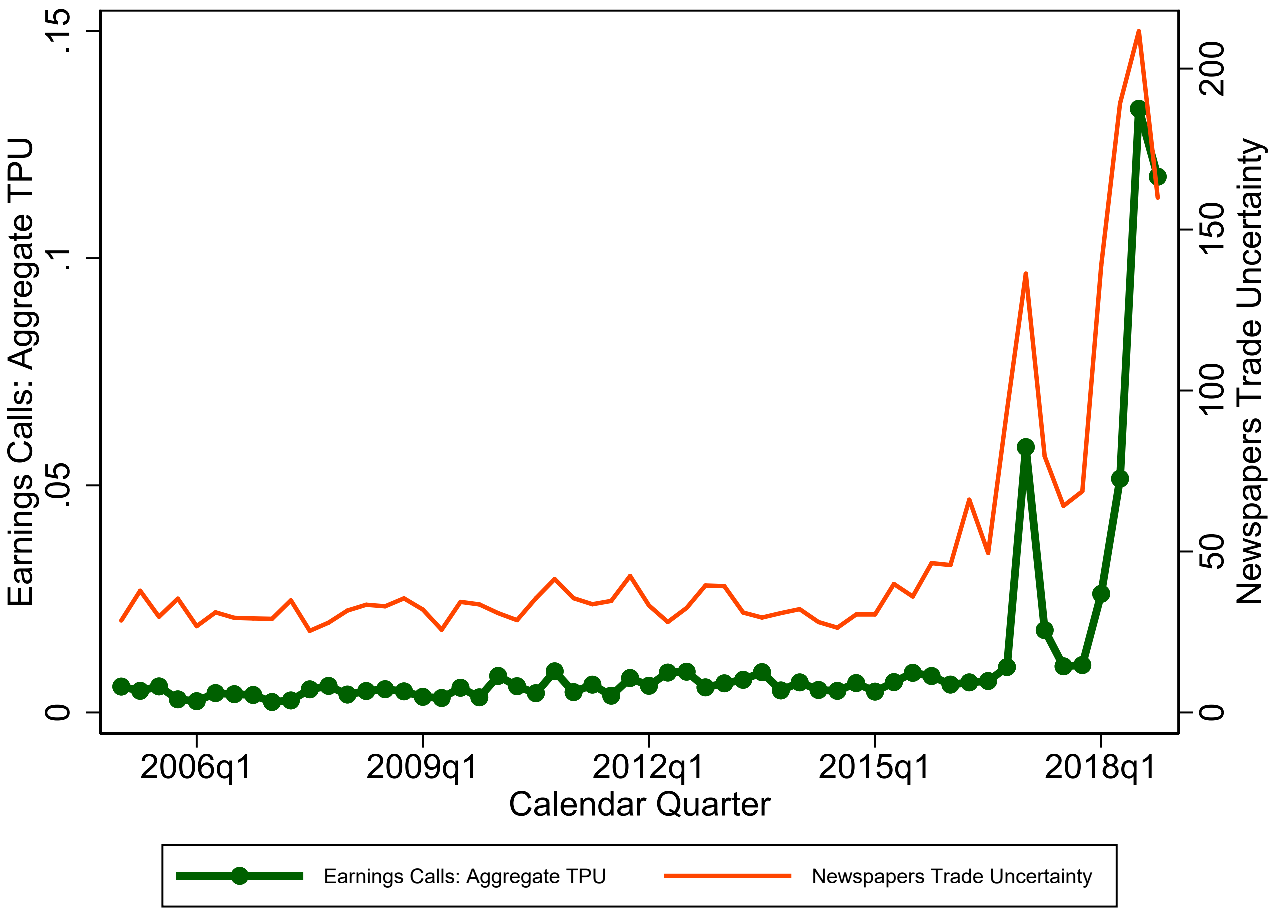
NOTE: The entries in the table denote the calibrated parameters of the DSGE model.

Table 5: Calibration – Exogenous Parameters and Selected Steady State Values

Parameter	Symbol	Value
(a) Technology process		
Autoregressive coef.	ρ_A	0.95
Standard deviation	σ_A	0.7
(b) Demand process		
Autoregressive coef.	ρ_D	0.16
Standard deviation	σ_D	0.08
(c) Government spending process		
Autoregressive coef.	ρ_G	0.99
Standard deviation	σ_G	0.2
Steady state G/Y	g/y	0.2
(d) Tariff process		
Autoregressive coef. (level)	ρ_{τ_m}	0.995
Autoregressive coef. (volatility)	ρ_{σ_m}	0.96
Standard deviation (volatility shock)	σ_{σ_m}	0.22
Steady state tariff tax	τ_m^{ss}	0.02
(e) Fiscal processes		
Autoregressive coef. capital tax	ρ_{τ_k}	0.98
Autoregressive coef. labor tax	ρ_{τ_l}	0.99
Standard deviation capital tax	σ_{τ_k}	0.75
Standard deviation labor tax	σ_{τ_l}	0.25
Steady state capital tax	τ_k^{ss}	0.36
Steady state labor tax	τ_l^{ss}	0.22
(f) Other parameters		
Relative size of the US economy		0.33

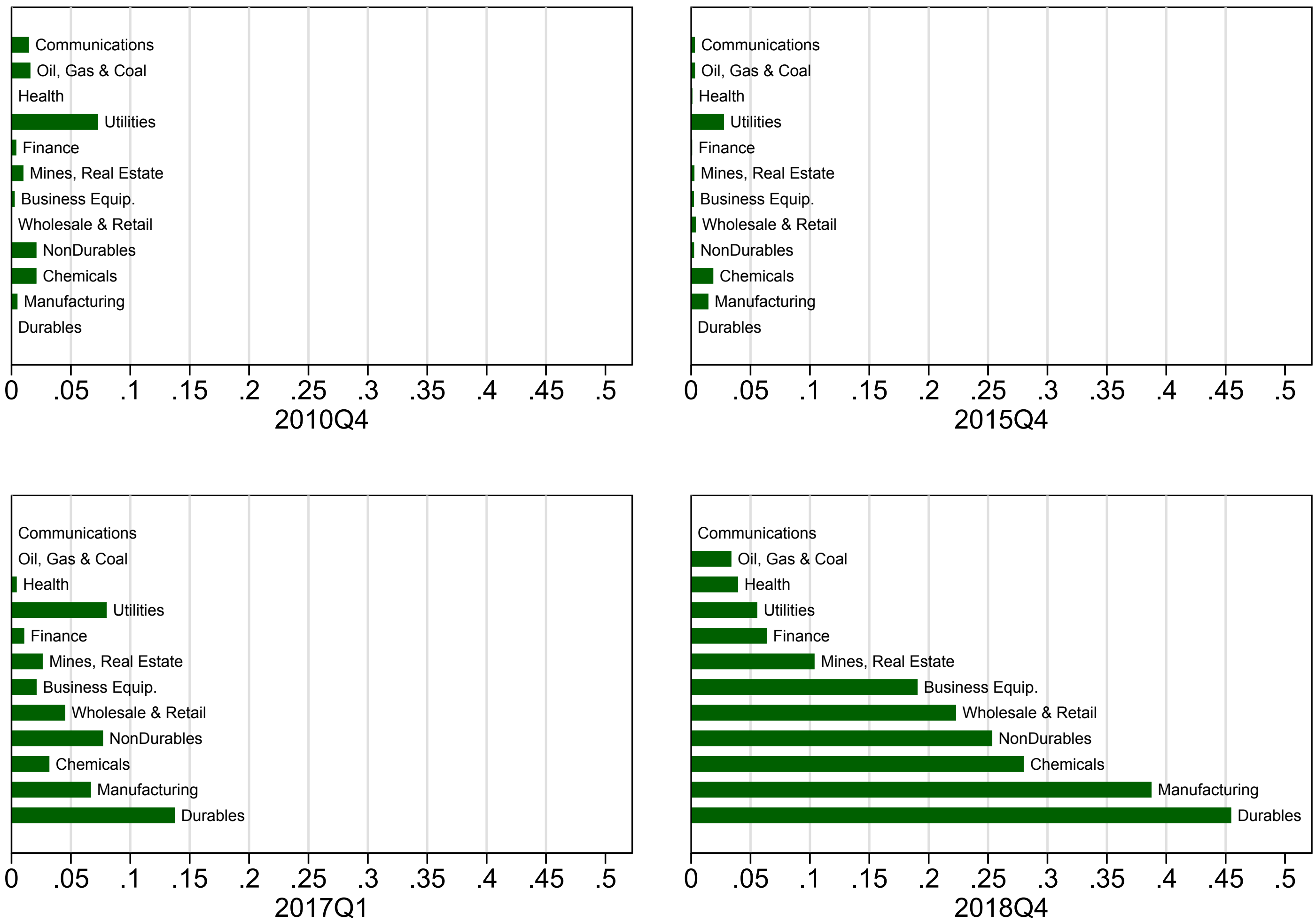
NOTE: The entries in the table denote the calibrated parameters of the DSGE model.

Figure 1: Trade Policy Uncertainty in Firms Earnings Calls



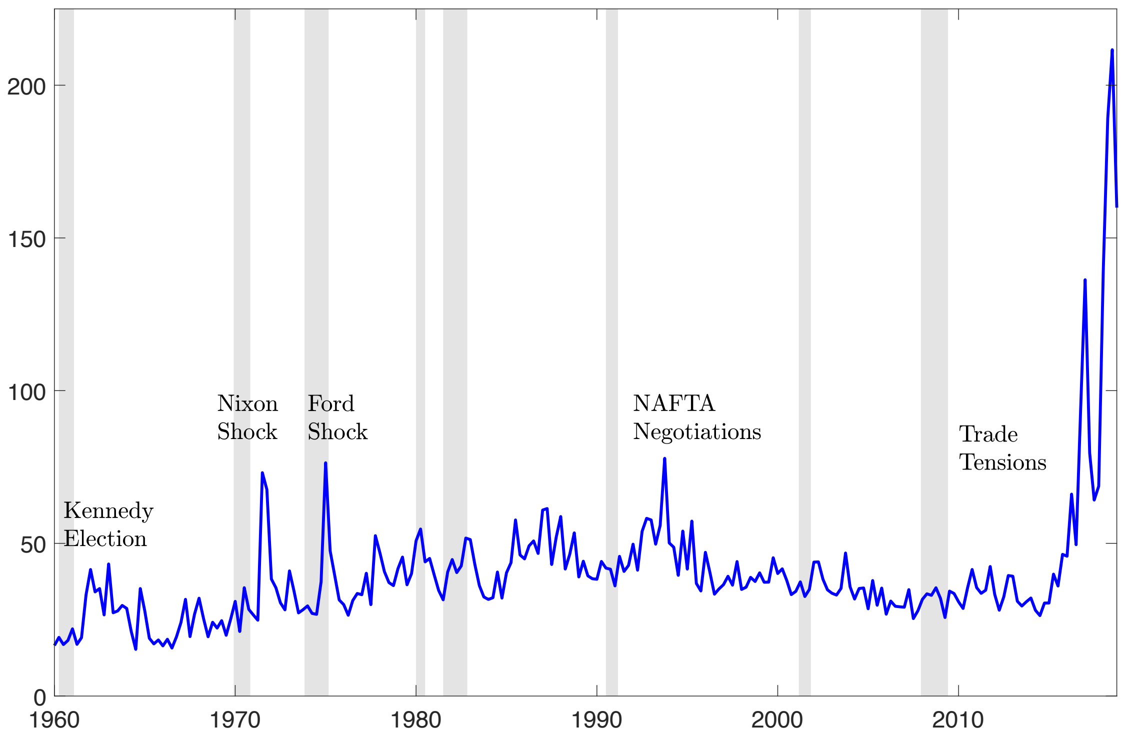
Note: In each quarter, aggregate TPU from earnings calls measures the fraction of firms mentioning trade policy uncertainty in their earnings call. Newspaper Trade Uncertainty is the percent share of articles from seven major newspapers mentioning trade uncertainty. The latter series is indexed to 100 for an article share of 1 percent.

Figure 2: Trade Policy Uncertainty by Industry over the Years



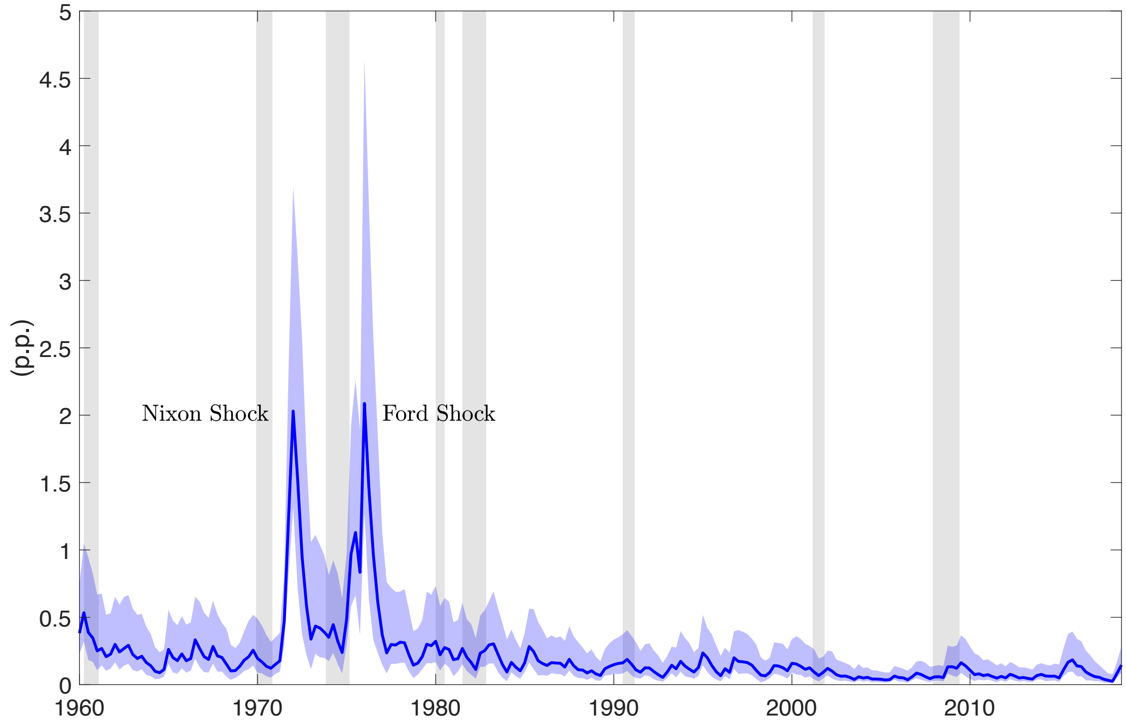
Note: Firms are grouped according to the Fama-French 12 industries classification.

Figure 3: News-Based Index of Aggregate Trade Policy Uncertainty



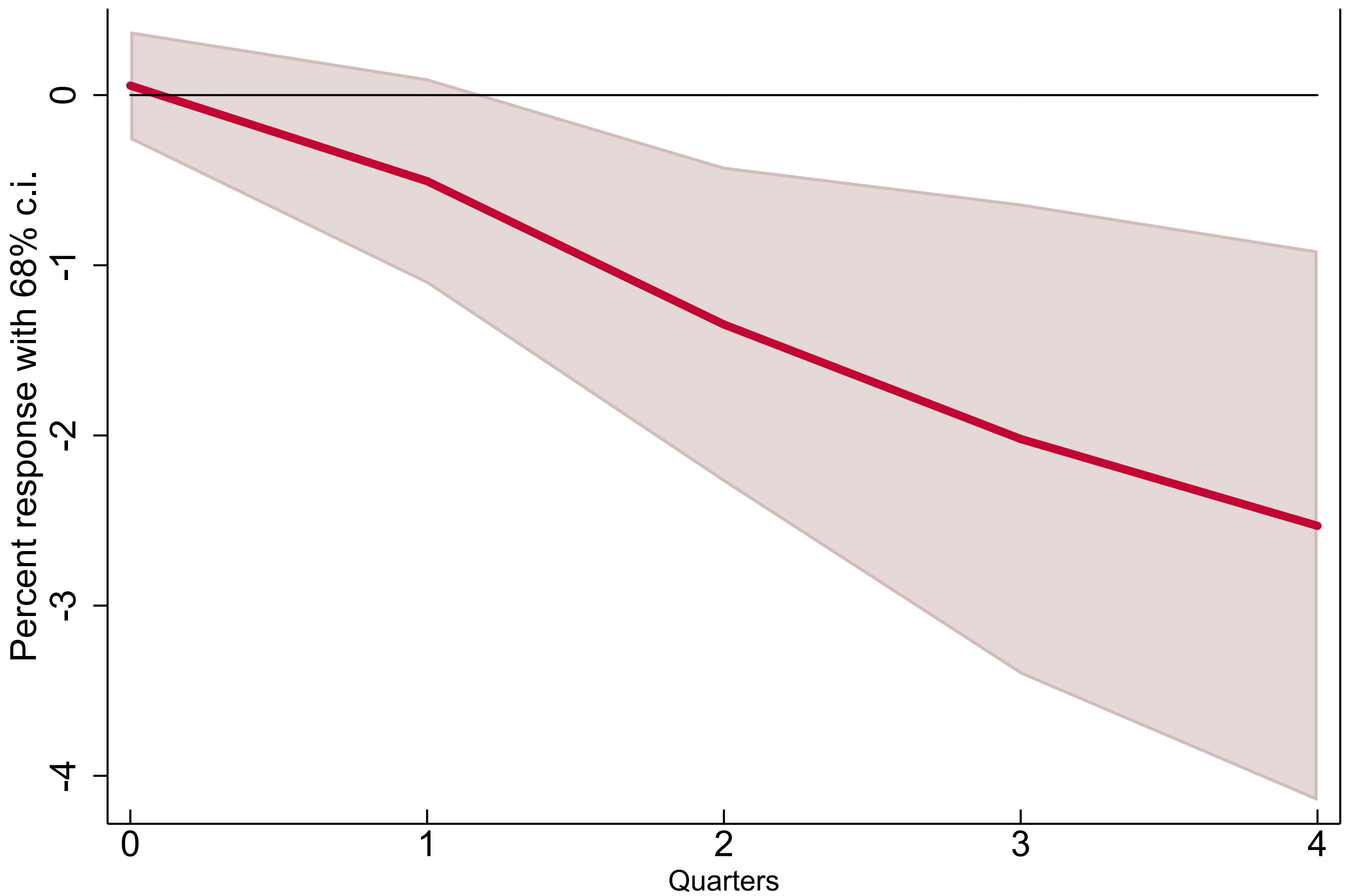
Note: The blue line plots the quarterly news-based trade policy uncertainty index. A value of 100 indicates that one percent of all newspaper articles discuss trade policy uncertainty. The vertical gray areas represent NBER recession dates.

Figure 4: Tariff Volatility Measure of Trade Policy Uncertainty



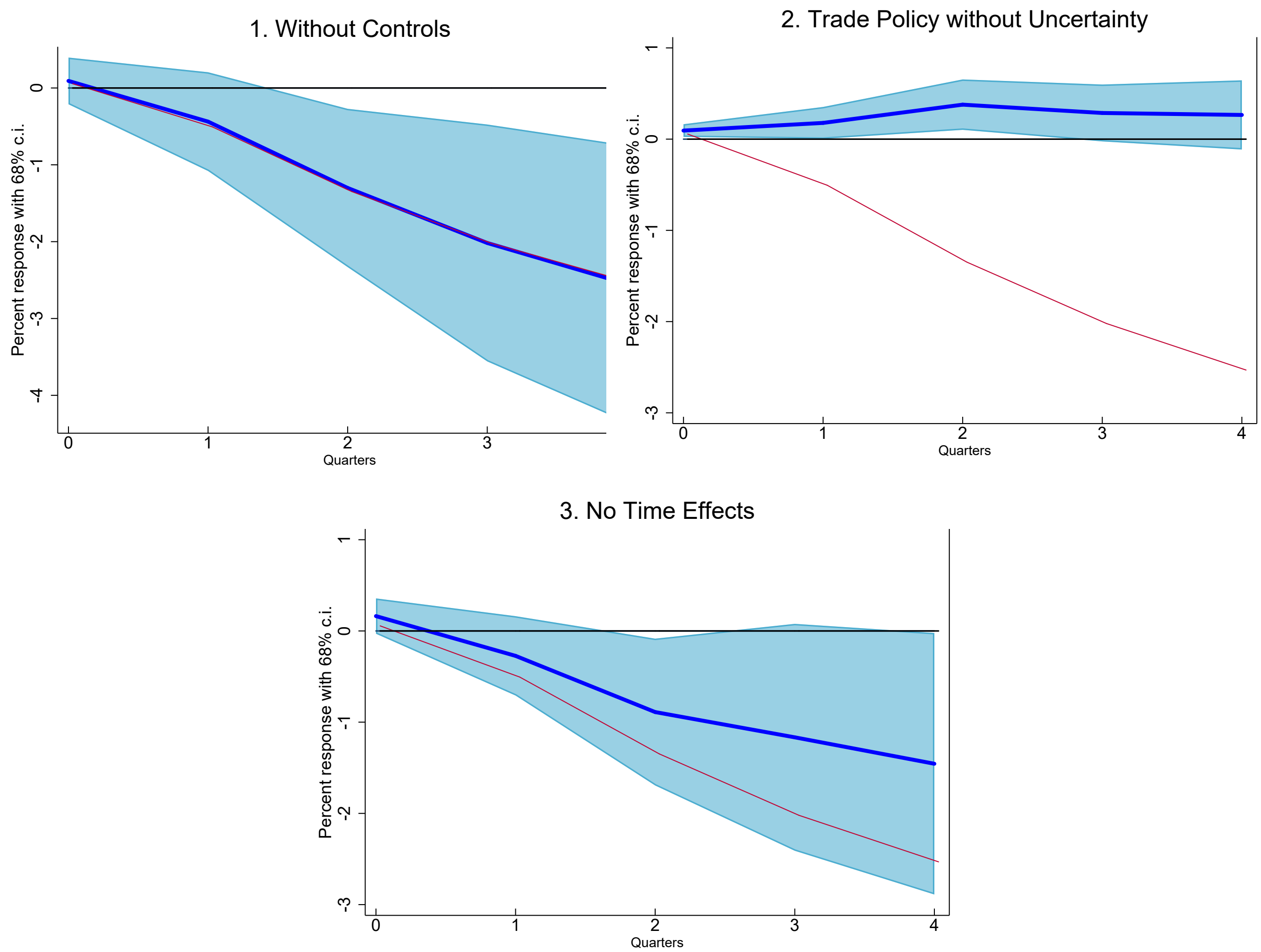
Note: The blue line plots the median of the filtered series of tariff volatility—expressed in percentage points—estimated using a stochastic volatility model. The blue shaded area surrounding the solid line represents the 90-percent point-wise credible sets, while the vertical gray areas represent NBER recession dates.

Figure 5: Response of Capital to Firm-Level TPU



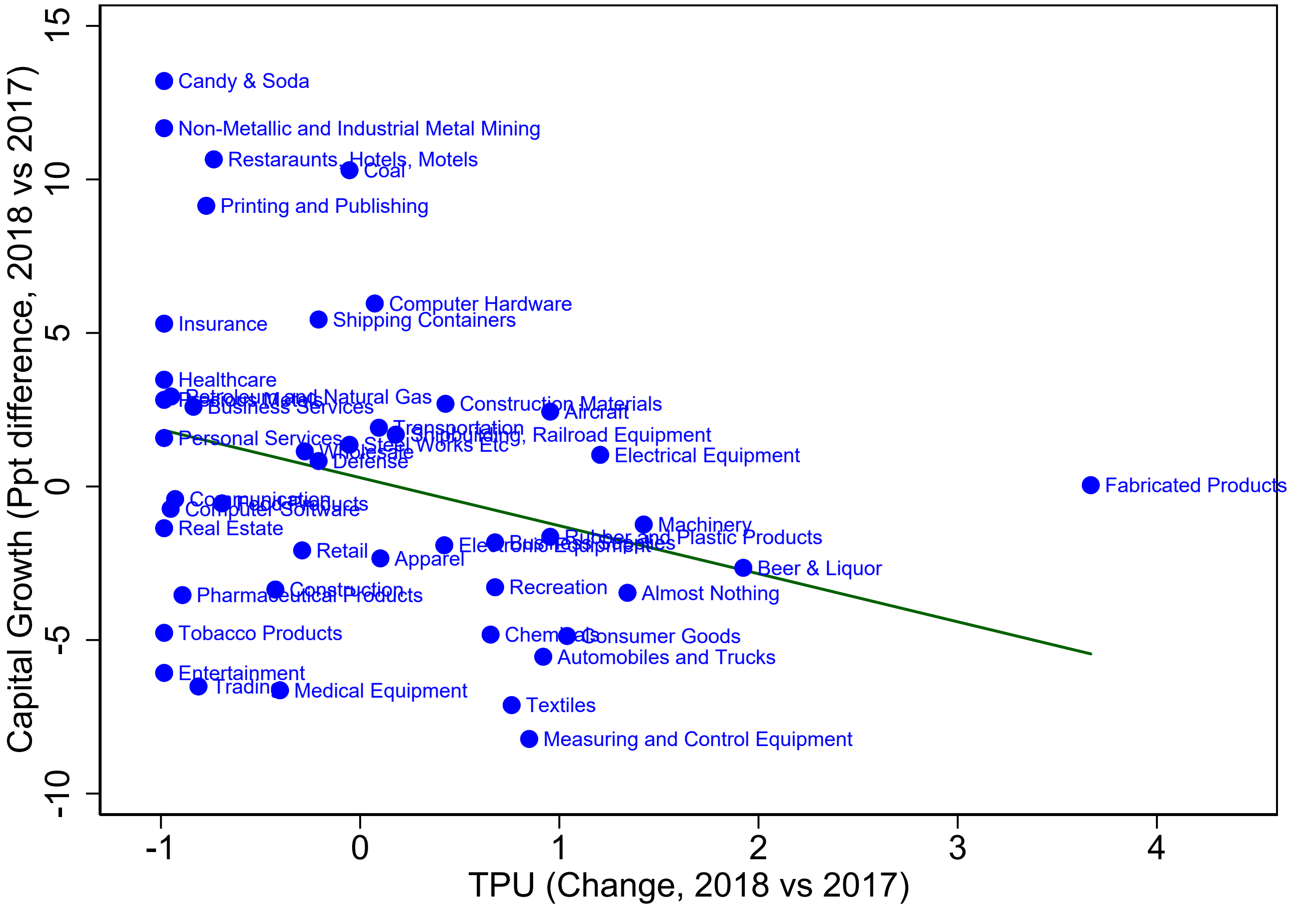
Note: Firm-Level response of investment at different horizons following an increase in firm-level TPU from 0 to 0.035, its average value when TPU is greater than 0. The shaded areas denote 1 standard error confidence interval. Standard errors are two-way clustered by firm and quarter.

Figure 6: Response of Capital to Firm-Level TPU: Additional Analysis



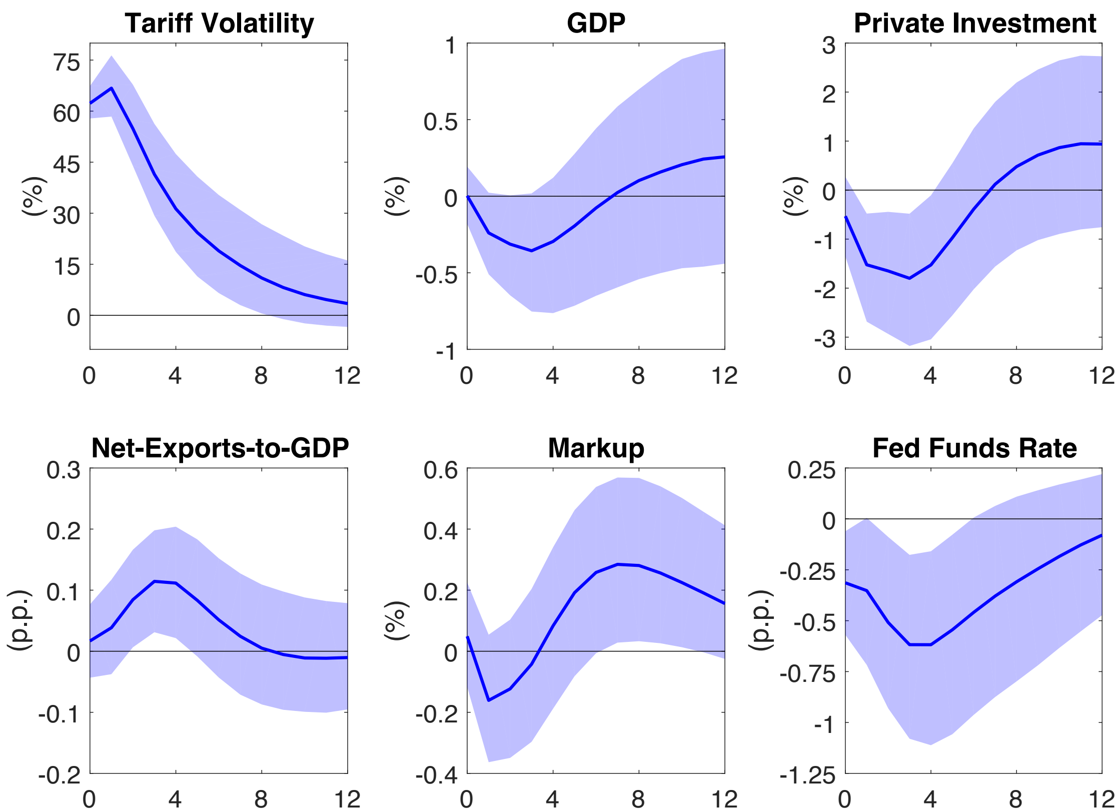
Note: Robustness. The thin red line is the response in the baseline experiment of Figure 5. Shaded areas denote 1 s.e. confidence interval. Standard errors are two-way clustered by firm and quarter.

Figure 7: Investment and TPU in 2018



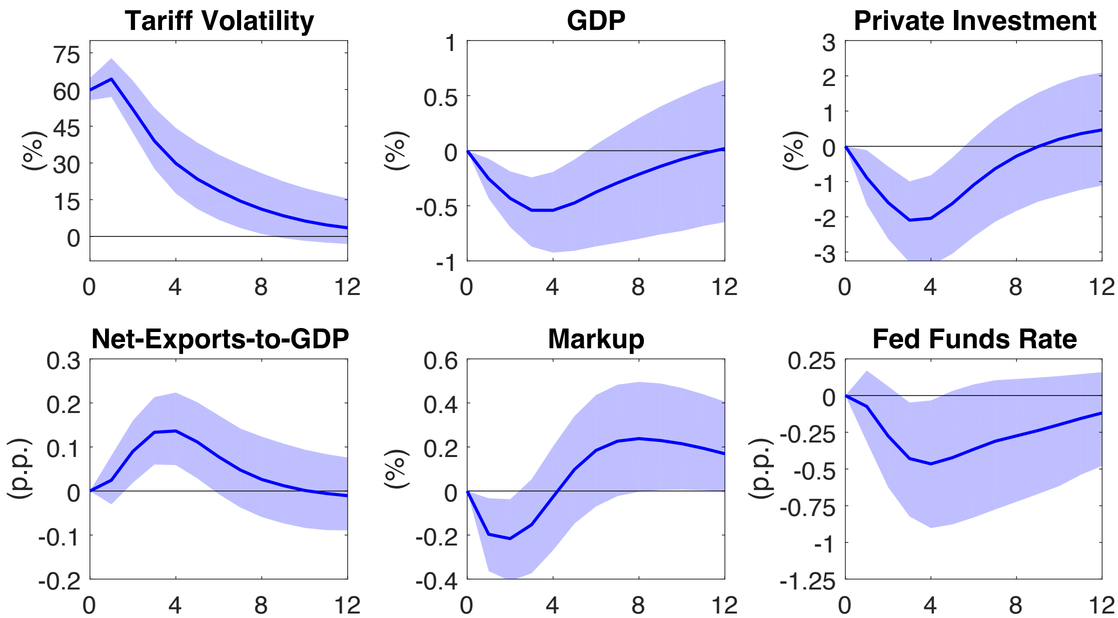
Note: Change in TPU in 2018 and change in investment in 2018 across industries.

Figure 8: The Macroeconomic Impact of Tariff Volatility Shocks



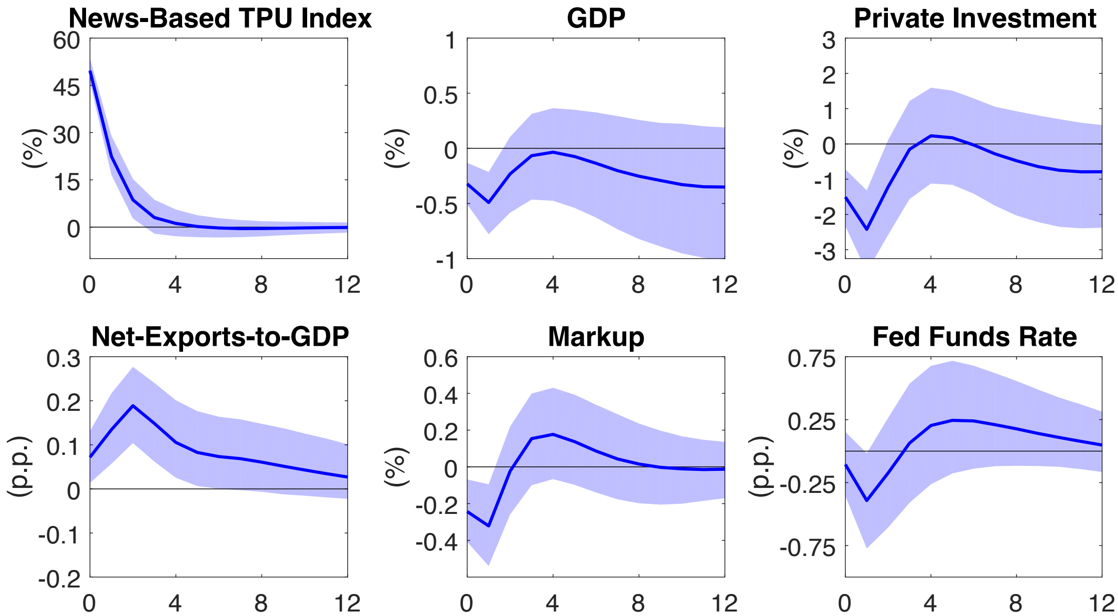
Note: The solid lines depict median responses of the endogenous variables to a tariff volatility shock of size two standard deviations. The VAR model is estimated on data that run from 1960 through 1984. the shaded bands represent the 70-percent point-wise credible sets.

Figure 9: The Macroeconomic Impact of Tariff Volatility Shocks (Alternative Identification)



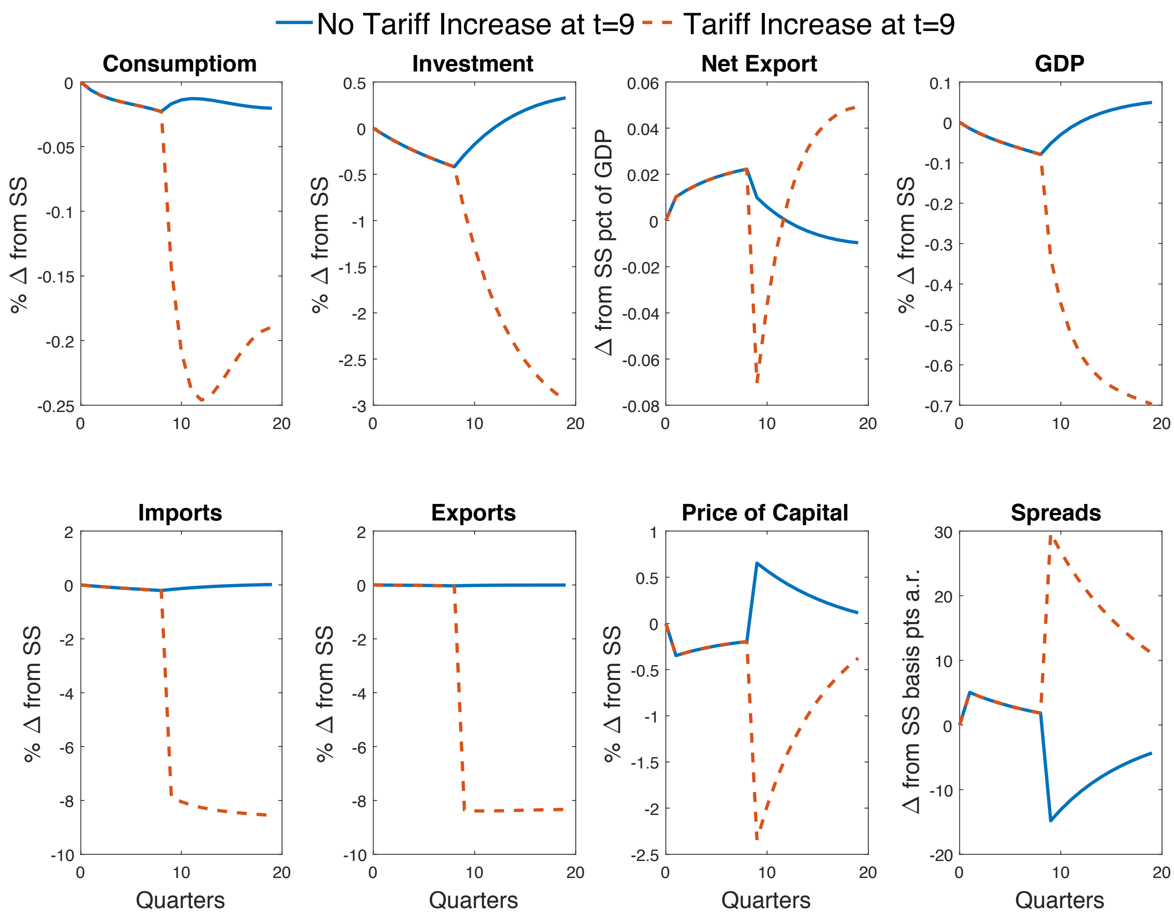
Note: The solid lines depict median responses of the endogenous variables to a tariff volatility shock of size two standard deviations identified using a Cholesky ordering with tariff volatility ordered last. The VAR model is estimated on data that run from 1960 through 1984. The shaded bands represent the 70-percent point-wise credible sets.

Figure 10: The Macroeconomic Impact of Tariff Volatility Shocks (News-Based Index of Trade Policy Uncertainty)



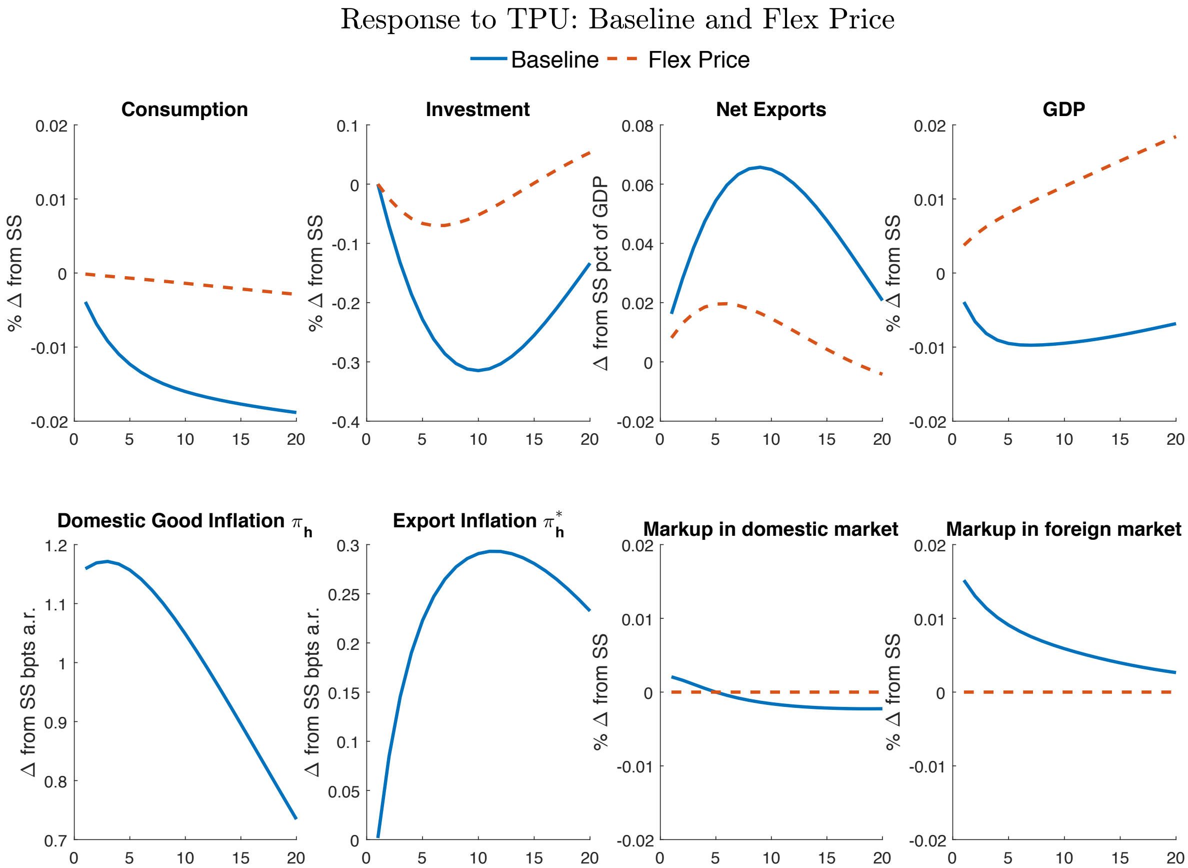
Note: The solid lines depict median responses of the endogenous variables to a trade policy uncertainty shock of size two standard deviations. Compared to the baseline VAR specification, we replace tariff volatility with the news-based index of trade policy uncertainty. The VAR model is estimated on data that run from 1960 through 1984. The shaded bands represent the 70-percent point-wise credible sets.

Figure 11: Impact of Increase in the Probability of Higher Future Tariffs



Note: Downside Risk Shock.

Figure 12: Impact of Higher Uncertainty about Future Tariffs



Note: Second Moment Shock.

Appendix

A.1 Description of Firm-Level and Industry Data

Our firm-level data source is the Compustat North America database. Our key variables are investment, cash flows, and Tobin's Q, which we construct following standard approaches to Compustat data in the literature (e.g. Ottonello and Winberry (2018)). Compustat variables names are shown in all capital letters.

1. *Data preparation.* We consider only firms with headquarters located in the United States (Compustat variable LOC is "USA"). We next drop observations with non-positive quarterly capital expenditures (CAPXY), total assets (ATQ) less than $1 million in chained 2009 dollars, and acquisitions (AQCY) are greater than 5% of assets. Lastly we drop observations where net property, plant, and equipment (PPENTQ) decreases and then increases (or vice versa) more than fifty percent between two successive quarters.

2. *Industries included.* We exclude firms in the utilities, banking, and finance sectors (firms with a 4-digit Standard Industrial Classification (SIC) code in the ranges 4900-4999 and 6000-6299). We also restrict the sample to sectors trading in agricultural, mining, and manufacturing goods (3-digit NAICS codes in the ranges 111-115, 211-212, and 311-339), omitting wholesale and service industries. These sectors are those for which we have complete data to construct our measure of openness, but they are also those with higher instances of TPU Our final industry selection includes roughly half the original sample Compustat firms.

3. *Investment.* For our measure of investment $\log k_{i,t+h} - \log k_{i,t-1}$ (with $h \geq 0$) we define a firm's capital stock $k_{i,t}$ as gross property, plant, and equipment (PPEGTQ) in the first period for which there is data are available. Thereafter we use PPENTQ.

4. *Tobin's Q.* We define Tobin's Q as the ratio of a firm's total market value to its total asset value, where market value is the book value of assets plus the market value of stock (price at close (PRCCQ) * common shares CSHQQ)) less the book value of stock (CEQ). The final measure is thus equal to $\frac{ATQ+(PRCCQ*CSHOQ)-CEQQ}{ATQ}$. We winsorize the variable at the 1st and 99th percentile.

5. *Cash flows.* We measure cash flows using the ratio of cash and short-term investments (CHEQ) to beginning-of-period property, plant, and equipment, which is the first lag of PPENTQ in our sample. We winsorize the variable at the 1st and 99th percentile.

6. *Openness.* Openness is defined at the 3-digit level of the North American Industry Classification System (NAICS). We use a standard measure equal to the ratio of an industry's gross output to usage, where usage is gross output plus imports less exports. Using gross output by industry from the Bureau of Economic Analysis' Industry Economic Accounts Data and exports/imports by industry from the U.S. Census Bureau's U.S. International Trade and Goods and Services report (FT900).

A.2 Stochastic Volatility Model: Robustness

In our bechmark empirical specification, we posit that tariffs follow an autoregressive process with (auturegressive) stochastic volatility. Table 1A compares our benchmark estimates to those obtained from two alternative models. Model 1 includes feedback from lagged values of detrended output and U.S. federal public debt. This approach follows closely the fiscal volatility rule adopted in Fernandez-Villaverde et al. (2015) and is meant to capture the idea that the state of the business cycle and the level of debt may influence behavior of government instruments, including tariffs. Model 2 allows for feedback from lagged values of detrended output and the U.S. net foreign asset position. This rule incorporates the idea that developments in the external position of the United States, approximated by the net foreign asset position, may also the seeting of tariffs.

Table 1A. Tariff Rule: Robustness

	Benchmark	Model 1	Model 2
ρ_τ	0.99 $[0.99; 0.99]$	0.99 $[0.99; 0.99]$	0.98 $[0.97; 0.99]$
σ	-6.14 $[-6.73; -5.47]$	-6.35 $[-6.84; -5.76]$	-6.05 $[-6.32; -5.78]$
ρ_σ	0.96 $[0.87; 0.99]$	0.93 $[0.85; 0.97]$	0.85 $[0.72; 0.92]$
η	0.37 $[0.29; 0.47]$	0.39 $[0.32; 0.49]$	0.37 $[0.29; 0.47]$

Note. Estimates refer to posterior medians. Numbers in brackets are the 90 percent probability interval.

Overall, we find that the inclusion of macroeconomic feedbacks does not greatly affect the estimation of the tariff rule parameters. The average standard deviation of tariffs varies from 100*exp(-6.14) = 0.24 percentage point in the bechmark model to 0.18 (Model 1) and 0.24 (Model 2). Model 2 also seems to have a slightly lower volatility persistence than our benchmark model (0.85 vs 0.96). A one-standard deviation shock to tariff volatility increases the volatility by about 10 basis points in all models.

A.3 Model Details

We assume that the set of assets S from which agents can invest in $\{A_t(s)\}_{s\in S}$ is made of only nominal bonds B_t^H, B_t^F. Real returns on bonds are then given by

$$R_{t+1}^H = \frac{(1+i_t)}{\pi_{t+1}} \tag{A.1}$$

$$R_{t+1}^F = \frac{(1+i_t^*)}{\pi_{t+1}^*}\frac{Q_{t+1}}{Q_t} \tag{A.2}$$

and symmetrically

$$R_{t+1}^{H*} = \frac{1+i}{\pi_{t+1}}\frac{Q_t}{Q_{t+1}} \tag{A.3}$$

$$R_{t+1}^{F*} = \frac{(1+i_t^*)}{\pi_{t+1}^*} \tag{A.4}$$

HH Problem to determine $\left\{C_t^h, b_t, b_t^F, D_t, L_t\right\}$

$$C_t^h + b_t^H + b_t^F + D_t + \int AC_{j,t}^w dj = L_t w_t + b_t^H R_{t+1}^H + b_t^F R_{t+1}^F + D_{t-1}R_t^d + T_t \tag{A.5}$$

$$\beta E_t \frac{U_c(t+1)}{U_c(t)}\frac{(1+i_t)}{\pi_{t+1}} = 1 \tag{A.6}$$

$$\beta E_t \frac{U_c(t+1)}{U_c(t)}\frac{(1+i_t^*)}{\pi_{t+1}^*}\frac{Q_{t+1}}{Q_t} = 1 \tag{A.7}$$

$$\beta E_t \frac{U_c(t+1)}{U_c(t)} R_t^d = 1 \tag{A.8}$$

$$(\pi_t^w - 1)\pi_t^w = \frac{\varepsilon_w}{\rho_w}\left(-\frac{U_{l_j}(t)}{U_c(t)} - \frac{(\varepsilon_w - 1)}{\varepsilon_w}w_t\right) + \beta E_t \frac{U_c(t+1)}{U_c(t)}\left(\pi_{t+1}^w - 1\right)\pi_{t+1}^w \frac{L_{t+1}}{L_t} \tag{A.9}$$

Aggregate investment $\left\{K_t, I_t, N_t, \psi_t, \phi_t, R_t^d\right\}$

$$K_t = I_t^k + (1-\delta)K_{t-1} \tag{A.10}$$

$$p_t^K = p_t^I + \frac{\kappa}{\eta}\left(\frac{I_t^k}{I_{t-1}^k} - 1\right)^{\eta} + \kappa\left(\frac{I_t^k}{I_{t-1}^k} - 1\right)^{\eta-1}\frac{I_t^k}{I_{t-1}^k} - E_t\beta\Lambda_{t,st+1}\kappa\left(\frac{I_{t+1}^k}{I_t^k} - 1\right)^{\eta-1}\frac{I_{t+1}^k}{I_t^k} \tag{A.11}$$

$$p_t^K K_t = N_t + D_t \tag{A.12}$$

$$N_t = \sigma\left[\left(r_t^k + (1-\delta)p_t^K\right)K_t - D_{t-1}R_t^d\right] + E^B \tag{A.13}$$

$$\phi_t = \frac{p_t^K K_t}{N_t} \tag{A.14}$$

$$\theta\phi_t = \psi_t \tag{A.15}$$

$$\psi_t = \beta E_t \Lambda_{t,t+1}\left[1 - \sigma + \sigma\psi_{t+1}\right]\left[\phi_t\left(R_{t+1}^k - R_t^d\right) + R_t^d\right] \tag{A.16}$$

Retailers demands $\{C_{N,t}, C_{T,t}, C_{Ht}, C_{Ft},\}$

$$C_{N,t} = (1-\gamma_c)\,(p_{Nt})^{-\varphi_c}\,C_t \tag{A.17}$$

$$C_{T,t} = \gamma_c\,(p_{Tt})^{-\varphi_c}\,C_t \tag{A.18}$$

$$C_{Ht} = \omega_c\left(\frac{p_{H,t}}{p_{Tt}}\right)^{-\theta_c} C_{T,t} \tag{A.19}$$

$$C_{Ft} = (1-\omega_c)\left(\frac{p_{F,t}\left(1+\tau^m_{C,t}\right)}{p_{Tt}}\right)^{-\theta_c} C_{T,t} \tag{A.20}$$

Similarly for investment$\{I_{N,t}, I_{T,t}, I_{Ht}, I_{Ft}\}$

$$I_{T,t} = \gamma_c\left(\frac{p_{Tt}}{p^I_t}\right)^{-\varphi_c} I_t \tag{A.21}$$

$$I_{N,t} = (1-\gamma_c)\left(\frac{p_{Nt}}{p^I_t}\right)^{-\varphi_c} I_t \tag{A.22}$$

$$I_{Ht} = \omega_i\left(\frac{p_{H,t}}{p^I_{Tt}}\right)^{-\theta_i} I_{T,t} \tag{A.23}$$

$$I_{F,t} = (1-\omega_i)\left(\frac{p_{F,t}\left(1+\tau^m_{I,t}\right)}{p^I_{Tt}}\right)^{-\theta_i} I_{T,t} \tag{A.24}$$

Prices $\left\{p_{Nt}, p^I_t, p_{Tt}, p^I_{Tt}, p_{H,t}, p_{F,t}, \pi_t, r^k_t, w_t, MC^N_t, MC_t, i_t, \pi_{Ht}, \pi_{Ft}, \pi_{Nt}, \pi^w_t, R^k_t\right\}$

$$1 = \gamma_c p^{1-\varphi_c}_{Tt} + (1-\gamma_c)\,p^{1-\varphi_c}_{Nt} \tag{A.25}$$

$$p^I_t = \left[\gamma_i\left[p^I_{Tt}\right]^{1-\varphi_i} + (1-\gamma_i)\,P^{1-\varphi_i}_{Nt}\right]^{\frac{1}{1-\varphi_i}} \tag{A.26}$$

$$p_{Tt} = \left[\omega_c p^{1-\theta_c}_{H,t} + (1-\omega_c)\left[p_{F,t}\left(1+\tau^m_t\right)\right]^{1-\theta_c}\right]^{\frac{1}{1-\theta_c}} \tag{A.27}$$

$$p^I_{Tt} = \left[\omega_i p^{1-\theta_i}_{H,t} + (1-\omega_i)\left[p_{F,t}\left(1+\tau^m_t\right)\right]^{1-\theta_i}\right]^{\frac{1}{1-\theta_i}} \tag{A.28}$$

$$(\pi_{Ht}-1)\,\pi_{Ht} = \frac{\varepsilon}{\rho_p}\left(MC_t - \frac{\varepsilon-1}{\varepsilon}p_{H,t}\right) + \beta E_t\Lambda_{t,t+1}\left(\pi_{Ht+1}-1\right)\pi_{Ht+1}\frac{Y_{H,t+1}}{Y_{Ht}} \tag{A.29}$$

$$(\pi_{Nt}-1)\,\pi_{Nt} = \frac{\varepsilon}{\rho_p}\left(MC^N_t - \frac{\varepsilon-1}{\varepsilon}p_{N,t}\right) + \beta E_t\Lambda_{t,t+1}\left(\pi_{Nt+1}-1\right)\pi_{Nt+1}\frac{Y_{N,t+1}}{Y_{Nt}} \tag{A.30}$$

$$(\pi_{Ft}-1)\,\pi_{Ft} = \frac{\varepsilon}{\rho_p}\left(MC^*_t Q_t - \frac{\varepsilon-1}{\varepsilon}p_{F,t}\right) + \beta E_t\Lambda_{t,t+1}\left(\pi_{Ft+1}-1\right)\pi_{Ft+1}\frac{Y_{F,t+1}}{Y_{Ft}} \tag{A.31}$$

$$r_t^k = MC_t^N \left(1-\alpha_N\right) \frac{Y_{N,t}}{K_{N,t}} \tag{A.32}$$

$$w_t = MC_t^N \alpha_N \frac{Y_{N,t}}{L_{N,t}} \tag{A.33}$$

$$r_t^k = MC_t \left(1-\alpha\right) \frac{Y_{T,t}}{K_{T,t}} \tag{A.34}$$

$$MC_t = \left(\frac{r_t^k}{\alpha}\right)^{\alpha} \left(\frac{w_t}{(1-\alpha)}\right)^{1-\alpha} \tag{A.35}$$

$$i_t = f\left(\pi_t, \pi_{ht}, y_t^{gap}\right) \tag{A.36}$$

$$\pi_{Ht} = \frac{p_{H,t}}{p_{H,t-1}} \pi_t \tag{A.37}$$

$$\pi_{Ft} = \frac{p_{F,t}}{p_{F,t-1}} \pi_t \tag{A.38}$$

$$\pi_{Nt} = \frac{p_{N,t}}{p_{N,t-1}} \pi_t \tag{A.39}$$

$$\pi_t^w = \frac{w_t}{w_{t-1}} \tag{A.40}$$

$$p_t^K = p_t^I + \frac{\kappa}{\eta}\left(\frac{I_t}{I_{t-1}} - 1\right)^{\eta} + \frac{\kappa}{\eta}\left(\frac{I_t}{I_{t-1}} - 1\right)^{\eta-1} \frac{I_t}{I_{t-1}} - E_t \beta \Lambda_{t,st+1} \frac{\kappa}{\eta}\left(\frac{I_{t+1}}{I_t} - 1\right)^{\eta-1} \frac{I_{t+1}}{I_t} \tag{A.41}$$

$$R_t^k = \frac{r_t^k + (1-\delta)\, p_t^K}{p_{t-1}^K} \tag{A.42}$$

Markets clearing $\{C_t, Y_{Ht}, Y_{Nt}, K_{Tt}, L_{Tt}, K_{Nt}, L_{Nt}\}$

$$C_t = C_t^h + ROT_t + \frac{\kappa}{\eta} I_t^k \left(\frac{I_t^k}{I_{t-1}^k} - 1\right)^{\eta} \tag{A.43}$$

$$ROT_t = \frac{\rho_p}{2}\left(\pi_{Ht}-1\right)^2 Y_{H,t} + \frac{\rho_p}{2}\left(\pi_{Ht}^{*}-1\right)^2 \frac{n^*}{n} Y_{H,t}^{*} + \frac{\rho_p}{2}\left(\pi_{Nt}-1\right)^2 Y_{N,t} + AC_t^w \tag{A.44}$$

$$Y_{Ht} = C_{Ht} + I_{Ht} \tag{A.45}$$

$$Y_{Nt} = C_{Nt} + I_{N_t} \tag{A.46}$$

$$K_{t-1} = K_{Tt} + K_{Nt} \tag{A.47}$$

$$L_t = L_{Tt} + L_{Nt} \tag{A.48}$$

$$Z_t K_{Tt}^{\alpha} L_{Tt}^{1-\alpha} = Y_{Ht} + \frac{n^*}{n} Y_{Ht}^{*} \tag{A.49}$$

$$Z_t K_{Nt}^{\alpha} L_{Nt}^{1-\alpha} = Y_{Nt} \tag{A.50}$$

Notice that we have 40 equations for 40 variables but we still need to pin down the real exchange rate Q_t which can be done by adding

$$b_t^H + \frac{n^*}{n} Q_t b_t^{H*} = 0 \tag{A.51}$$

By Walras Law we do not need to also add

$$b_t^F + \frac{n^*}{n} Q_t b_t^{F*} = 0 \tag{A.52}$$

since this is implied by the two budget constraints and the market clearing for domestic bonds. To see this notice that the budget constraint is

$$C_t^h + b_t^H + b_t^F + D_t + \int AC_{j,t}^w dj = L_t w_t + b_t R_{t+1} + b_t^F R_{t+1}^F + D_{t-1} R_t^d + T_t \tag{A.53}$$

where in T_t we have all transfers

$$T_t = \Pi_t^T + \Pi_t^N + \Pi_t^k + \Pi_t^b + \tau_t^m p_{Ft} Y_{Ft} \tag{A.54}$$

Π_t^T are profits from tradable producing firms

$$\Pi_t^T = p_{Ht} Y_{Ht} + Q_t p_{Ht}^* Y_{Ht}^* - r_t^k K_{Tt} - W_t L_{Tt} - \frac{\rho_p}{2} \left(\pi_{Ht} - 1\right)^2 Y_{H,t} - \frac{\rho_p}{2} \left(\pi_{Ht}^* - 1\right)^2 Y_{H,t} \tag{A.55}$$

Π_t^T are profits from non tradable producing firms

$$\Pi_t^N = p_{Nt} Y_{Nt} - r_t^k K_{Nt} - W_t L_{Nt} - \frac{\rho_p}{2} \left(\pi_{Nt} - 1\right)^2 Y_{N,t} \tag{A.56}$$

Π_t^k are profits from capital producing firms

$$\Pi_t^k = p_t^K I_t - I_t \left[p_t^I + \frac{\kappa}{\eta} \left(\frac{I_t}{I_{t-1}} - 1 \right)^\eta \right] \tag{A.57}$$

Π_t^b are net transfers from banks

$$\Pi_t^b = (1-\sigma) \left[\left(r_t^k + (1-\delta) p_t^K \right) K_t - D_{t-1} R_t^d \right] - E^B \tag{A.58}$$

also notice that using

$$p_t^K K_t = N_t + D_t \tag{A.59}$$

$$N_t = \sigma \left[\left(r_t^k + (1-\delta) p_t^K \right) K_t - D_{t-1} R_t^d \right] + E^B \tag{A.60}$$

we can write

$$D_t = p_t^K K_t - \sigma \left[\left(r_t^k + (1-\delta) p_t^K \right) K_t - D_{t-1} R_t^d \right] - E^B \tag{A.61}$$

so that:

$$\Pi_t^b + D_{t-1} R_t^d - D_t = \left(r_t^k + (1-\delta) p_t^K \right) K_{t-1} - p_t^K K_t \tag{A.62}$$

Substituting everything back into the budget constraint we get

$$C_t^h + I_t \left[p_t^I + \frac{\kappa}{\eta} \left(\frac{I_t}{I_{t-1}} - 1 \right)^\eta \right] + b_t + b_t^F = b_t R_{t+1} + b_t^F R_{t+1}^F + p_{Ht} Y_{Ht} + Q_t p_{Ht}^* Y_{Ht}^* + p_{Nt} Y_{Nt} + \tau_t^m p_{Ft} Y_{Ft} - ROT_t \tag{A.63}$$

$$ROT_t = \frac{\rho_p}{2} \left(\pi_{Ht} - 1\right)^2 Y_{H,t} + \frac{\rho_p}{2} \left(\pi_{Ht}^* - 1\right)^2 Y_{H,t}^* + \frac{\rho_p}{2} \left(\pi_{Nt} - 1\right)^2 Y_{N,t} + AC_t^w \tag{A.64}$$

now notice that

$$p_{Ht}Y_{Ht}+\frac{n^*}{n}Q_tp^*_{Ht}Y^*_{Ht}+p_{Nt}Y_{Nt}=p_{Ht}Y_{Ht}+p_{Ft}\left(1+\tau^m_t\right)Y_{Ft}+p_{Nt}Y_{Nt}+\frac{n^*}{n}Q_tp^*_{Ht}Y^*_{Ht}-p_{Ft}\left(1+\tau^m_t\right)Y_t \tag{A.65}$$

$$=C_t+p^I_tI_t+\frac{n^*}{n}Q_tp^*_{Ht}Y^*_{Ht}-p_{Ft}\left(1+\tau^m_t\right)Y_t$$

$$=C^h_t+ROT_t+I_t\left[p^I_t+\frac{\kappa}{\eta}\left(\frac{I_t}{I_{t-1}}-1\right)^\eta\right]+\frac{n^*}{n}Q_tp^*_{Ht}Y^*_{Ht}-p_{Ft}\left(1+\tau^m_t\right)Y_t$$

where we are using the fact that

$$C_t=p_{Ht}C_{Ht}+p_{Ft}\left(1+\tau^m_t\right)C_{Ft}+p_{Nt}C_{Nt} \tag{A.66}$$

$$p^I_tI_t=p_{Ht}I_{Ht}+p_{Ft}\left(1+\tau^m_t\right)I_{Ft}+p_{Nt}I_{Nt} \tag{A.67}$$

$$C_{Xt}+I_{Xt}=Y_{Xt} \tag{A.68}$$

so using ($A.65$) in the budget constraint we get the usual BOP equation

$$b^H_t+b^F_t=b^H_{t-1}R^H_t+b^F_{t-1}R^F_{t-1}+\frac{n^*}{n}Q_tp^*_{Ht}Y^*_{Ht}-p_{Ft}Y_{Ft} \tag{A.69}$$

similarly in the foreign country we have

$$b^{H*}_t+b^{F*}_t=b^{H*}_{t-1}R^{H*}_t+b^{F*}_{t-1}R^{F*}_t+\frac{n}{n^*}\frac{p_{Ft}Y_{Ft}}{Q_t}-p^*_{Ht}Y^*_{Ht} \tag{A.70}$$

which implies that summing the bop at home with the bop abroad multiplied by $\frac{n^*}{n}Q_t$ gives

$$b^H_t+\frac{n^*}{n}Q_tb^{H*}_t+b^F_t+\frac{n^*}{n}Q_tb^{F*}_t=b^H_{t-1}R^H_t+b^F_{t-1}R^F_t+\frac{n^*}{n}Q_tb^{H*}_{t-1}R^{H*}_t+\frac{n^*}{n}Q_tb^{F*}_{t-1}R^{F*}_t \tag{A.71}$$

which given that we have market clearing in domestic bonds,

$$b^H_t+\frac{n^*}{n}Q_tb^{H*}_t=0 \tag{A.72}$$

and given that

$$R^H_t=R^{H*}_t\frac{Q_t}{Q_{t-1}} \tag{A.73}$$

$$R^{F*}_t=R^F_t\frac{Q_{t-1}}{Q_t} \tag{A.74}$$

yields

$$b^F_t+\frac{n^*}{n}Q_tb^{F*}_t=b^F_{t-1}R^F_t+\frac{n^*}{n}Q_{t-1}b^{F*}_{t-1}R^F_t \tag{A.75}$$

and symmetrically

$$R^{H*}_{t+1}=\frac{1+i}{\pi_{t+1}}\frac{Q_t}{Q_{t+1}} \tag{A.76}$$

$$R_{t+1}^{F*} = \frac{(1 + i_t^*)}{\pi_{t+1}^*} \tag{A.77}$$

So if we have 2 countries we need 1 bond market clearing.

A.4 Additional Tables

Table A.1: Episodes of High Aggregate Trade Policy Uncertainty

U.S. President	*Policy Action*	*Quarter*	*Quotes or Additional Narrative Material*
President Kennedy	Trade Negotiations	1960q1	"This is the year to decide. The Reciprocal Trade Act is expiring. We need a new law—a wholly new approach—a bold new instrument of American trade policy. Our decision could well affect the economic growth of our Nation for a generation to come. "
President Nixon	Tariff Increase	1971q4	"I am taking one further step to protect the dollar, to improve our balance of payments, and to increase jobs for Americans. As a temporary measure, I am today imposing an additional tax of 10 percent on goods imported into the United States. This is a better solution for international trade than direct controls on the amount of imports. This import tax is a temporary action...When the unfair treatment is ended, the import tax will end as well."
President Ford	Tariff Increase	1975q2	"...we need immediate action to cut imports. ...Therefore, I am using Presidential powers to raise the fee on all imported crude oil and petroleum products...To that end, I am requesting the Congress to act within 90 days on a more comprehensive energy tax program. It includes: excise taxes and import fees totaling $2 per barrel on product imports and on all crude oil; deregulation of new natural gas and enactment of a natural gas excise tax...I am prepared to use Presidential authority to limit imports, as necessary, to guarantee success...To provide the critical stability for our domestic energy production in the face of world price uncertainty, I will request legislation to authorize and require tariffs, import quotas, or price floors to protect our energy prices at levels which will achieve energy independence."

NOTE: Narrative analysis of major increases in aggregate trade policy uncertainty.

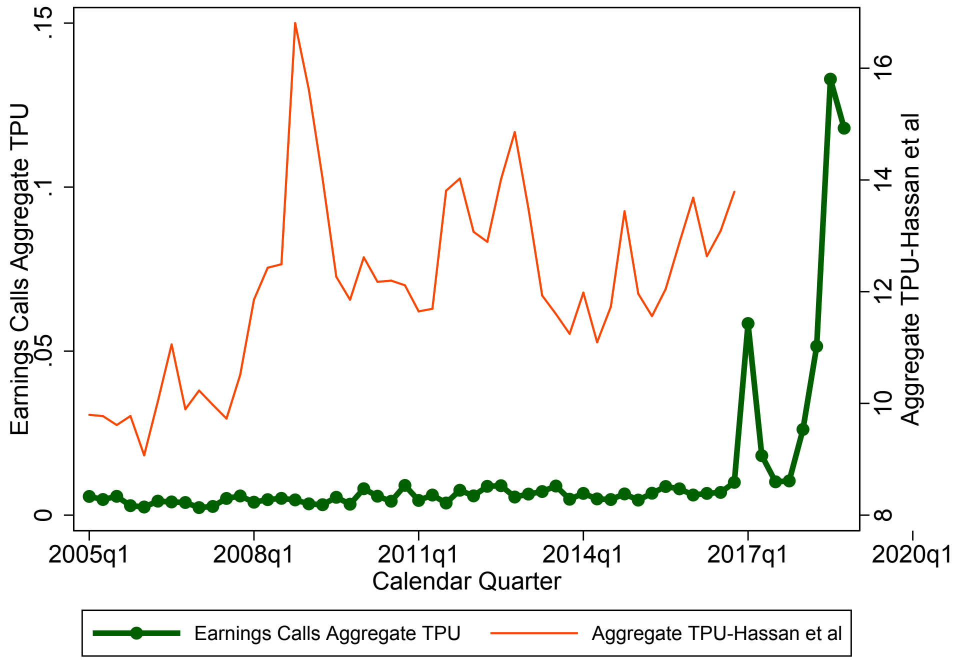
Table A.2: Selected Quotes from Earnings Call Transcripts Mentioning Trade Policy Uncertainty

Company Name	*Sector*	*Quarter*	ΔK_{+1}	*TPU*	*Selected Quotes Mentioning Trade Policy Uncertainty*
SUNPOWER	Electronic Equipment	2017q3	-14.6	2	In September, the ITC is scheduled to decide whether to recommend the imposition of import tariffs or quotas on solar panels and to subsequently propose specific remedies in November. [...] the requested remedies could significantly impact the U.S. solar market, imposing a direct burden on manufacturers
BUILDERS FIRSTSOURCE	Construction Materials	2017q2	-11.0	3	Q: [...] on the lumber import tariff how have you handled [...] the tariff and the price volatility? [...] A: Yes, could be a slight headwind to working capital.
RENEWABLE ENERGY GROUP	Petroleum and Natural Gas	2017q3	-9.5	2	Q: I wanted to ask thoughts around the postponed EU vote last week around Argentina's challenge to the EU antidumping duties there and if there is the potential for gallons to potentially flow back into the EU from Argentina and Indonesia. A: Well, we were certainly watching that as it affects our European operation margins...
WEYERHAEUSER	Construction Materials	2017q3	-5.7	2	On June 26, the Department of Commerce announced preliminary antidumping duties on Canadian lumber producers. For most producers, the duty will be approximately 7 percent and will also be assessed retroactively. [...] The government will continue its investigation through the remainder of the year, as the Department of Commerce and International Trade Commission collect and evaluate additional information in support of final determinations of the duties and a level of material injury to U.S. producers. These determinations are expected later this year. The U.S. coalition continues to work closely with the Department of Commerce, and we remain hopeful we will be able to reach a quota-based agreement.
RENEWABLE ENERGY GROUP	Petroleum and Natural Gas	2017q4	-6.2	2	Finally, antidumping determinations are expected in early January. Based on these very positive preliminary rulings, we are confident that the final decision will be supportive of domestic biodiesel production.
BROADWIND ENERGY	Machinery	2017q3	-3.1	3	Q. Have you done any type of quantitative impact or assessment on [...] the towers business, but potentially all of your segments, if such a [steel] tariff was put into place? A. It's not – would not be a good thing, because of the steel that we consume in our businesses.
RENEWABLE ENERGY GROUP	Petroleum and Natural Gas	2017q2	-5.4	2	[...] Our industry trade group took on an initiative to pull domestic producers together in a coalition to just ask for a fair trade, a level playing field and countervailing duties and antidumping against 2 countries.
MOHAWK INDUSTRIES	Textiles	2017q2	-2.9	2	Q. Great. Any potential impact from the proposed Canadian tariff? A. Listen, if you can tell me what the proposals will look like, I'll decide what it is.
CABOT CORP	Chemicals	2016q2	-2.3	2	There is some concern about [inventories] – with anti-dumping duties against truck tires out of China that, that could cause the same phenomenon to happen again. But I think we are probably closer to natural inventory levels than certainly we were over the last 18 months or so as those passenger car duties were implemented.
INTL PAPER	Business Supplies	2015q2	-2.1	2	Q. ... Just turning to Brazil. [...] Potentially, higher taxes and tariffs on energy usage. A. I mean, the Brazil packaging business is in the same market, experiencing the same dynamics as our paper business. So, demand has been a challenge.
FORD MOTOR	Automobiles and Trucks	2017q1	-.8	2	Q. You clearly mentioned the prospects of an import tariff. There is [...] probability of a border tax adjustment, and if that doesn't happen, then we're just going to see import tariffs. A. [...] whether it's a border tax or border adjustment, as Bob mentioned, this is a multifaceted blueprint that's out there.

NOTE: Selected mentions of firm-level trade policy uncertainty extracted from the earnings call which are followed by a decline in firm-level investment in the next calendar quarter. The ΔK column indicates the percent change in the firm's capital stock in the calendar quarter subsequent to the mention. The TPU column lists the total number of mentions of trade policy uncertainty in the transcript of the earnings call.

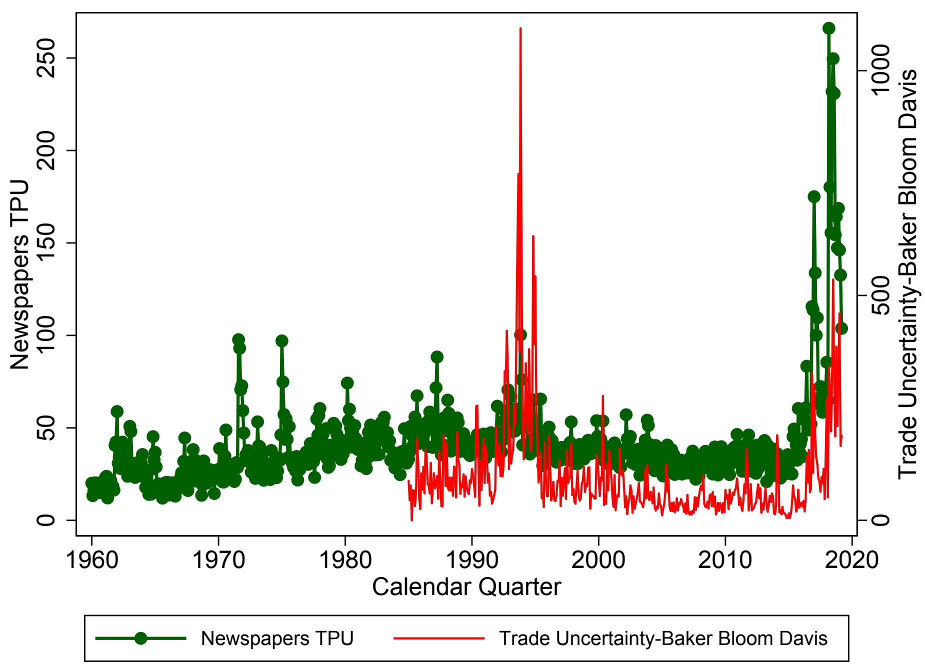
A.5 Additional Figures

Figure A.1: Comparison with Hassan et al. (2017)



Note: Aggregate TPU from earnings calls in this paper and in Hassan et al. (2017)

Figure A.2: Comparison with Baker, Bloom, and Davis (2016)



Note: News-based TPU in this paper and in Baker, Bloom, and Davis (2016).