

Trade Protection, Stock-Market Returns, and Welfare*

Mary Amiti

Federal Reserve Bank of New York

Matthieu Gomez

Columbia University

Sang Hoon Kong

Columbia University

David E. Weinstein

Columbia University, CEPR, and NBER

April 22, 2024

Abstract

This paper develops a method to assess the expected impact of trade policy on aggregate welfare using financial-market reactions to policy announcements. Seen through the lens of a specific factors model, a policy's impact on firm cash flows is a sufficient statistic for identifying movements in sales, wages, employment, and total factor productivity. Using our framework, we find that the U.S.-China trade war caused large declines in U.S. stock prices, expected firm cash flows, and expected productivity. Overall, we estimate the consumption-equivalent welfare losses to be around 3 percent.

JEL CLASSIFICATION: F13 F14 G10 F16

KEYWORDS: Event Study, Specific Factors Model, Trade War, Policy Uncertainty

*This paper supersedes an earlier unpublished paper, "The Effect of the U.S.-China Trade War on U.S. Investment." We thank George Alessandria, Kirill Borusyak, Dave Donaldson, Patrick Farrell, Ethan Ilzetzki, Peter Neary, Michael Peters, Ashwin Rao, Steven Redding, Peter Schott, Yeji Sung, James Tybout, Jon Vogel, and Michael Waugh for many useful comments. We thank Daniel Lewis for sharing the economic surprise data. We also thank Yingjie (Angela) Wu, Dongcheng Yang, and Michael Duarte for providing excellent research assistance. The views expressed in this paper are those of the authors and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System.

1 Introduction

This paper develops a method of using financial data to understand the expected impact of trade policy change on welfare and other real variables when the policy has heterogeneous and uncertain impacts on firms. Financial data is particularly well suited for understanding the impact of a policy change in general equilibrium because markets are forward looking and agents have strong incentives to incorporate processes that are not captured by conventional models into asset prices. However, economists have largely ignored financial market data when modeling the impact of trade policy on real activity because we lacked a mapping from asset prices into welfare. Our analysis fills this gap. The use of financial data enables us to relax many common assumptions used in modeling policy analysis. Relative to the calibration of canonical static trade models, we make no assumptions about how and when prices and wages adjust to tariffs or whether tariffs cause productivity or macro variables like exchange rates or interest rates to change. We apply this methodology to the U.S.-China trade war and find impacts of the trade war that are an order of magnitude larger than those typically found in static studies.

We apply this framework to understanding the implications of the U.S.-China trade war on U.S. welfare by examining movements in asset prices on days in which markets reacted to tariff announcements. We focus on tariff announcements as opposed to tweets and other announcements because these were the first announcements of policies that affected the prices of a large number of traded goods. In order to identify the tariff-announcement dates, we search for the first mention in the media of each tariff wave implemented by the U.S. or China during the 2018-2019 trade war. We document three stylized facts about the trade war that we use to motivate our theory and empirical analysis.

First, we find that tariff-announcements produced large, broad, and persistent stock price declines. The cumulative drop in the market on the eleven event dates was 11.5 percent. This amounts to a 3.3 trillion dollar loss in firm value. Moreover, the drop in market value did not just happen at the outset of the trade war but happened consistently with each new tariff announcement, which implies that markets were not just reacting to a sudden realization that U.S. policies were changing but rather each wave of tariffs produced an impact of comparable size. Indeed, the two biggest drops in the market happened in 2019—over a year after the trade war began. The data show that these drops were broad, with the full distribution of firm returns shifting downward. In contrast, markets hardly responded to non-tariff executive actions and orders, which suggests that mere “saber rattling” did not move stock returns. Moreover, since two of these orders and actions predated the tariff-war announcements, the lack of a market reaction to non-tariff actions motivates us to focus theory on policies that likely have important economic impacts.

According to modern financial theory, a policy can only have a large and persistent impact on stock returns if it has a large and persistent impact on firm cash flows or discount rates. We document that both of these channels were likely active. Our second stylized fact focuses on the first of these: the cash-flow channel. Abnormal returns on tariff announcement days should largely reflect movements in expected cash flows and not discount rates. We show that firms that were *directly* exposed to China through sales

or input purchases had *relatively* worse stock returns. This result, which was also found by [Huang et al. \(2023\)](#) when examining abnormal returns on two of the eleven tariff-announcement days, suggests that tariff announcements did not simply change discount rates; they affected expected cash flows. We corroborate this link between returns and future cash flow by using [Greenland et al. \(2024\)](#)'s empirical specification to show that firms with worse stock returns had worse future *real* outcomes. Firms that had poor returns around tariff-announcement days had significantly lower future profits (i.e., cash flow), employment, sales, and labor productivity. These difference-in-differences regression provide evidence that tariffs did not just affect discount rates. A complete model must also incorporate a tariff's impact on expectations of future cash flows—a point we also confirm empirically through the lens of our model.

Third, we show that there is a *prima facie* case that tariff-announcements also moved discount rates because they affected interest rates and equity premia. This novel empirical finding provides the final linchpin in developing a theory that allows stock returns to move through discount rates and cash flow and to quantify the amount that each channel contributed to the market decline.

Motivated by these data patterns, we address two theoretical challenges in order to obtain a mapping from stock returns into welfare. The first is to specify a general-equilibrium production structure that can be integrated into an asset-pricing model. We show how to adapt [Jones \(1975\)](#)'s *industry* specific factors model into a *firm-level* specific factors model to describe the production side of the economy. In this setup, payments to firm-specific factors equal firm cash flows (i.e., revenues less variable costs). A key difference is that the Jones model maps price changes into output, employment, and factor prices, whereas we invert this logic to show how knowledge of returns to the specific factor can be used to identify the other variables Jones considers. This difference is important because it avoids having to model how tariffs affect *all* prices in the economy and instead only requires knowledge of how the tariff affects the returns to the specific factor. We show that the returns to the specific factor are the same as the change in firm cash flow in the firm-level specific factors model. This insight enables us to derive analytic solutions for how movements in expected cash flow map into movements in expected firm-level effective rates of protection, sales, wages, employment, and both quantity and revenue total factor productivity (TFPR).

The second theoretical challenge is to integrate the production structure of the specific factors model into one that will allow us to model the welfare impacts of the policy. We do this by assuming that our inverted specific factors model describes the equilibrium in each period in a model with an infinite number of future periods. We refer to this as the "baseline" equilibrium and treat a policy shock as a policy that shifts input and output prices in each future period away from this baseline. Since we can express real wages in each period as a function of real cash flows, we can also write real income (or equivalently consumption) in each period as a function of real cash flows. We then show that the present value of consumption can be written as a the present value of real cash flows and tariff revenues. Moreover, in this setup we can specify welfare in terms of its first-order impact on expected consumption as well as higher-order moments like the variance and skewness of future consumption. Finally, we follow [Campbell and Shiller \(1988\)](#) to show that we can write the present discounted value of cash flows as the sum of the policy-

induced change in the value of the firm and the change in the expected discount rate. The change in firm value can be estimated from stock price movements arising from a tariff announcement, and the movement in discount rates can be measured using the vector-autoregression (VAR) methodology of [Campbell and Vuolteenaho \(2004\)](#).

With our estimates of the implied movements of each firm's cash flow in hand, we turn to measuring the implied impact of the tariffs on welfare. We identify three main reasons why equity-price drops might overstate movements in firm cash flow. First, when firms are debt financed, small drops in cash flow can lead to large drops in market value, and hence large observed drops in market value may only imply small drops in cash flow. Second, movements in the market value of Compustat firms overstates movements in market value of all firms in the U.S. economy because the Compustat sample of firms overweights large firms and these firms had lower market returns than small firms. This problem requires us to reweight the Compustat sample of firms so we can infer what happened to cash flows of a sample of firms that matched the industry-size distribution of firms in the U.S. economy. Finally, increases in discount rates due to worse expected macro outcomes (e.g., drops in future consumption or heightened uncertainty) can cause drops in firm market value without firm cash flow changing.

These effects are sizable. Our theory tells us that a first-order approximation of the welfare change is comprised of three terms: a firm value-added weighed average of changes in firm values, a weighted average of discount rates, and tariff revenues. Theory tells us that the 11.5 percent decline in stock returns is likely to overstate the decline in firm values for two reasons. First, firms typically have some debt whose value does not change in response to a rise in tariffs, so stock returns for levered firms move disproportionately more than movements in firm value (or cash flow). This issue requires us to use a mapping from stock returns into cash flow that adjusts for each firm's leverage. Second, listed firms tend to be large, and large firms are more likely to be exporters, importers, or multinationals, which makes them more exposed than the average firm. As a result, the average market responses of listed firms to a tariff announcement are likely to overstate the impact of tariffs because the Compustat sample overweights exposed firms relative to their prevalence in the U.S. economy. We deal with this problem by using population weights when we aggregate across firms instead of the Compustat sample weights. The leverage and sampling adjustments imply that changes in firm value are just over half as big as the 11.5 percent drop in equity value discussed above. Of this 6.7 percent decline in firm value, 3.1 percentage points can be explained by higher discount rates, which means that the impact of the tariffs on cash flows drove welfare down by 3.6 percent. Finally, in order to be conservative, we assume that the tariff revenues arising from the trade war equal 2017 import values multiplied by the increase in tariffs. This is an upper bound because tariffs likely caused import values to fall. However, this upper bound implies that increased tariff revenues could not have raised welfare by more than 0.6 percent, which yields our baseline estimate of the welfare loss of 3.0 percent. We show that this estimate is robust to a wide range of alternative specifications, and to the extent that the trade-war increased the variance or skewness of consumption (by increasing policy uncertainty or asymmetrically increased the probability of bad outcomes), we have underestimated the impact.

This result raises the question of why market participants believed the tariffs would

have a large effect on the economy but conventional economic models suggest they would have small effects. The higher estimated losses in this exercise than those in conventional analyses likely arises from two main sources. First, our identifying assumptions differ from those commonly used in estimating the impact of tariffs on welfare. Conventional analyses make strong assumptions about the pass-through of tariffs into prices, the timing of output-, input-, and factor-price changes, the absence of dynamic effects, the structure of input-output linkages, and how tariffs affect “unexposed” firms, how TFP is affected by tariffs. It is well known that welfare estimates can be very sensitive to these assumptions. Our model relaxes these assumptions. Relaxing the assumption that protection does not affect productivity is likely to be particularly consequential. For example, [Perla et al. \(2021\)](#) show that trade liberalization generates large welfare gains if it also can affect the incentive of firms to invest in new technologies. Second, while we are rigorous in our estimation of the impact of tariff announcements on expected cash flows, we make no assumptions about why tariffs move cash flows as they do. As a result, our approach likely incorporates other secondary impacts of unilaterally levying tariffs on things like the world trading system, political stability, policy uncertainty, macro policy, etc. While conventional analyses are excellent at providing an estimate of welfare effects through the lens of a particular model, the approach has difficulty computing the total impact of tariffs that arises from their affect on other policies. The gain in precision associated with only examining a narrow channel through which tariffs affect welfare comes at the cost of not being able to discuss alternative channels. By not taking a stand on why the expected cash flows fall following a tariff announcement, we allow for trade policy to have complex interactions with other variables in the global economy. In this sense, our approach can be seen as complementary to existing ones. Standard exercises examine one mechanism through which tariffs affect firms whereas our approach allows for many possibilities.

Related Literature Our work is closely related to the voluminous literature on stock-market event studies that use trade data ([Grossman and Levinsohn \(1989\)](#), [Hartigan et al. \(1986\)](#), [Breinlich \(2014\)](#), [Fisman et al. \(2014\)](#), [Moser and Rose \(2014\)](#), [Breinlich et al. \(2018\)](#), [Crowley et al. \(2019\)](#), [Huang et al. \(2023\)](#), and [Greenland et al. \(2024\)](#)). We differ in the use of a general equilibrium model to interpret the data. [Greenland et al. \(2024\)](#) is particularly relevant in that they show that positive firm abnormal returns in response to lower trade uncertainty, through the granting of permanent normal trade relations in 2000, led to future increases in firm employment, sales, productivity and profits. Our approach yields a theoretical foundation for their regressions, and their results validate our assumption that movements in expected cash flows are tightly linked to movements in future accounting profits and other non-financial variables. We also document a significant link between firm stock returns and future movements in non-financial variables using a structural approach to measuring the impact of policy announcements.

The specific factors model, which forms the basis of our approach, has also been used extensively in empirical estimation in recent years (c.f., [Topalova \(2010\)](#), [Kovak \(2013\)](#), and [Dix-Carneiro and Kovak \(2017\)](#)). These papers have shown that many of the large effects of trade policy changes on wages often take a decade to be fully apparent in the data. Our paper provides a complementary way of thinking about the long-term effects of a policy change in terms of expected wages. In particular, most papers in this literature

only look at the impact of output tariffs, so tariffs are assumed to always raise the effective rate of protection. However, in our setup, we allow tariffs to affect input prices as well, so the imposition of tariffs can either raise the ERP by increasing firm output prices or lower it by raising the cost of the firm's imported intermediate inputs.

Our paper is related to the vast empirical trade literature over the last two decades showing that trade liberalizations have big effects on per capita income and productivity. These studies have shown that *firm-level* TFP is very sensitive to ERP and import competition more generally.¹ We also identify large impacts of trade policy on revenue TFP, but our identification is based on using stock-price data filtered through a general equilibrium model. Our paper is also related to the macro literature evaluating the impact of trade on income that has found evidence of large impacts of trade on productivity and income (c.f., [Frankel and Romer \(1999\)](#); [Alcalá and Ciccone \(2004\)](#); [Feyrer \(2019\)](#)). These studies find that the elasticity of per capita income with respect to trade ranges from 0.5 to 3 and that most of the effect arises through trade's impact on productivity. Although our work also finds large impacts of trade on productivity and welfare, an important difference between our work and the macro literature is that we build these estimates up from firm-level data on stock prices and use a structural general equilibrium setup to obtain our estimates.

We also contribute to the burgeoning literature on understanding the importance of protection for the economy through macro or policy uncertainty channels ([Baker et al. \(2016\)](#); [Pierce and Schott \(2016\)](#); [Handley and Limão \(2017\)](#); [Caldara et al. \(2019\)](#); [Greenland et al. \(2024\)](#)). Like these papers, our paper also suggests that trade policy announcements can have impacts that arise through uncertainty or changing the macro environment, but we differ in our use of financial data to identify the shocks and the use of a general equilibrium model. Our paper is also related to work on the China shock. For example, [Autor et al. \(2013\)](#) and [Caliendo et al. \(2019\)](#) show how trade with China affected U.S. employment, wages, and welfare, but our work focuses on trade policy announcements. Finally, [Barrot et al. \(2019\)](#) show that firms in industries with lower shipping costs tend to have higher average returns, suggesting that foreign productivity shocks are associated with times where the marginal utility of consumption for investors is high.

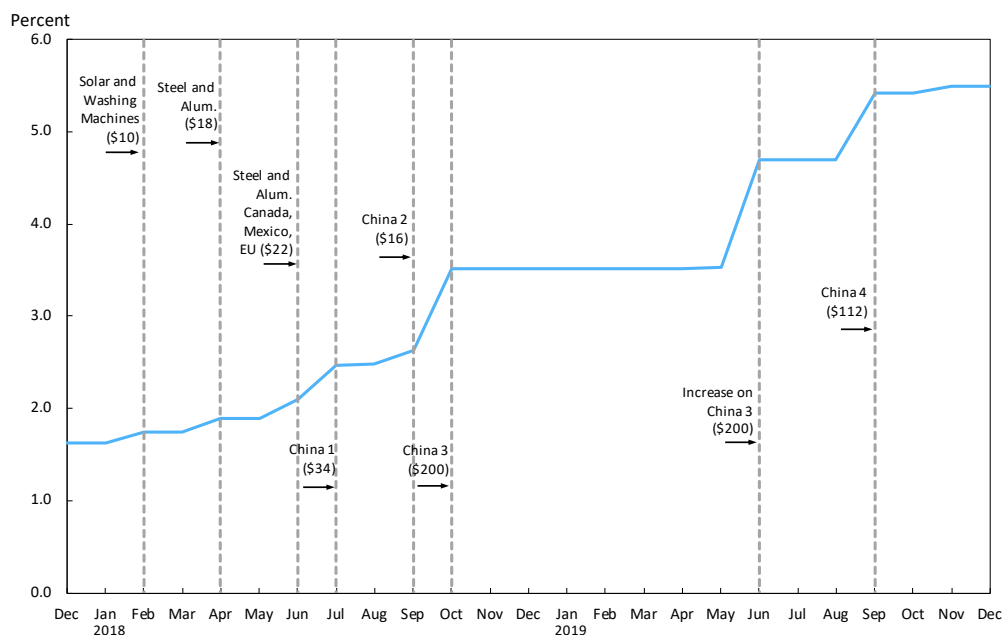
Finally, our paper is related to the literature documenting the impact of the trade war on prices (c.f., [Amiti et al. \(2020\)](#); [Fajgelbaum et al. \(2020\)](#); [Flaaen et al. \(2020\)](#); [Amiti et al. \(2019\)](#); [Cavallo et al. \(2021\)](#)). These papers have found that during the U.S.-China trade war, tariff passthrough into import prices was close to complete, consistent with our finding that higher U.S. tariffs negatively affected importers. [Cavallo et al. \(2021\)](#) found that Chinese tariffs depressed U.S. exporter prices, also consistent with our findings of negative abnormal returns for firms exporting to China following Chinese retaliation events.

¹For example, [Amiti and Konings \(2007\)](#) estimate the elasticity of firm-level TFP with respect to input tariffs to be -1.2 in Indonesia for firms that import their inputs. There were also gains to non-importers but these were smaller, so the average elasticity across all firms was -0.44. [Topalova and Khandelwal \(2011\)](#) estimate the elasticity to be -0.5 in Indian data, and [Brandt et al. \(2017\)](#) and [Brandt et al. \(2019\)](#) estimate the elasticity to be -2.3 in Chinese data. [Bloom et al. \(2016\)](#) find that Chinese import competition accounts for 14 percent of European technology upgrading.

2 Stylized Facts

This section documents three stylized facts about the trade-war announcements that motivate our theory and welfare analysis. First, we examine the impact of the announcements on stock prices to demonstrate that the *tariff* announcements (and not executive orders and actions) *consistently* produced large, broad, and persistent stock price declines. Second, we show that firms *directly* exposed to China through importing, exporting, or multinational sales had more negative returns on tariff announcement days than unexposed firms and had worse future real outcomes. Thus, while the data indicates that the distribution of all stock returns shifted to the left, the announcements have a relatively larger negative effect on directly exposed firms. These results establish that firm cash flows were likely affected by the trade war. Third, we show that tariff announcements affected discount rates by driving down expected inflation and nominal and real treasury yields while raising the equity premium.

Figure 1: Average U.S. Tariffs in the 2018-2019 Trade War



Note: Source: [Amity et al. \(2020\)](#). Data from the U.S. Census Bureau, U.S. Trade Representative (USTR), and U.S. International Trade Commission. Tariffs on the 10-digit Harmonized Tariff Schedule (HTS) product code by country, weighted by 2017 annual import value. Dashed vertical lines indicate the implementation of new tariffs during 2018-2019; tariffs implemented after the 15th of the month are counted in the subsequent month. Four tranches of tariffs were imposed on China, designated by 1, 2, 3, and 4. Numbers in parentheses correspond to the value of imports covered by the new tariffs in billions.

2.1 The Tariff Announcements

Over the course of the trade war, the U.S. implemented tariffs in waves, which we plot in Figure 1. The figure shows that the average rate of tariffs on all U.S. imports rose by approximately 4 percentage points as tariffs on a wide range of Chinese imports reached

25 percent by the end of the period. For each of these new tariffs we found the earliest announcement date in the media using Factiva and Google search. In addition, we also used the same method to identify the earliest announcement dates for each time that China imposed retaliatory tariffs on U.S. exports. Events were chosen based on the announcement of *new waves of tariffs that were implemented*, not just threats or revisions to existing waves. Our approach to choosing event dates has the advantage of being comprehensive and objective in the sense that we do not use events based on actions or statements that did not correspond to observable changes in tariffs.

2.2 Stylized Fact 1: Tariff Announcements Produced Large, Broad, and Persistent Stock Price Declines

Table 1: Stock Market Return on Days with Tariff Announcements

Event Date	$\ln R_{M,t}$ (x100)	Country	Description
23jan2018	0.3	US	U.S. imposes tariffs on solar panels and washing machines
01mar2018	-1.1	US	U.S. will impose steel and aluminum tariffs
22mar2018	-2.4	US	U.S. imposes \$60B in annual tariffs on China
23mar2018	-1.9	CHN	China retaliates and announces tariffs on 128 U.S. exports
15jun2018	-0.2	CHN	China announces retaliation against U.S. tariffs on \$50B of imports
19jun2018	-0.4	US	U.S. announces imposition of tariffs on \$200B of Chinese goods
02aug2018	0.5	CHN	China unveils retaliatory tariffs on \$60B of US Goods
06may2019	-0.4	US	U.S. to raise tariffs on \$200B of Chinese goods up to 25%
13may2019	-2.5	CHN	China to raise tariffs on \$60B of U.S. goods starting June 1
01aug2019	-0.9	US	U.S. will impose a 10% tariff on another \$300B of Chinese goods
23aug2019	-2.5	CHN	China retaliates with higher tariffs on soy and autos
Cumulative	-11.5		

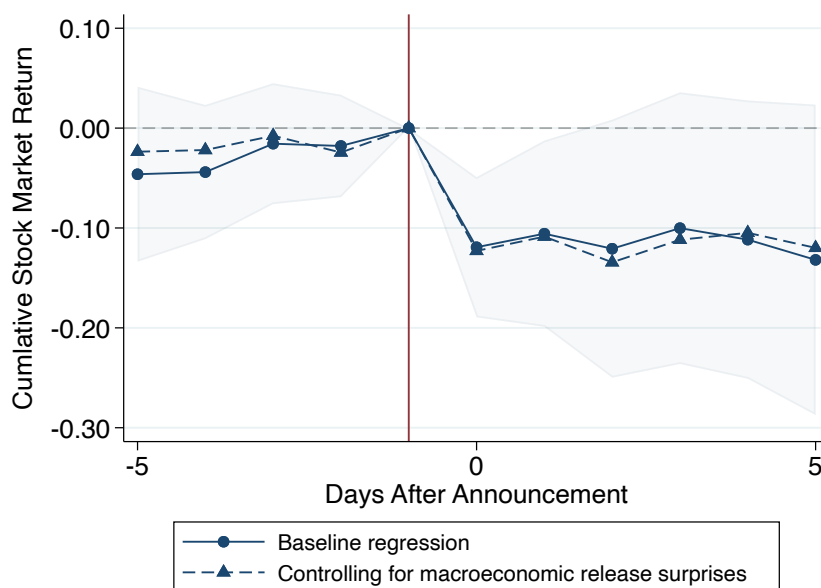
Note: $R_{M,t}$ is the return that an investor would receive from holding the market portfolio (i.e., the net return) plus one. The first and last columns report the date and description of each tariff announcement. The second column reports the (log) stock market return on each announcement day. The third column lists the country that imposed the tariffs associated with each event. The stock market return is the value-weighted market portfolio return from CRSP.

Table 1 presents the eleven tariff announcement dates, comprising six U.S. tariff and five Chinese tariff-retaliation events. The first column reports the first day markets could trade on new tariff information, which may be after the announcement if it was made after markets closed. Our first event (January 23, 2018) corresponds to the announcement of U.S. tariffs on solar panels and washing machines that were implemented on February 7, 2018 on China and, in this case, more broadly on other countries too. The second event date (March 1, 2018) is the announcement of steel and aluminum tariffs, also more broadly applied, which were imposed on March 23, 2018. All of the subsequent U.S. tariff events only apply to China. At the start of the trade war, the U.S. announced new tariffs on China so rapidly that China sometimes did not have time to retaliate before the next round of tariffs were announced. On March 22, 2018, the U.S. announced tariffs on \$60 billion of Chinese imports. The U.S. implemented the steel and aluminum tariffs on March 23, 2018, prompting China to announce retaliatory tariffs that day. China then retaliated on the U.S. tariffs hitting \$60 billion of Chinese exports (which was subsequently reduced to

\$50 billion) on June 15, 2018, hitting \$50 billion of U.S. exports to China. After these initial announcements, a pattern developed in which the U.S. would announce new tariffs and China would then retaliate. All eleven events are listed in Table 1 in date order, with more details and links to the announcement of each event provided in Appendix C.1.

Stock markets reacted consistently to these tariff announcements. Table 1 reports the value-weighted stock-market return on each of the tariff announcement date. We focus on the set of firms in the Compustat-CRSP linked dataset and incorporated in the USA. (i.e., when Compustat variable `fic` is “USA”). We see that the stock market fell on all of the event dates except one U.S. event date and one Chinese event date, with a total drop of 11.5 percent over all of the events using a one-day window. These consistent declines suggest that markets did not fully anticipate future tariff announcements or the deteriorations in U.S.-China relations at the outset.

Figure 2: The Dynamics of Stock Market Returns around Tariff Announcements



Note: This figure plots the cumulative log stock market return starting the day before the announcement. Formally, we estimate the following regression on all trading days between 2017 and 2019: $\ln R_{M,t} = \alpha + \sum_{s=-4}^5 \beta_s D_{s,t} + \epsilon_t$, where $D_{s,t} = 1$ if day t is s days after an announcement; $D_{s,t} = 0$ otherwise. We then plot the cumulative return of the stock market from the eve of the announcement as $11 \sum_{k=s+1}^{-1} \hat{\beta}_k$ if $s < -1$ and $11 \sum_{k=0}^s \hat{\beta}_k$ if $s > -1$. The dashed line reports the results of the same procedure controlling for economic surprises, i.e. $\ln R_{M,t} = \alpha + \sum_{s=-4}^5 \beta_s D_{s,t} + \sum_{d=1}^D \gamma_d \times ES_{d,t} + \epsilon_t$ where $ES_{d,t}$ denotes the difference between the release value for a data series d and the Bloomberg median of economists’ forecast on the previous day between 2017 and 2019 created by Lewis (2020). Shaded areas correspond to the 95 percent confidence-interval computed using robust standard errors. The stock market return is the value-weighted market portfolio return from CRSP.

Figure 2 plots the log stock market return over an eleven-day window around the tariff-announcements so that we can better understand the dynamics of the stock market surrounding these announcements. The data reveal that in the five trading days before the events, stock-price movements were quite small on average — there is little evidence of

anything out of the ordinary happening in the market before the announcements. However, as Table 1 showed, we see that there were large declines of over 10 percent on the announcement days. These falls were *persistent*, as the market did not recover in the following five trading days. One potential concern is that trade war announcements might be systematically correlated to other announcements happening on the same day. While no monetary policy announcement occur in our window, we also report log stock market returns around tariff-announcements after controlling for the set of macroeconomic release surprises compiled by Lewis (2020). As shown in Figure 2, we find that controlling for these contemporaneous economic releases do not change our estimates, implying that there is no systematic correlation between surprises from economic data releases and tariff-announcements.

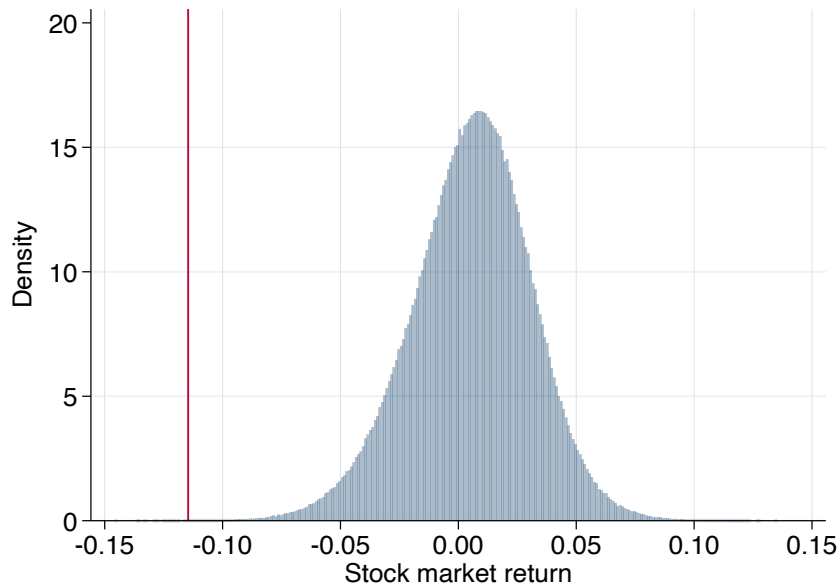
Tariff Announcements Caused Large Declines in Stock Returns The stock market movements on tariff-announcement days were not only consistently negative and persistent, but also large in magnitude. We show this by comparing the average stock price movement on tariff announcement days with the distribution of stock market changes we would obtain if we had just randomly picked 11 days between 2017 and 2019. In order to estimate this, we compute the distribution of log returns obtained by aggregating the daily log returns over 11 placebo event days, repeating this procedure one thousand times. Figure 3 plots the actual change in returns on our tariff-announcement days, compared to the density of changes in log return in blue on placebo days. Out of all our draws, only 0.04 percent of them produced a change in log returns lower than our estimate. Thus, we can strongly reject the hypothesis that the negative stock returns on the tariff-announcement dates arose by chance.

Non-Tariff Actions and Orders Against China Did Not Move Markets Much Tariff announcements differ from many other policy actions in that they affect a large number of prices in the economy. In order to establish that there is something different about tariff announcements than other announcements targeting China, we examine stock-price movements on all days in 2017-2019 in which the U.S. announced executive orders and actions targeting China and unrelated to tariffs.² These actions antagonized China and often required firms to comply with sanctions but did not have the broad impact on firms that tariffs did. We report the effects of these announcement on stock returns in Table 2. We find that that the mere targeting of China for a perceived infraction did not have much of an impact on stock markets. Instead, the negative stock market returns we observe on tariff-announcement days seems to be specifically related to *tariff announcements*. The obvious explanation is that executive orders and actions have little more than symbolic impacts on the U.S. economy as a whole and markets largely shrugged them off even if they may also have been harbingers of deteriorating relations with China.

Tariff Announcements Caused Broad Declines in Stock Returns Interestingly, we find that these aggregate stock-market declines were the result of broad-based declines in the market. Figure 4 compares the density of firm-level returns during announcement days with all the other days during our sample period. The data reveal that the distribution of stock returns is shifted to the left on tariff-announcement days and that there is a left

²See <https://www.uscc.gov/research/timeline-executive-actions-china-2017-2021>

Figure 3: Cumulative Stock Market Returns on Days with Tariff Announcements versus Random Days



Note: The figure compares the cumulated log stock market return over our 11 announcement days (in red) with the density of cumulated log stock market returns obtained over 11 random days between 2017 and 2019 (in blue). The stock market return is the value-weighted market portfolio return from CRSP.

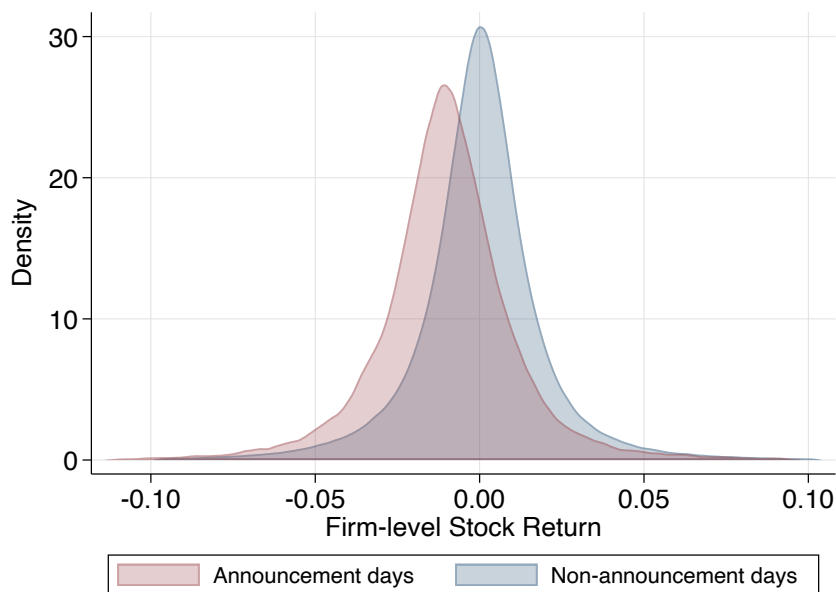
Table 2: Stock Market Returns on Announcement Days of Executive Orders and Actions Targeting China

Event Date	$\ln R_{M,t}$ (x100)	Description
17jul2017	0.0	Treasury sanctions Chinese companies for proliferation activities in support of a key designated Iranian defense entity
20dec2017	-0.0	U.S. sanctions human rights abusers and corrupt actors
27apr2018	0.1	Treasury identifies Chinese trafficker as a Significant Foreign Narcotics Trafficker
18sep2018	0.5	Department of Justice orders Xinhua and China Global Television Network to register as foreign agents
25sep2019	0.6	Treasury sanctions six Chinese entities and five individuals for Iran sanctions violations
07oct2019	-0.4	Commerce Department adds 28 organizations to its Entity List for human rights violations in Xinjiang
08oct2019	-1.5	State Department issues visa restrictions on Chinese officials responsible for human rights abuses in Xinjiang
Cumulative	-0.7	

Note: The first and last columns report the date and description of each event day. The second column reports the log stock market return on each announcement day. $\ln R_{M,t}$ is the log of one plus the proportional change of the stock market return, defined as the value-weighted market portfolio return from CRSP.

tail of firms which were disproportionately hurt by the announcements. The broadness of the impact on returns indicates that we cannot easily divide the sample into “treated” and “untreated” firms: the full distribution of returns shifted to the left.

Figure 4: Effect of Trade War Announcements on the Cross-Section of Firm-level Returns



Note: The figure compares the average density of firm-level returns on announcement days (in red) and non-announcement days (in blue). More precisely, we first residualize firm-level returns with respect to a set of day fixed effects (while still leaving a dummy corresponding to announcement days). We then plot the density of residuals on announcement days and non-announcement days.

2.3 Stylized Fact 2: Tariff Announcements Differentially Affected “Exposed” Firms

Next, we investigate whether firms with significant direct China exposure experienced more pronounced negative stock market returns than firms that were not exposed. To do this, we consider three ways in which firms were exposed to China: importing, exporting, and foreign sales (either through exporting or subsidiaries). As Table 3 shows, it is important to capture indirect imports that are ultimately purchased by U.S. firms because many firms do not import directly from China but instead obtain Chinese inputs through their subsidiaries or the U.S. subsidiaries of foreign firms. These data show that the supply-chain information is critical in understanding firms’ exposure to international trade. From Table 3, we see that only 10 percent of the firms in our sample import directly from China, and only 2 percent export directly to China. However, if we take subsidiaries into account, these numbers rise to 26 and 4 percent, respectively. When we add imports by all firms in the supply chain, we see that 31 percent of all listed firms in the U.S. import directly or indirectly from China. In the last row of the table, we construct a variable, “Firm Exposed to China” if any firm in the firm’s network exported to or imported from China or if the firm had positive revenues from China (possibly from affiliate sales).

We see that 52 percent of all firms were exposed to China through one or more of these channels.

Table 3: China Trade Exposure of Listed U.S. Firms

	Mean
Firm imports from China	0.10
Firm or subsidiary imports from China	0.26
Firm, subsidiary, or supplier imports from China	0.31
Firm exports to China	0.02
Firm or subsidiary exports to China	0.04
Firm sells in China via exports or affiliates	0.42
Average share of revenue from Chinese exports or affiliate sales	0.03
Firm exposed to China through imports, exports, or affiliate sales	0.52
Number of Firms: 2,437	

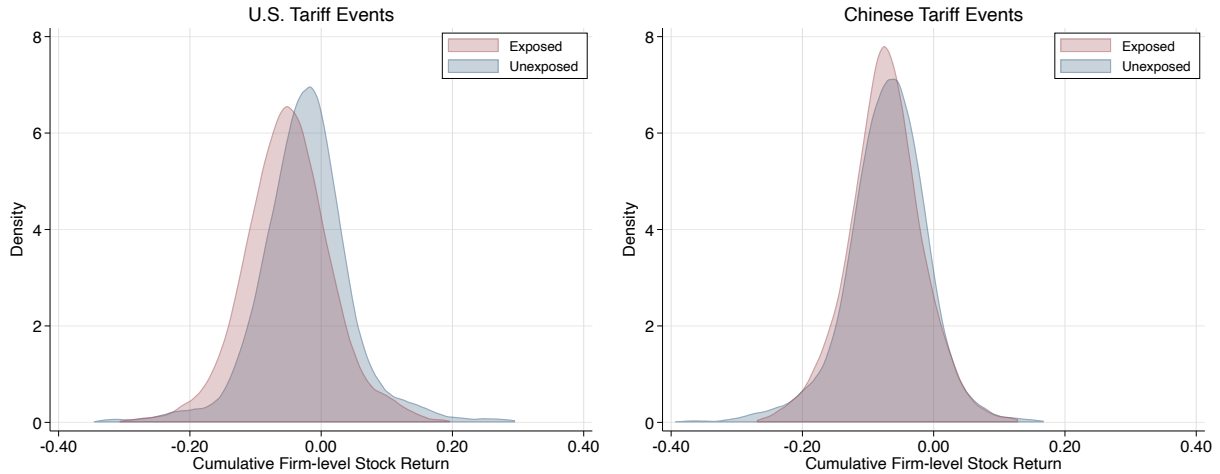
Note: This table reports the means of indicator variables that are 1 if a firm satisfies the listed criterion, as well as the mean of the continuous Chinese revenue share variable. See Appendix C.3 for construction of these variables. This sample of firms excludes the finance sector.

In Figure 5, we plot the kernel densities of the cumulative returns of the firms directly exposed to China “exposed” vs those firms that were not directly exposed “unexposed.” There are three important takeaways from this figure. First, we see that exposed and unexposed firm returns were on average negative on event days. Thus, the overall negative shift in the return distribution that we saw in Figure 4 was not just driven by exposed firms having lower returns—the distribution of returns for unexposed firms also shifted to the left. Second, the distribution of stock market returns for exposed firms during the U.S. tariff announcement events is to the left of the untreated firms. Third, both Chinese and U.S. tariff announcements produced lower returns overall and even lower returns for exposed firms. This result, which is also present if one does a traditional stock-market event study (see, for example, [Huang et al. \(2023\)](#)), establishes that tariff announcements not only drove down the full distribution of firm returns, but they differentially lowered the returns of exposed firms.

Firms with Worse Stock Market Returns Had Worse Future Real Outcomes We follow the approach of [Greenland et al. \(2024\)](#) to see if firms that experienced worse stock market returns on tariff-announcement dates also experienced worse future real outcomes. [Greenland et al. \(2024\)](#) pioneering work on the granting of permanent normal trade relations to China in 2000 demonstrates an important link between stock price movements and *future* movements in cash flow. We replicate these results using tariff-announcement data or the period 2013 to 2021 by regressing firm employment, sales, profits, and labor productivity on the average of firm returns around tariff announcement dates, interacted with a post dummy that takes a value of one for the years 2019, 2020, and 2021.

Table 4 reports the results for the U.S.-China trade war. The data reveal that firms that had particularly poor returns around tariff-announcement days had significantly lower future employment, sales, profits, and labor productivity. Moreover the magnitudes are quite substantial. A firm whose average return around tariff-announcement days was

Figure 5: Dispersion in Returns (One-Day Windows)



Note: This figure plots the kernel densities of cumulative abnormal returns of firms exposed to China (light red) and unexposed (light blue) during one-day windows around trade-war announcements. Exposed firms are firms that export to, import from, or have positive revenues in China.

one standard deviation lower (-0.56 percent) had average sales, employment, profits, and labor productivity that were 4.5, 6.1, 13, and 1.7 percent lower, respectively, between 2019 and 2021 than before the trade war began. Moreover, the fall in labor productivity in addition to the fall in firm size and profitability echoes micro studies that find a strong link between tariffs and within-firm productivity. The empirical link between stock returns, cash flow, and other outcome variables motivates our building a mapping between stock return and cash flow, which forms the basis of our identification strategy.

2.4 Stylized 3: Tariff Announcements Moved Interest Rates and Equity Premia

We now discuss the effect of the trade-war announcements on discount rates by examining their impact on interest rates and the equity premium. As discussed in Section 4, separating discount rate movements from stock returns is necessary to identify the impact of a policy on expected cash flows.

We first estimate the effect of announcements on the nominal yield curve. We measure the daily (annualized) yield to maturity on 3-month, 6-months, and 12-months T-bills from FRED and the yield to maturity of 1- to 20-year treasuries from [Gürkaynak et al. \(2007\)](#). Figure 6 shows the cumulative daily changes in these yields across all trade-war announcements. As in the previous section, all of these specifications control for surprises in contemporaneous macroeconomic releases. Tariff announcements are associated with decreased nominal rates at all maturities. The effect is U-shaped with respect to maturity: interest rates declined by approximately 20 basis points (bps) for 3-month maturities, 60bps for 4-year maturities, and 40bps for 20-year maturities. The finding that announcements affect yields at very long maturities is reminiscent of [Hanson and Stein \(2015\)](#), who find that monetary policy shocks impact the yield-to-maturity of long-term

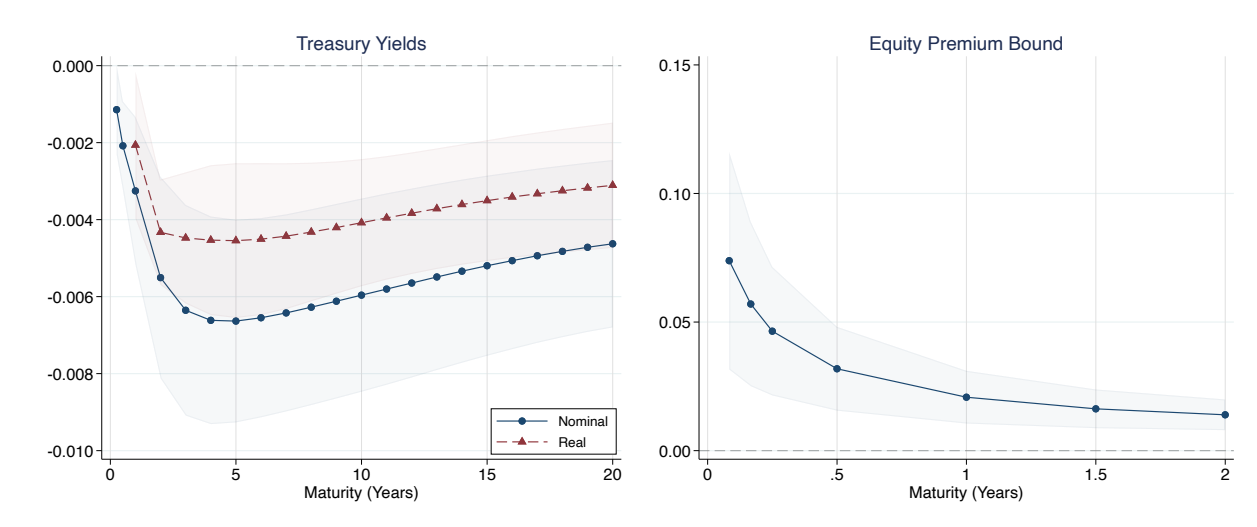
Table 4: Relationship between Changes in Returns and Future Observables

	(1)	(2)	(3)	(4)
	$\ln(L_{ft})$	$\ln(\text{Sales}_{ft})$	$\ln(\text{Profit}_{ft})$	$\ln(\text{Sales}/L)_{ft}$
Post \times $\ln R_f$	0.07*** (0.01)	0.12*** (0.02)	0.23*** (0.04)	0.04** (0.02)
Firm FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
Controls	✓	✓	✓	✓
R^2	0.976	0.962	0.915	0.873
Observations	17032	16760	11940	16736

Note: Data is at the firm-annual level for the period 2013 to 2021, from Compustat and CRSP. Profit is defined as operating income after depreciation less interest and related expenses. $\ln R_f$ is the log of one plus the average return on 5 days surrounding the tariff-announcement dates across all event dates in 2017-2019. In this table, $\ln R_f$ is then multiplied by 100. The Post dummy takes a value of one in 2019, 2020, and 2021. All columns include the following control values at the start of the sample (i.e. 2013) interacted with the Post dummy as covariates: Property, Plant, and Equipment (PPE) per worker, market capitalization, cash-flow-to-asset ratio, book leverage and Tobin's Q. Appendix Table G.1 reports the coefficients on the control variables and Appendix C.2 provides details on variable construction. Standard errors are in parenthesis. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

bonds.

Figure 6: Cumulative Effect of Trade War Announcements on Discount Rates



Note: Each figure reports the cumulated daily change of variables over all days with a trade war announcement, after controlling for surprises in macroeconomic releases. The first subfigure reports the change in the nominal and real yield curves, using data from FRED (for nominal yields at the 3-months, 6-months, and 12-months maturity) and [Gürkaynak et al. \(2007\)](#) (for nominal and real yields at longer maturity). The second subfigure reports the change in the equity premium bound, constructed using the methodology of [Martin \(2017\)](#) on data from OptionMetrics. Shaded areas correspond to the 95% confidence-interval computed using robust standard errors.

Changes in nominal yields could reflect a change in real yields or a change in the

inflation premium. To isolate the first component, we also plot in the left panel of Figure 6 (in red) the effect of tariff announcements on the real yield curve, that is, the yield to maturity of Treasury Inflation-Protected Securities (TIPS), as reported in [Gürkaynak et al. \(2007\)](#). We find that tariff announcements decreased real rates for all maturities, although less so than for nominal rates. The difference suggests that the tariff announcements had a negative effect on expected inflation or on the inflation risk premium.

Finally, we examine the effect of announcements on the proxy for the equity risk premium, which is the extra return investors require in order to hold equities rather than risk-free bonds. We compute the lower bound for the equity premium by following the procedure developed in [Martin \(2017\)](#). Like the VIX, this proxy is constructed from the price of out-of-the-money call and put options on the S&P500 index. [Martin \(2017\)](#) argues that it produces a tight lower bound on the equity premium—i.e., the equity premium tracks it closely—so we refer to it as the Equity Premium Bound (EPB) in the rest of the paper. We follow [Martin \(2017\)](#)'s methodology to construct an annualized EPB from the one-month horizon to the three-years horizon using data from OptionMetrics.

Figure 6 shows that tariff announcements also had a large and significant positive effect on the (annualized) EPB. Interestingly, the effect of announcements on the EPB decline rapidly with maturity: while announcements increase the EPB at the 1-month horizon by 6 percentage points, they only increase the EPB at the 3-year horizon by 1 percentage point. Empirically, this reflects the fact that trade announcements dramatically increase the price of out-of-the-money call or put options with short maturity, but they have more muted effects on long maturity ones.

We examine the robustness of these findings in the Appendix. Similarly to Table 1, Appendix Table (E.1) reports the change in nominal yields, real yields, and in the equity premium bound event-by-event. This shows that our results are not driven by one outlier event: almost all announcements tend to decrease real yields and increase the equity premium bound. Finally, similarly to Figure 3, Appendix Figure E.1 reports the dynamic effect of announcements on these variables over a five days window. This figure shows that the change in these variables is concentrated on the days of the announcements, which seems to refute the idea that the market under or overreacted during these days.

3 Theory

In this section we show how to use the systematic movements in asset prices due to tariff announcements that we documented to estimate movements in welfare. We develop this theory using three building blocks. First, in Section 3.1, we develop a dynamic infinite-horizon, firm-level, specific factors model of production and derive how a change in the effective rate of protection at any point in the future maps into firm cash-flow movements and wage movements. We invert this model to show that movements in firm cash flow (which are identical to the returns to the specific factor in this setup) are sufficient statistics that pin down the movements in wages, firm sales, employment, prices, effective rates of protection (ERP), and TFP. Second, in Section 3.2, we show how, if we embed these policy-induced movements in cash flows into a dynamic model of consumer behavior, we can express the consumption-equivalent welfare effect of the policy in terms of the present discounted value of the cash-flow movements we derived in the first Section 3.1.

3.1 Production

The production structure is based on the [Jones \(1975\)](#) specific-factors model, extended along two dimensions. First, we rederive the model under the assumption that fixed factors are firm specific instead of industry-specific. Second, we extend it from a static one-period model into a dynamic infinite-horizon model (where production decisions in each period would mimic those of a static model in the absence of any policy shocks). In our model, time is discrete and indexed by t ; and there is a continuum of firms in the economy indexed by f . At each time t , firm f produces according to a constant-returns-to-scale technology, which combines three types of inputs: a firm-specific fixed factor V_f , a quantity of labor L_{ft} hired in a competitive labor market, and a set of differentiated intermediate inputs m_{1ft}, \dots, m_{nft} . Firms maximize profits taking the output price as given.³ There are no adjustment costs between periods. Hence, profit maximization over all periods is equivalent to profit maximization in each period (and the same is true for cost minimization).

As in [Jones \(1975\)](#), it is easiest to solve this model by focusing on the unit-cost function. Denote firm f 's unit cost of production at time t by $c_{ft}(w_t, r_{ft}, q_{1t}, \dots, q_{nt})$, where the arguments correspond to the wage (w_t), the shadow price of the firm's fixed factor (r_{ft}), and prices of a set of intermediate inputs (q_{1t}, \dots, q_{nt}). Shephard's Lemma tells us that the unit-input requirements are given by the derivative of the cost function; that is, $a_{Lft} = \frac{\partial c_{ft}}{\partial w_t}$, $a_{Vft} = \frac{\partial c_{ft}}{\partial r_{ft}}$, and $a_{ift} = \frac{\partial c_{ft}}{\partial q_{it}}$, where $a_{Lft}, a_{Vft}, a_{ift}$ denote the unit-input requirements for labor, fixed factor, and intermediate input i , respectively. We assume that each firm f sets the price of its output p_{ft} equal to its marginal cost so

$$a_{Lft}w_t + a_{Vft}r_{ft} + \sum_i a_{ift}q_{it} = p_{ft}. \quad (1)$$

We impose the full-employment conditions on labor and each firm's specific factor in each period:

$$\sum_f a_{Lft}y_{ft} = L, \text{ and} \quad (2)$$

$$a_{Vft}y_{ft} = V_f, \quad (3)$$

where L denotes the total supply of labor, which is fixed at the aggregate level. Since $a_{Lft}y_{ft} = L_{ft}$, the first full-employment condition (2) requires that firm-level employment will adjust with firm-level production. In contrast, the second full-employment condition (3) stipulates that the unit-input requirement of the specific factor (a_{Vft}) is inversely proportional to firm output (y_{ft}) because the amount of the firm-specific factor (V_f) is fixed. Note that this second full-employment condition implies that the total compensation received by firm f 's fixed factor equals firm f 's cash flow (its revenue net of labor and input expenses); that is, $r_{ft}V_f = (p_{ft} - a_{Lft}w_t - \sum_i a_{ift}q_{it})y_{ft}$.

In order to model the impact of a policy change, we start with a "baseline" equilibrium in which all cost functions, product prices, and input prices are unchanging over time (i.e., $c_{ft} = c_f$, $p_{ft} = p_f$, and $q_{it} = q_i$), and then treat a policy shock as a policy that shifts input and output prices in each period away from this baseline. Since, in the baseline

³As long as the marginal productivity of V_f tends to infinity as V_f tends to zero, each firm's production is positive in equilibrium.

equilibrium, aggregate employment (L), each firm's specific factor (V_f), and input and output prices are fixed over time, we know that the wage and firm level employments are also fixed over time; that is, $w_t = w$ and $L_{ft} = L_f$. Accordingly, we simplify notation going forward by dropping the t subscript whenever we are discussing variables that do not change over time in the baseline equilibrium. While we assume that the baseline equilibrium does not have growth, we show in Appendix B that we can easily modify the setup to allow for productivity growth without changing any of our propositions.

We model a tariff change as causing a set of log-change deviations in output and input prices ($\hat{p}_{it}, \hat{q}_{it}$) in the period t baseline values ($p_{ft} = p_{f0}$ and $q_{it} = q_{i0}$). Because the amount of each firm's specific asset is fixed ($\hat{V}_f = 0$), log changes in the shadow price of the specific factor equal the log change in firm cash flow (i.e., $\hat{r}_{ft} = \widehat{r_{ft}V_f}$), where hats over variables indicate log changes in these variables from their baseline values in period t . Thus, we will henceforth refer to \hat{r}_{ft} as the log change in the firm's cash flow in period t (due to the policy change).

Following Jones (1975), we assume that the production function is separable in that the share of expenditures on intermediate inputs in costs is unchanging. This assumption enables us to write the factor intensity of production ($a_{V_{ft}}/a_{L_{ft}}$) as a function of the elasticity of substitution between the specific factor and labor (σ):⁴

$$\hat{a}_{V_{ft}} - \hat{a}_{L_{ft}} = \sigma (\hat{w}_t - \hat{r}_{ft}). \quad (4)$$

We are now ready to prove our first proposition linking changes in cash flows to wages.

Proposition 1. *If the elasticity of substitution between labor and the specific factor for all firms is constant, the log change in wages equals the employment-share weighted average of the log changes in cash flow, i.e.,*

$$\hat{w}_t = \sum_f \frac{L_f}{L} \hat{r}_{ft},$$

and the log change in employment in each firm equals $\hat{L}_{ft} = \sigma \left(\hat{r}_{ft} - \sum_{f'} \frac{L_{f'}}{L} \hat{r}_{f't} \right)$.

Proof. See Appendix A.1 □

The intuition behind the first equation in Proposition 1 is that the full-employment condition implies that changes in factor prices cannot yield an increase in the aggregate

⁴Importantly, this assumption does not imply that the elasticity of substitution between imports and labor is one. For example, suppose that production is given by a Cobb Douglas function: $Y_f = V_f^{\alpha_1} L_f^{\alpha_2} Q_f^{(1-\alpha_1-\alpha_2)}$, where Y_f is output of firm f ; Q_f is a composite intermediate used by the firm; and the α_i are parameters between zero and one that satisfy $\alpha_1 + \alpha_2 < 1$. In this case, the elasticity of substitution between the composite input and labor is one. If the composite intermediate input is a function of domestic and imported intermediates (D_f and I_f), so $Q_f = g(D_f, I_f)$, the elasticity of substitution between labor and imported intermediates, could take on values greater than one. For example, if domestic and imported inputs are highly substitutable, the elasticity of substitution between labor and imported intermediates will also be high because the ratio of imported intermediates to labor will fall rapidly when the price of imports rises.

demand for labor. However, the aggregate demand for labor will only remain constant if the changes in relative wages ($\hat{w}_t - \hat{r}_{ft}$) are zero “on average,” i.e., log changes in wages (\hat{w}_t) in period t from their baseline value of w equal a firm-size weighted change in the average of log changes in cash flow ($\sum_f \frac{L_{ft}}{L} \hat{r}_{ft}$). The second line follows immediately from this equation and the fact that the amount of the specific factor is fixed, so the left-hand side of equation (4) is just $-\hat{L}_{ft}$.⁵

Proposition 1 is based on the structure of Jones (1975) but differs in a number of respects. First, Jones was concerned about a mapping from changes in product prices into factor prices. Here, we invert the logic in Jones to show that knowing the log changes in cash flow pins down changes in wages and employment. Second, by assuming that there is one elasticity of substitution between labor and the specific factor, we simplify the expressions in his canonical model and are able to construct a sufficient statistic for computing wage and employment changes using only information on changes in cash flow.⁶ Wages move one for one with the employment-weighted average of log changes in cash flow.⁷

As in Jones, the remaining propositions require that the share of expenditures on total intermediate inputs are a constant fraction of sales. We do this by defining $\omega_{L,f}$, $\omega_{V,f}$, and $\omega_{i,f}$ as the expenditures of firm f on labor, the specific factor, and input i expressed as a share of total revenue and assuming $\sum_i \omega_{ift} = \sum_i \omega_{ifs}$ for all s and t .⁸

We can also use the structure of our model to obtain mappings from cash-flow movements into many other variables of interest. Our starting point is the firm-level definition of the effective rate of protection (ERP):

$$\hat{p}_{ft}^e \equiv \frac{\hat{p}_{ft} - \sum_i \omega_{if} \hat{q}_{it}}{1 - \sum_i \omega_{ift}}. \quad (5)$$

The numerator in this definition is the change in the firm’s output prices, less a weighted average of all of the input prices, while the denominator is the share of value added in sales. While Jones (1975) was principally concerned with how movements in firm prices (and hence ERP) affect factor prices, a major limitation of his approach is that it is impossible to rigorously map *tariff changes* into ERP changes without making implausible assumptions.⁹

⁵We relax the assumption of a vertical labor supply curve in Appendix A.1.1. Allowing aggregate employment to move with changes in cash flow does not undermine the basic result that we can express equilibrium wage changes as a linear function of changes in cash flow.

⁶By contrast, implementing the Jones approach would require us to know the full set of firm-level elasticities. While the assumption of a single elasticity of substitution is more restrictive, other studies have often adopted even more restrictive assumptions, e.g., assuming that $\sigma = 1$ (c.f., Kovak (2013)). Knoblauch and Stöckl (2020) conduct a meta-analysis of 49 studies and find that the value of σ typically falls between 0.4 and 0.7.

⁷At first, it may seem surprising that wages rise one for one with average log changes in cash flow, however, this result is present in other models in which firms have positive operating profits. For example, in Melitz (2003), both per worker welfare and average firm profits are monotonically rising in average productivity.

⁸The assumption that $\sum_i \omega_{ift} = \sum_i \omega_{ifs}$ is standard whenever one wants to analyze a value-added production function and is common in the macro literature whenever TFP is defined as the residual from subtracting capital and labor input growth from output growth (see, for example, Hsieh and Klenow (2009)).

⁹Examples of common implausible assumptions include: firms use no intermediate inputs, perfect or

An advantage of our approach is that we can use movements in cash flow to conduct comparative statics exercises and measure a policy's impact on many variables, including ERP, without making any assumptions about how tariffs affect ERP. We proceed by first recalling a result from [Jones \(1975\)](#), who proved that the movement in the returns to each specific factor (i.e., changes in cash flow) can be written as

$$\hat{r}_{ft} = \left(\varphi_{ft} + \frac{1}{\theta_{Vft}} \sum_{f' \neq f} \varphi_{f't} \right) \hat{p}_{ft}^e - \frac{\theta_{Lft}}{\theta_{Vft}} \sum_{f' \neq f} \varphi_{f't} \hat{p}_{f't}^e \text{ and } \hat{w}_t = \sum_f \varphi_{ft} \hat{p}_{ft}^e, \quad (6)$$

where

$$\varphi_{ft} \equiv \frac{L_{ft}}{\theta_{Vft}} / \sum_{f'} \frac{L_{f't}}{\theta_{Vf't}},$$

θ_{Lft} and θ_{Vft} are the wage bill and cash flow expressed as a share of value added:

$$\theta_{Lft} \equiv \frac{\omega_{Lft}}{(1 - \sum_i \omega_{ift})}, \text{ and } \theta_{Vft} \equiv \frac{\omega_{Vft}}{(1 - \sum_i \omega_{ift})}. \quad (7)$$

The first term in equation (6) captures the direct link between a firm's change in cash-flow and its ERP. Intuitively, the shadow price of a firm's specific factor will rise if its ERP rises and fall if the ERPs of other firms rise because this causes them to bid up the wage. Two important properties of the mapping between ERP and factor prices, which we will use later, are that it is linear and homogeneous of degree 1, which means that factor prices will not change if the ERP does not change.

As we prove in the following proposition, movements in cash flow provide a sufficient statistic for the ERP.

Proposition 2. *The log change in the ERP for a firm (\hat{p}_{ft}^e) can be expressed as a linear function of the log changes in cash flows*

$$\hat{p}_{ft}^e = \theta_{Vf} \hat{r}_{ft} + \theta_{Lf} \sum_{f'} \frac{L_{f'}}{L} \hat{r}_{f't}$$

and is equivalent to the log change in its revenue total factor productivity

$$\widehat{TFPR}_{ft} \equiv \hat{p}_{ft} + \widehat{TFP}_{ft} = \hat{p}_{ft}^e,$$

where $\widehat{TFP}_{ft} \equiv \hat{y}_{ft} - \theta_{Lf} \hat{L}_{ft} - \theta_{Vf} \hat{V}_{ft}$ is the log change in the firm's total factor productivity. The log changes in revenue and markup for a firm can also be expressed as linear functions of the log changes in cash flows:

$$\hat{p}_{ft} + \hat{y}_{ft} = (\theta_{Lft} \sigma + \theta_{Vft}) \hat{r}_{ft} + \theta_{Lft} (1 - \sigma) \sum_{f'} \frac{L_{f't}}{L} \hat{r}_{f't}.$$

constant passthrough of tariffs into prices, no heterogeneity in firm-level input-output matrices, no effects of tariffs on exchange rates, no impact of tariffs on productivity, etc. For example, a common approach to measuring ERP is to follow [Corden \(1966\)](#) and define it as the change in the output tariff less an input-share weighted average of the input tariff changes all divided by the share of value added in sales. Despite the popularity of this approach, [Ethier \(1977\)](#) proves that the Corden tariff-based measure of ERP and the Jones price-based measure of ERP cannot be rigorously linked.

Proof. See Appendix A.2 □

Proposition 2 proves that the ERP is simply TFPR. The intuition for this result stems from the fact that cash flow equals the payments to the firm's specific factor, which implies that $\hat{p}_{ft}^e = \theta_{V_{ft}}\hat{r}_{ft} + \theta_{L_{ft}}\hat{w}_t$. The left-hand side will only be positive if aggregate payments to factors rise, which can only happen if a firm's revenue is growing faster than its costs, i.e., TFPR is rising.

Although we will not use these results empirically, if we had information on firm-level input-output linkages (ω_{ift}) and the changes in intermediate input prices of importers (\hat{q}_{ft}^*), we could recover movements in all prices (\hat{p}_{ft}), quantities (\hat{q}_{ft}^*), and TFPQ (\widehat{TFP}_{ft}) for all firms. We prove this in the following proposition:

Proposition 3. *The vectors of log changes in firm output prices (\hat{p}_t), output (\hat{y}_t), and TFP (\widehat{TFP}_t) can be expressed as linear functions of the vectors of log changes in cash flows (\hat{r}_t) and imported intermediate input prices (\hat{q}_t^*):*

$$\begin{aligned}\hat{p}_t &= \mathbf{A}_1\hat{r}_t + \mathbf{A}_2\hat{q}_t^* \\ \hat{y}_t &= \mathbf{A}_3\hat{r}_t - \mathbf{A}_2\hat{q}_t^* \\ \widehat{TFP}_t &= \mathbf{A}_4\hat{r}_t - \mathbf{A}_2\hat{q}_t^*,\end{aligned}$$

where the elements of matrices \mathbf{A}_1 , \mathbf{A}_2 , \mathbf{A}_3 , and \mathbf{A}_4 only depend on the baseline factor shares in revenue and value-added (ω_f, θ_f), shares of total employment (L_f/L), and the elasticity of substitution between labor and the specific factor (σ).

Proof. See Appendix A.3 □

These propositions demonstrate that a researcher with knowledge of how a policy change would affect cash flows (\hat{r}_t) can solve for a wide variety of equilibrium variables such as changes in wages, employment, sales, ERP, and TFPR. Thus, to the extent that stock returns covary with expected cash flows, we should expect real firm outcomes to covary with stock returns as Section 2.4 shows actually happens. Moreover, Proposition 3 tells us that if one also knew how intermediate input prices shifted in response to the policy, one could also solve the model for all price, quantity, and TFP changes as well. We build off these insights in the next sections, which show how to map movements in cash flows into welfare shifts and how to measure these cash flow movements using stock market data.

3.2 Welfare

In order to understand the welfare implications of a policy change, we assume there is a representative agent supplying the quantity of labor L and owning all firms indexed by f . The agent's nominal income in period t , I_t , is the sum of labor income, firm cash flows, and potential government transfers TR_t :

$$I_t = w_t L + \sum_f r_{ft} V_{ft} + TR_t.$$

The agent's real consumption, C_t , equals nominal income divided by the consumption price index. To simplify notation, and without loss of generality, we normalize this price index to equal one. Hence, the consumption of the representative agent is equal to its aggregate income, i.e., $C_t = I_t$. The last two equalities imply that the log deviation in consumption can be written as a weighted average of the log deviation in wages, factor prices, and government revenues:

$$\hat{C}_t = \frac{wL}{C} \hat{w}_t + \sum_f \frac{r_f V_f}{C} \hat{r}_{ft} + \frac{TR}{C} \hat{T}R_t. \quad (8)$$

The policy change can be thought of as affecting an infinite sequence of changes in wage, cash flow, and tariff revenue: \hat{w}_t , \hat{r}_t , and $\hat{T}R_t$ for t ranging between 0 and infinity. Because the policy affects prices at different time horizons and in different states of the world, $(\hat{C}_t)_{t=0}^\infty$ is a sequence of random variables. We define the "consumption-equivalent welfare effect" of this deviation, denoted \mathcal{C} , as the (fixed and deterministic) deviation in log consumption that would generate the same change in welfare as the (time-varying and stochastic) deviation in log consumption $(\hat{C}_t)_{t=0}^\infty$. In other words, the consumption-equivalent welfare effect is the log change in consumption (in every state and every period) that would compensate the agent for the effect of the policy.

To characterize this consumption-equivalent welfare effect, we assume that the representative agent has Epstein-Zin preferences. Formally, the value function of the agent is defined recursively as follows:

$$W_t = \left((1 - \beta) \frac{C_t^{1-1/\psi}}{1 - 1/\psi} + \beta \left(\text{E}_t [W_{t+1}^{1-\gamma}]^{\frac{1}{1-\gamma}} \right)^{1-1/\psi} \right)^{\frac{1}{1-1/\psi}}.$$

where β is the subjective discount factor (SDR); γ determines the agent's relative risk aversion (RRA); and ψ is the elasticity of intertemporal substitution (EIS). Finally, we assume that log consumption growth is i.i.d. on the baseline path.¹⁰ As shown in the proof of the proposition, this ensures that the ratio of consumption, C_t , to the present value of consumption, W_t , is constant along the baseline path.

Proposition 4. *The consumption-equivalent welfare effect of the deviation path $(\hat{C}_t)_{t=0}^\infty$ is*

$$\mathcal{C} = (1 - \rho) \sum_{t=0}^{\infty} \rho^t \text{E}_0 \left[\frac{C_t^{1-\gamma}}{\text{E}_0 [C_t^{1-\gamma}]} \hat{C}_t \right],$$

where $\rho \equiv 1 - C_t/W_t$ denotes the consumption-to-wealth ratio, which is constant in the baseline economy.

This proposition expresses the welfare effect as a time-discounted, weighted average of the deviations in consumption. The first set of weights, $(1 - \rho)\rho^t$, adjust for the agent's

¹⁰If this is not the case, the proposition below should be understood as a first-order approximation that is valid as long as the baseline path is close to this balanced growth path.

discounting over time (they sum to one across time) while the weights $\frac{C_t^{1-\gamma}}{\mathbb{E}_0[C_t^{1-\gamma}]}$ represent the agent's discounting of different states of nature (they sum up to one across states of nature in a given time period). This implies that positive deviations in log consumption are particularly important for welfare if they happen close to the current period or if they happen in states of nature in which $C_t^{1-\gamma}$ is particularly high (i.e. states in which consumption is low as long as $\gamma > 1$).

To better understand this formula, we can rewrite the consumption-equivalent welfare effect as the sum of two terms:

$$\mathcal{C} = \underbrace{(1 - \rho) \sum_{t=0}^{\infty} \rho^t \mathbb{E}_0 [\hat{C}_t]}_{\equiv \mathcal{C}^{\text{first-order}}} + \underbrace{(1 - \rho) \sum_{t=1}^{\infty} \rho^t \text{cov}_0 \left(\frac{C_t^{1-\gamma}}{\mathbb{E}_0 [C_t^{1-\gamma}]}, \hat{C}_t \right)}_{\equiv \mathcal{C}^{\text{higher-order}}}. \quad (9)$$

The first term, $\mathcal{C}^{\text{first-order}}$, corresponds to the weighted change in average log consumption. The second term, $\mathcal{C}^{\text{higher-order}}$, corresponds to the normalized covariance of $C_t^{1-\gamma}$ and changes in log consumption. This second term is null if $\gamma = 1$ or if deviations in log consumption are independent of the realization of consumption along the baseline path. The corollary below gives an equivalent expression for the second term.

Corollary 1. *The consumption-equivalent welfare effect of the deviation path $(\hat{C}_t)_{t=0}^{\infty}$ due to higher-order terms is:*

$$\begin{aligned} \mathcal{C}^{\text{higher-order}} &= \frac{1 - \gamma}{2} \sum_{t=1}^{\infty} (1 - \rho) \rho^t d(\text{Var}_0 \ln C_t) \\ &\quad + \frac{(1 - \gamma)^2}{3!} \sum_{t=1}^{\infty} (1 - \rho) \rho^t d(\text{Skewness}_t[\ln C_t] \cdot \text{Var}_0[\ln C_t]^{3/2}) \\ &\quad + \frac{(1 - \gamma)^3}{4!} \sum_{t=1}^{\infty} (1 - \rho) \rho^t d(\text{Excess Kurtosis}_0[\ln C_t] \cdot \text{Var}_0[\ln C_t]^2) \\ &\quad + \dots \end{aligned}$$

This corollary says that, while $\mathcal{C}^{\text{first-order}}$ captures the welfare effect of the policy through changes in average log consumption, $\mathcal{C}^{\text{higher-order}}$ captures its effect through changes in its higher-order cumulants, such as the variance, skewness, and kurtosis of log consumption. In particular, if $\gamma > 1$, the representative agent dislikes an increase in even cumulants (e.g. variance or kurtosis) but enjoys an increase in odd cumulants (e.g. skewness). The converse is true if $\gamma < 1$. In the rest of the paper, we will focus on the intermediate case of log utility $\gamma = 1$.

4 Estimating Consumption-Equivalent Welfare

The theory section provides a mapping from wage, cash-flow, and tariff changes in each period into aggregate welfare movements. In order to empirically implement this, we need to adapt the mappings that use unobservable infinite sequences of these variables

to mappings from variables that we can estimate—firm values and discount rates. We do this in three steps. In Section 4.1, we show how to map the present value of deviations in firm values and discount rates into the first-order impact on consumption-equivalent welfare (\mathcal{C}^{\log}). Sections 4.2 and 4.3 then show how to use asset-price movements to estimate the impact of a tariff-announcement on firm values and discount rates, respectively.

4.1 Linking Cash Flows and Firm Values and Discount Rates

We begin by decomposing the first-order welfare effect into how much is due to each source of household income. If we substitute equation (8) into equation (9), to obtain an expression for the first-order welfare effect in terms of the discounted value of policy induced changes in wages, cash-flows, and tariffs:

$$\begin{aligned}\mathcal{C}^{\text{first-order}} &= (1 - \rho) \sum_{t=0}^{\infty} \rho^t \mathbb{E}_0 [\hat{C}_t]. \\ &= (1 - \rho) \sum_{t=0}^{\infty} \rho^t \mathbb{E}_0 \left[\frac{wL}{C} \hat{w}_t + \sum_f \frac{r_f V_f}{C} \hat{r}_{ft} + \frac{TR}{C} \widehat{TR}_t \right].\end{aligned}$$

We now can use Proposition 1 to solve for the change in wages in terms of the change in firm cash flows. Substituting $\hat{w}_t = \sum_f \frac{L_f}{L} \hat{r}_{ft}$ into the previous equation and rearranging gives:

$$\mathcal{C}^{\text{first-order}} = \sum_f \frac{wL_f + r_f V_f}{C} \left((1 - \rho) \sum_{t=0}^{\infty} \rho^t \mathbb{E}_0 [\hat{r}_{ft}] \right) + \frac{TR}{C} \left((1 - \rho) \sum_{t=0}^{\infty} \rho^t \mathbb{E}_0 [\widehat{TR}_t] \right). \quad (10)$$

This equation expresses the first-order welfare effect as the sum of two terms: the present value of the deviation in (expected) firm cash flows and the present value of the deviation in tariff revenues.

The first term in equation (10) cannot be computed directly from cash flows because it requires us to know an infinite sequence of their movements, but we can show that it can be computed from movements in firm values and discount rates. Let Π_{ft} be the total valuation of firm f at time t (i.e., the market value of its equity plus its debt). The return of owning firm f between t and $t + 1$ is defined as:

$$R_{f,t+1} \equiv \frac{\Pi_{f,t+1}}{\Pi_{f,t} - r_{f,t} V_f}.$$

Assuming the no-bubble condition $\lim_{t \rightarrow \infty} R_f^{-1} \Pi_{ft} = 0$, we can express a firm's value as the discounted value of its future cash-flows.¹¹

$$\Pi_{f0} = \mathbb{E}_0 \left[\sum_{t=0}^{\infty} \frac{r_{ft} V_f}{R_{f1} \dots R_{ft}} \right]. \quad (11)$$

¹¹Indeed, the definition of returns gives $\Pi_{f0} = r_{f0} V_f + \frac{\Pi_{f1}}{R_{f1}} = r_{f0} V_f + \frac{r_{f1} V_f}{R_{f1}} + \frac{\Pi_{f2}}{R_{f1} R_{f2}}$. Iterating forward gives the result.

We can log-linearize this formula to express the deviation in firm value due to a policy announcement as the sum of two terms: a deviation in the present value of firm cash-flows and a deviation in the present value of firm discount rates:

Proposition 5. (*Campbell and Shiller (1988)*) *Around a baseline path in which the cash flow-to-firm value ratio, $r_{ft}V_f/\Pi_{ft}$ is equal to the constant consumption-to-wealth ratio, C_t/W_t , and we have:*

$$\hat{\Pi}_{f0} = (1 - \rho) \sum_{t=0}^{\infty} \rho^k \mathbb{E}_0 [\hat{r}_{ft}] - \sum_{t=1}^{\infty} \rho^t \mathbb{E}_0 [\hat{R}_{ft}].$$

This Proposition says that an increase in the value of a firm can reflect an increase in the expected future cash flows earned by firm owners or a decrease in the rate at which these future cash flows are discounted. We can solve for the present value of the deviation in firm cash flows—the first term on the right—in terms of the deviation in firm value ($\hat{\Pi}_{f0}$) plus the present value of the deviation in firm discount rates ($\sum_{t=1}^{\infty} \rho^t \mathbb{E}_0 [\hat{R}_{ft}]$). Combining this result with (10) allows us to write the aggregate welfare effect as a sum of three components:

$$c^{\text{first-order}} = \underbrace{\sum_f \frac{wL_f + r_f V_f}{C} \hat{\Pi}_{f0}}_{\text{Deviation in firm values}} + \underbrace{\sum_f \frac{wL_f + r_f V_f}{C} \left(\sum_{t=0}^{\infty} \rho^t \mathbb{E}_0 [\hat{R}_{ft}] \right)}_{\text{Deviation in firm discount rates}} + \underbrace{\frac{TR}{C} (1 - \rho) \sum_{t=0}^{\infty} \rho^t \mathbb{E}_0 [\widehat{TR}_t]}_{\text{Deviation in tariff revenues}}. \quad (12)$$

The first term is a weighted average of the log change in firm value due to the policy announcement. The second term is a weighted average of the change in firm discount rates at the time of the announcement, which accounts for the fact that only deviations in firm values due to deviations in cash flows (as opposed to deviations in discount rates) matter for welfare. The third term accounts for deviations in tariff revenues. We now provide details about how each term can be estimated.

4.2 Measuring the Deviation in Firm Values

The deviation in firm values is a weighted average of the change in each firm's value ($\hat{\Pi}_{f0}$), where the weights correspond to the value added generated by the firm ($wL_f + r_f V_f$) divided by baseline consumption (C). We estimate the change in the each firm's value due to announcement j as its log return on the first day the markets could trade the new information ("high-frequency identification"). There is a bias tradeoff in choosing the length of the window. On the one hand, a shorter window may lead to biased estimates if there is over- or under-reaction in the short run, if the tariff announcement leaks before its formal announcement, or if relevant information is released later. On the other hand, a longer window may lead to noisy estimates, as unrelated news is released over time.¹² As a robustness exercise, we also experiment with a three-day window, and we find that our results are qualitatively similar.

Formally, we identify the effect of tariff announcement j on the market value of equity of a firm f as the coefficient $\beta_{f,j}$ in the following regression:

¹²Another reason we use a relatively large one-day window is that some of our announcements happen outside market hours.

$$\ln R_{f,t} = \alpha_f + \sum_{j=1}^J \beta_{f,j} D_t^j + \sum_{d=1}^D \gamma_{f,d} ES_{d,t} + \epsilon_{f,t}. \quad (13)$$

where D_t^j is an indicator variable equal to one if day t is in the window of announcement j , and $ES_{d,t}$ corresponds to the surprise in the economic series d . We estimate this regression using all trading days between 2017 and 2019, separately for each firm f . We then construct the effect of announcement j on the overall market value of firm f as

$$\hat{\Pi}_{f0} \equiv \sum_{j=1}^J \kappa_f \beta_{f,j} \quad (14)$$

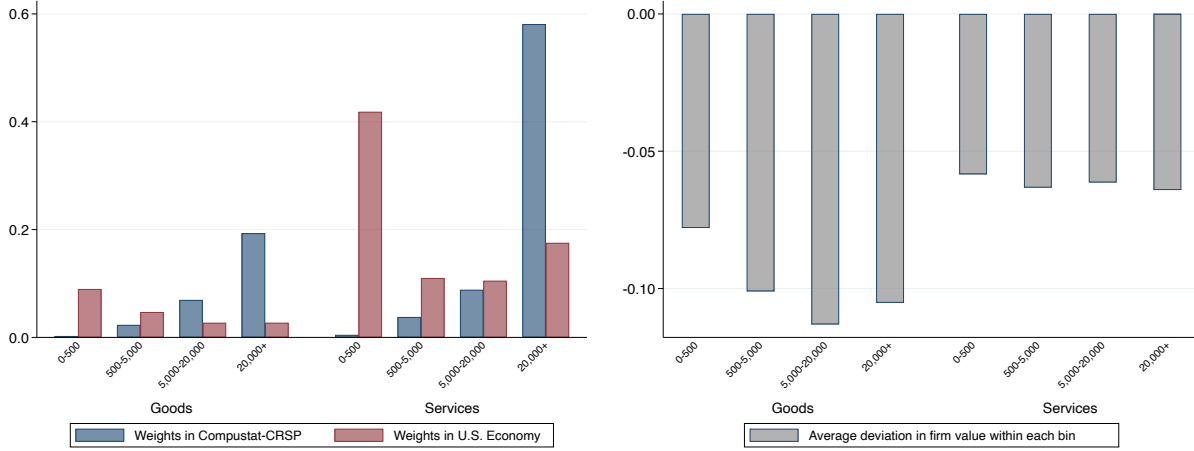
where κ_f denotes the ratio of firm f 's market value of equity to its market value of assets. This leverage adjustment reflects the fact that the overall market value of a firm is the sum of the value of its debt and the value of its equity. Under the assumption that firm debt is risk-free and has zero maturity, its value does not react to the announcement, and so we obtain the formula above.

Aggregation We compute the aggregate deviation in firm values (the first term in equation 12) by taking a weighted average of the $\hat{\Pi}_{f0}$ in which the weights are $(wL_f + r_f V_f) / C$. One problem in constructing these weights is that our Compustat-CRSP sample is only composed of public firms, which is not representative of the overall economy. In particular, our sample tends to underweight small firms and service-sector firms, so we need to weight firms in our sample to approximate the distribution of employment size and sectors in the U.S. economy. Unfortunately, we only observe value-added as a share of consumption (the weight for the first two terms in equation 12) at the sector level, so we can only weight returns by employment after we've aggregated all the firms into industries. We therefore weight the data in four steps. First, we divide the set of firms in Compustat into 18 sectors (that are indexed by s and defined by their 2-digit NAICS codes) and four employment bins (indexed by b and defined by three employment thresholds: 500 and below, 501-5,000, 5,001-20,000, and over 20,000). We then form a weighted average using firm employment as weights to compute the average deviation in firm values ($\hat{\Pi}_{f0}^j$) for all firms in an employment bin-sector-event, i.e., a $\{b, s, j\}$ -tuple. Second, we then sum across events (j) to obtain the cumulative effect of tariff announcements within each "cell," which we define to be bin-sector, i.e., a $\{b, s\}$ tuple. Third, we construct the weighted average of these deviations across all employment bins (b) using the share of U.S. employment in each bin-sector cell as weights to compute aggregate returns at the sector level (s). Fourth, we aggregate across sectors using U.S. value-added produced by the sector in 2017 (using data from the Census Bureau and the BEA, respectively) divided by C , which we define to be total U.S. value added plus tariff revenue. We describe this methodology in more detail in Appendix D.

The left panel in Figure 7 compares our constructed weights with the relative employment share of cells within the CRSP-Compustat sample. One can see our weighting procedure weights small firms and services more than the CRSP-Compustat sample. The right panel of Figure 7 plots the average deviation in firm values within these cells. One can see that the drops in asset values tend to be smaller, in magnitude, for smaller and

service firms relative to other firms, which is consistent with the fact that these firms tend to be less exposed to trade. Combining these two figures implies that our weighting procedure will tend to decrease the magnitude of the deviation in firm values relative to the value-weighted CRSP-Compustat return.

Figure 7: Weights and changes in firm value by sector and employment bins



Note: For goods (2-digit NAICS: 11, 21, and 31-33) and services (remaining 2-digit NAICS) sectors in 2017.

We find that tariff announcements caused aggregate firm values to fall by 6.5 percent (see Table 8). This drop is just over half the decline in the aggregate stock market return reported in Table 1. The difference in the two numbers is due to the combination of two effects: first, as we can see from equation (14), firms with more leverage have larger drops in market equity than in firm value. As a result, the implied fall in firm value is smaller than the drop in equity prices. Second, smaller and service-sector firms tend to have lower drops in asset values in magnitude, and so our weighting procedure tends to dampen the overall effect of announcements on asset values (Figure 7). We explore the robustness of our results to changes in the event window and in the weighting methodology in Section 5.2.

4.3 Measuring Deviations in Firm Discount Rates

We now turn to the estimation of the deviation in firm discount rates, which corresponds to the second term in the deviation in aggregate welfare in Equation (12). The challenge in computing this term is in obtaining an expression for the change in discount rates induced by the policy ($\sum_{t=0}^{\infty} \rho^t E_0 [\hat{R}_{ft}]$). Intuitively, adjusting the change in firm values by the change in their discount rates will allow us to infer the change in their expected cashflows. By definition, the deviation in the discount rate of firm f (\hat{R}_{ft}) corresponds to a weighted average of the deviation of the interest rate on its debt (\hat{R}_{ft}^D) and the deviation in the expected return of its equity (\hat{R}_{ft}^E):

$$E_0 [\hat{R}_{ft}] = (1 - \kappa_f) E_0 [\hat{R}_{f,t}^D] + \kappa_f E_0 [\hat{R}_{f,t}^E], \quad (15)$$

where κ_f denotes the ratio of the market value of equity to the market value of assets for firm f . To make progress, we make the simplifying assumption that the interest rate on a firm's debt is equal to the risk-free rate and that the expected return on its equity is equal to the risk-free rate plus an adjustment for the firm equity exposure to the stock market (beta) multiplied by the expected return of the aggregate stock market return, as per the Capital Asset Pricing Model (CAPM):

$$\begin{aligned} \mathbb{E}_0 \left[\hat{R}_{f,t}^D \right] &= \hat{R}_{\text{risk-free},t}, \\ \mathbb{E}_0 \left[\hat{R}_{f,t}^E \right] &= \hat{R}_{\text{risk-free},t} + \beta_{f,M} \left(\hat{R}_{M,t} - \hat{R}_{\text{risk-free},t} \right) \end{aligned} \quad (16)$$

where $\beta_{f,M}$ can be estimated as the slope coefficient in a regression of excess firm-level returns on the excess returns of the stock market. We will relax these assumptions to account for credit spreads and additional equity factors below. Substituting these two equations into (15) and aggregating over time gives the following expression for the deviation in firm f discount rate:

$$\underbrace{\sum_{t=1}^{\infty} \rho^t \mathbb{E}_0 \left[\hat{R}_{ft} \right]}_{\text{Deviation in firm } f \text{ discount rate}} = \underbrace{\sum_{t=1}^{\infty} \rho^t \mathbb{E}_0 \left[\hat{R}_{\text{risk-free},t} \right]}_{\text{Deviation in future risk-free rates}} + \kappa_f \beta_{f,M} \underbrace{\sum_{t=1}^{\infty} \rho^t \mathbb{E}_0 \left[\hat{R}_{M,t} - \hat{R}_{\text{risk-free},t} \right]}_{\text{Deviation in future excess returns}}. \quad (17)$$

This equation makes clear that the deviation in firm f discount rate is the sum of the deviation in future risk-free rates and the deviation in future excess stock-market returns multiplied by two firm specific quantities: its equity-to-asset ratio (κ_f) and its equity-market beta ($\beta_{f,M}$), which captures the firm's overall exposure to changes in equity premia. Overall, this equation reduces the problem of estimating firm-specific deviations in discount rates to the estimation of two aggregate quantities: the deviation in future risk-free rates and the deviation in future excess stock market returns.

We adapt the vector-autoregression (VAR) methodology of [Campbell and Vuolteenaho \(2004\)](#) and [Bernanke and Kuttner \(2005\)](#) to measure these two quantities. More precisely, we assume that a vector of asset prices \mathbf{x}_t , which includes the log risk-free rate and the log excess stock market return as its first two elements, evolves according to a VAR process:

$$\mathbf{x}_{t+1} = \mathbf{a} + \mathbf{B}\mathbf{x}_t + \mathbf{u}_{t+1}. \quad (18)$$

This VAR structure allows us to express the expected effect of a policy announcement on \mathbf{x}_t in terms of its effect on \mathbf{x}_0 : $\mathbb{E}_0[d\mathbf{x}_t] = \mathbf{B}^t d\mathbf{x}_0$. Hence, the VAR structure implies the following equation for the deviation in future risk-free rates and excess returns defined in (17):¹³

¹³Indeed, the deviation in future risk-free rates is

$$\sum_{t=1}^{\infty} \rho^t \mathbb{E}_0 \left[\hat{R}_{\text{risk-free},t} \right] = \sum_{t=1}^{\infty} \rho^t \left(e_1' \mathbb{E}_0 [d\mathbf{x}_t] \right) = \sum_{t=1}^{\infty} \rho^t \left(e_1' \mathbf{B}^t d\mathbf{x}_0 \right) = e_1' \left(\sum_{t=1}^{\infty} (\rho \mathbf{B})^t \right) d\mathbf{x}_0 = e_1' \rho \mathbf{B} (\mathbf{I} - \rho \mathbf{B})^{-1} d\mathbf{x}_0.$$

A similar derivation holds for the deviation in future excess stock market returns .

$$\underbrace{\sum_{t=1}^{\infty} \rho^t \mathbb{E}_0 \left[\hat{R}_{\text{risk-free},t} \right]}_{\text{Deviation in future risk-free rates}} = e'_1 \rho \mathbf{B} (\mathbf{I} - \rho \mathbf{B})^{-1} d\mathbf{x}_0, \quad (19)$$

$$\underbrace{\sum_{t=1}^{\infty} \rho^t \mathbb{E}_0 \left[\hat{R}_{M,t} - \hat{R}_{\text{risk-free},t} \right]}_{\text{Deviation in future excess returns}} = e'_2 \rho \mathbf{B} (\mathbf{I} - \rho \mathbf{B})^{-1} d\mathbf{x}_0, \quad (20)$$

where e_i denotes a vector whose i -th element equals one, and zero otherwise. Hence, the problem of estimating the deviation in firm discount rates (the left-hand-side in (17)) is reduced to the problem of estimating two aggregate quantities: the matrix \mathbf{B} , which governs the law of motion of variables in the VAR, and the vector $d\mathbf{x}_0$, which measures the effect of the announcement on the variables in the VAR. We now turn to the estimation of these two quantities.

VAR Estimation We now briefly discuss our VAR estimation (see Appendix E.2 for more details). For our baseline results, we consider a system (18) at the quarterly frequency where the vector \mathbf{x}_t contains seven variables:

$$\mathbf{x}_t = \left(\ln R_{\text{risk-free},t}, \ln R_{M,t} - \ln R_{\text{risk-free},t}, \text{TS}_t, \text{EPB}_t, \text{VS}_t, \text{CS}_t, \ln PD_t \right).$$

Our choice of frequency and variables is similar to the original paper by [Campbell and Vuolteenaho \(2004\)](#). We opt for a quarterly frequency (even though our data is available at the daily frequency) as we are interested in measuring the long-term impacts of changes in the vector \mathbf{x}_0 on future risk-free rates and excess stock market returns. The first variable in the VAR is the log real risk-free rate in the quarter (annualized yield of 3-month T-Bills minus smoothed average of inflation in the previous twelve months, divided by four). The second variable is the log excess stock market return in the quarter (the log value-weighted stock market return minus the annualized yield of 3-month T-Bill). The remaining variables are the term spread TS (the difference in the yield-to-maturity of ten-year treasuries and the annualized yield of 3-month T-Bills), the equity premium bound EPB (discussed in the previous section), the value spread VS (the log difference in the book to market value equity of value minus growth firms), the credit spread CS (the difference in the yield of BAA and 3-month T-bill), and the log price-dividend ratio $\ln PD$ (the ratio between the value of the stock market and the dividends distributed in the previous year). One key difference, relative to [Campbell and Vuolteenaho \(2004\)](#), is that we augment the VAR with the equity premium bound defined by [Martin \(2017\)](#), which is available starting from 1996. We will examine the robustness of our results with respect to changing the set of variables in the VAR below.

We first estimate the VAR matrix \mathbf{B} by regressing each variable in the VAR on a constant term as well as the quarterly lagged variables in the VAR. To get more power, we estimate our VAR on all trading days instead of only the days at the end of every quarter.¹⁴

¹⁴This is similar to what [Martin \(2017\)](#) does to assess the predictability power of the equity premium bound on quarterly excess returns.

Table 5 reports the result of this estimation. Consistent with the literature, we find that the log price-dividend ratio and the equity premium bound are two important predictors of log excess returns. The R^2 of this regression is approximately 12 percent (at a quarterly horizon) which is high relative to the existing literature, suggesting that our VAR captures a large amount of excess return predictability. We then estimate the unexpected change

Table 5: VAR Matrix B

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	F.log $R_{\text{risk-free}}$	F.log R_{EM}	F.TS	F.EPB	F.VS	F.CS	F.log PD
log $R_{\text{risk-free}}$	0.917*** (0.05)	-0.526 (1.71)	0.075 (0.10)	-0.114 (0.56)	-2.517 (2.36)	-0.022 (0.03)	1.773 (1.80)
log R_{EM}	-0.004 (0.00)	0.176** (0.08)	0.007 (0.01)	-0.022 (0.03)	-0.177 (0.13)	-0.001 (0.00)	0.180** (0.08)
TS	0.038 (0.05)	2.554* (1.54)	0.485*** (0.12)	0.218 (0.34)	0.675 (2.69)	-0.068** (0.03)	4.744*** (1.55)
EPB	0.003 (0.01)	0.794*** (0.30)	0.012 (0.02)	0.574*** (0.07)	0.095 (0.41)	0.000 (0.00)	1.117*** (0.29)
VS	-0.001 (0.00)	0.036 (0.03)	-0.003 (0.00)	0.001 (0.01)	0.930*** (0.05)	-0.001 (0.00)	0.092*** (0.03)
CS	-0.194 (0.15)	-12.704** (5.64)	1.419*** (0.44)	-0.059 (1.35)	-9.455 (9.25)	1.124*** (0.11)	-19.043*** (5.71)
log PD	-0.003** (0.00)	-0.163*** (0.05)	0.005 (0.00)	0.015 (0.01)	0.002 (0.07)	0.001* (0.00)	0.795*** (0.05)
R^2	0.83	0.12	0.84	0.37	0.89	0.87	0.84
N	6,545	6,545	6,545	6,545	6,482	6,545	6,545

Note: The table reports the result of estimating the regression (18), using daily variables to get more identification. That is, we estimate the VAR specification: $\mathbf{x}_{s+63} = \mathbf{a} + \mathbf{B}\mathbf{x}_s + \mathbf{u}_{s+63}$ where s denotes a day (note that 63 corresponds to average number of trading days in a quarter). The sample is all trading days between 1996 and 2022. Standard errors are estimated using Newey-West robust standard errors with a bandwidth of 63 to account for overlapping observations.

of the VAR variables due to tariff announcements, $d\mathbf{x}_0$. Similar to our procedure used to estimate the deviation in firm values, we estimate $d\mathbf{x}_0$ as the sum of daily changes in the vector \mathbf{x}_t over all announcement days after controlling for the release of macroeconomic surprises; that is, as the sum of β_j in the regression

$$\Delta \mathbf{x}_s = \boldsymbol{\alpha} + \sum_{j=1}^J \beta_j D_s^j + \sum_{d=1}^D \gamma_d ES_{d,s} + \boldsymbol{\epsilon}_s, \quad (21)$$

where D_t^j is an indicator variable equal to one if day t is in the window of announcement j , and $ES_{d,t}$ corresponds to the surprise in the economic series d . Table 6 reports the results of the estimation. As discussed in Section 2, the stock market drops around the announcement days, the risk-free rate decreases, slightly at the 3-month horizon and more strongly at the 10-year horizon, while the equity premium increases. Moreover, the value spread also increases; that is, the value of the equity of growth firms (firms with

low book-to-market ratio) drops more than the value of equity of value firms (firms with high book-to-market ratio). This is consistent with the idea that growth firms tend to have cash flows with a longer maturity than value firms, and, therefore, are more sensitive to changes in discount rates.

Table 6: Cumulative Effect of Trade War Announcements on the VAR Components dx_0

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	$\log R_{\text{risk-free}}$	$\log R_{EM}$	TS	EPB	VS	CS	$\log PD$
Event	-0.000**	-0.125***	-0.005***	0.046***	0.092***	-0.001***	-0.127***
	(0.000)	(0.040)	(0.001)	(0.013)	(0.030)	(0.000)	(0.039)
N	753	754	753	753	753	753	753

Note: The table reports the sum of β_j in the regression (21). The sample includes all trading days from 2017 to 2019. Robust standard errors in parentheses.

Table 7 combines the estimates for B (Table 5) and the estimate for dx_0 (Table 6) to compute the deviation in future risk-free rates and future excess stock market returns following equations (19) and (20). We find that the deviation in future risk-free rates due to tariffs announcements is approximately -2.1 percentage points while the deviation in future excess stock returns is approximately 8.9 percentage points. These estimates imply that the overall change in discount rates for the aggregate stock market return is 6.8 percentage points ($= -2.1 + 8.9$). Put differently, changes in discount rates account for approximately half of the decline in the aggregate stock market returns around tariffs announcements.

Table 7: Estimated Changes in Future Discount Rates

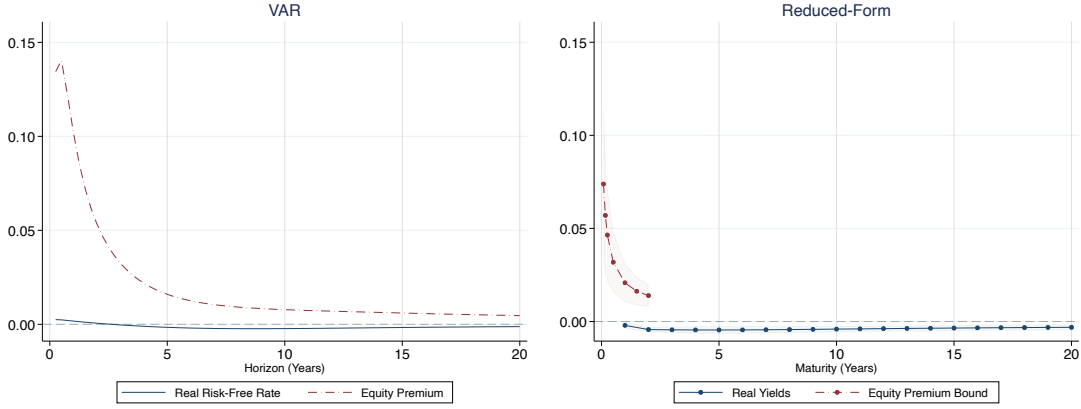
	Deviation in Future Risk-free Rates	Deviation in Future Excess Returns
	$\sum_{t=1}^{\infty} \rho^t E_0 [\hat{R}_{\text{risk-free},t}]$	$\sum_{t=1}^{\infty} \rho^t E_0 [\hat{R}_{M,t} - \hat{R}_{\text{risk-free},t}]$
Baseline	-0.021	0.089

Note: The table reports the deviation in risk-free rate, $e_1' \rho B (I - \rho B)^{-1} dx_0$, and the deviation in the equity premium, $e_2' \rho B (I - \rho B)^{-1} dx_0$. Note that the matrix B is reported in Table 5 while the vector dx_0 is reported in Table 6. We use $\rho = 0.975^{1/4}$ which corresponds to an annualized consumption-to-wealth ratio of $1 - 0.975 = 2.5\%$, to match the average dividend yield of the overall stock market between 2017 and 2019.

We check the plausibility of the estimates coming from the VAR by comparing the VAR's estimates for movements in the real risk-free rate and equity premium with observed movements in these variables. The left-panel of Figure 8 plots the change in the average (real) risk-free rate and the excess stock-market return predicted by the VAR as a function of time. The right-panel of Figure 8 reproduces the change in the term structure of real Treasury yields and in the equity premium bound around announcement days obtained in the previous section. Despite the slight difference between these two objects, these two figures give very consistent results on the evolution of discount rates following tariffs announcements: the real risk-free rate decreases, especially at longer horizons,

while the expected excess stock market returns sharply increases, especially at short horizons. Thus, the VAR seems to sensibly predict movements in these variables.¹⁵

Figure 8: Effect of Announcements on Discount Rates: VAR versus Reduced-Form



Note: The figure in the left-panel plots the effect of tariffs announcements on the annualized (real) risk-free rate and excess stock market return between 0 and t ; that is, $(4/T) \sum_{t=1}^T E_0[\hat{R}_{\text{risk-free},t}] = (4/T) \sum_{t=1}^T e_1' B^t dx_0$ and $(4/T) \sum_{t=1}^T E_0[\hat{R}_{M,t} - \hat{R}_{\text{risk-free},t}] = (4/T) \sum_{t=1}^T e_2' B^t dx_0$. The right panel plots the effect of tariff announcements on the yield to maturity of TIPS as well as on the equity premium bounds across different maturities, as defined by [Martin \(2017\)](#) (the right panel was reported earlier in Figure 6).

Aggregation We then aggregate these firm-level deviation in discount rates using the same weighting scheme as the one used for the deviation in firm values; that is, we reweight firms based on their employment level and industry to approximate the composition of firms in the U.S. economy.

4.4 Measuring the Deviation in Tariff Revenues

The last term for the welfare effect of the policy is the deviation in tariff revenues. In order to avoid introducing additional estimates into the procedure, we opt to bound the impact of tariff revenues on our estimation. We have yearly U.S. tariffs rates at the product h (HS10) and country c (exported to the U.S.). Let Ω_{py}^{US} be the set of countries that export product h to the U.S. in year y and Ω_y^{US} the set of products that the U.S. imports in year y . The percent change in tariff revenue for year \widehat{TR}_y relative to the baseline of 2017 is the sum of the product of the total import value and the tariff rate:

$$\widehat{TR}_y = (TR_{2017})^{-1} \sum_{h \in \Omega_y^{US}} \sum_{c \in \Omega_{hy}^{US}} \text{Tariff Rate}_{yhc} \times \text{Import Value}_{yhc} - 1.$$

¹⁵Relatedly, [Knox and Vissing-Jorgensen \(2022\)](#) propose to only use the reduced-form changes in the yields of Treasuries and in the equity premium bound to back out discount rates. The downside of that methodology is that the equity premium bound is only a lower bound on the “true” equity premium and that it is only available up to a three year maturity. Our VAR methodology solves these two issues at the cost of assuming more structure on the evolution of the economy.

We can construct the upper bound for how much revenue will be generated by an increase in tariffs by assuming that higher tariffs have no impact on import values. In this case we can set future import values equal to their 2017 values. Similarly, the lower bound for the amount of revenue raised by a tariff is zero if all tariff increases result in prohibitive tariffs that cause import values to fall to zero. In this case, $\widehat{TR}_y = -1$. In order to be conservative and estimate the smallest possible decline in welfare, we focus on the the upper bound for the increase in tariff revenues but note that because TR/C in equation (12) is small, there is little scope for different assumptions about the movement in tariff revenues to affect the results.

5 Results on Aggregate Welfare

We now compute the aggregate welfare effect of the tariff announcements, which is the sum of the three components in equation (12) described above, across all announcement days: the deviation in firm values, the deviation in firm discount rates, and the deviation in tariff revenues.

5.1 Baseline Results

We report the impact of the tariff announcements on welfare in Table 8. In our baseline specification, we find that the deviation in firm value is -6.7% while the deviation in firm future discount rates is approximately 3.1% ; as a result, the implied deviation in firm future cash-flows is $-6.7\% + 3.1\% = -3.6\%$. Combined with the fact that the maximum increase welfare due to higher tariff revenues is 0.6% , we find that the overall welfare effect of tariff announcements is -3.0% .

5.2 Robustness

We now assess the robustness of our baseline estimates along a number of dimensions. The results of these robustness checks are reported as additional rows in Table 8.

Firm sample We first explore the robustness of our results with respect to the sample of firms. We first show that our estimates remain the same if we restrict ourselves to a balanced sample by removing all firms with missing returns between 2017 and 2019, which removes approximately 10 percent of the firms. We also show that our estimates remain the same if we remove firms with firm specific announcements during the same window as one of our tariff announcements (as reported in Capital IQ).

Firm weights As explained above, to compute the aggregate welfare effect of tariffs announcements, it is essential to weight firms in the Compustat-CRSP sample to approximate the distribution of employment and sectors in the U.S. economy. We now explore the robustness of our results with respect to this weighting scheme by using three alternative procedures.

First, we use finer employment bins within each sector (defined by employment thresholds of 500, 750, 1000, 1500, 2000, 2500, 5000, 10000, 20000). To deal with the fact that this leads to sparsely populated cells, we regress deviations in firm values and discount rates on log employment and log employment squared within each sector and announcement. We then use the predicted values from these regressions to fill out deviations within

Table 8: Welfare Effect

	Components			Welfare
	Firm Value	Firm Discount Rate	Tariff Revenues	$\mathcal{C}^{\text{first-order}}$
Baseline	-0.067	0.031	0.006	-0.030
<i>Robustness w.r.t. firm sample</i>				
Enforcing balanced panel	-0.072	0.038	0.006	-0.028
Removing firm specific announcements	-0.068	0.031	0.006	-0.031
<i>Robustness w.r.t. firm weights</i>				
Finer employment grid	-0.061	0.032	0.006	-0.023
No effect on financial firms	-0.063	0.030	0.006	-0.026
No effect on firms below 500 employees	-0.035	0.016	0.006	-0.013
<i>Robustness w.r.t. announcement window</i>				
3-day window	-0.057	0.046	0.006	-0.005
<i>Robustness w.r.t. VAR variables</i>				
Without TS	-0.067	0.035	0.006	-0.025
Without EPB	-0.067	0.035	0.006	-0.025
Without VS	-0.067	0.047	0.006	-0.013
Without CS	-0.067	0.041	0.006	-0.020
Without log PD	-0.067	0.004	0.006	-0.056
<i>Robustness w.r.t. discount rate model</i>				
3-FFM instead of CAPM	-0.067	0.042	0.006	-0.019
Corp yields instead of risk-free rate	-0.067	0.032	0.006	-0.028

Note: The table reports the first-order welfare effect of trade announcements, $\mathcal{C}^{\text{first-order}}$, as well as its three components defined in equation (12): the aggregate deviation in firm values, the aggregate deviation in firm discount rates, and the effect on tariff revenues.

each cell. We find that this alternative methodology tends to find a slightly less negative drop in firm value, and, therefore, on welfare. We describe this alternative methodology in more details in Appendix D.

Second, we estimate the welfare effect assuming that firms in the financial sector are unaffected by tariffs. This robustness exercise is motivated by two reasons: first, it reflects the fact that our model more naturally applies to nonfinancial firms, and, second, adding the deviation in financial firms may lead to a double counting, as these firms own claims on non-financial firms. Assuming tariffs have no impact on financial firms hardly affects the results.

Finally, we compute the welfare effect under the drastic assumption that there is no effect of tariff announcements on firms below 500 employees (that is, we assume that the deviation in firm values and discount rates is zero for all firms below this threshold). Despite this assumption, we still find a sizable welfare effect equal to -1.3% .

Announcement window In the baseline results, we estimated firm deviation in firm values and discount rates using the daily change in asset prices around each tariff announcement. As a robustness check, we now explore using a longer three-day window. This alternative procedure affects both the estimates for the deviation in firm value (as firm returns around announcement days differ when using a three-day window) but also the deviation in firm discount rates (as the effect of announcements on the VAR variables differ when using a three-day window). We find a smaller drop in firm value and a larger increase in discount rates, which implies a smaller magnitude for the welfare effect of tariff announcements. Nevertheless, the overall impact remains large compared to conventional analyses.

VAR variables To estimate firm level discount rates, we have specified a VAR with a set of variables that is very similar to the existing literature. Still, it is useful to check that our results are qualitatively not dependent on the exact choice of variables in the VAR. Hence, as a robustness check, we re-estimate the VAR after removing successively each one of the components of the vector x_t . We report the results for the deviation in future risk-free rates and future excess stock market returns in Appendix Table E.4 and the resulting numbers for the welfare effect in Table 8. Overall, we find similar changes in discount rates after successively removing each variable from the VAR.

Model for firm discount rates In the baseline results, we made the simplifying assumption that the interest rate paid on firm debt was the same as the risk-free rate and that the discount rate on firm equity was given by its beta exposure to the stock market times the expected excess return on the market (CAPM). As a robustness check, we now sequentially relax these two assumptions.

First, we use the Fama-French 3-factor model instead of the CAPM model to estimate the discount rate on firm equity. This effectively allows the discount rate of a firm equity to depend not only on its exposure to the stock market (as in the CAPM model) but also on its size and market-to-book equity characteristics. More precisely, we replace the second equation in (16) by

$$\begin{aligned} E_0 [\hat{R}_{ft}^E] &= E_0 [\hat{R}_{\text{risk-free},t}] + \beta_{EM,f} E_0 [\hat{R}_{M,t} - \hat{R}_{\text{risk-free},t}] \\ &\quad + \beta_{SMB,f} E_0 [\hat{R}_{SMB,t}] + \beta_{HML,f} E_0 [\hat{R}_{HML,t}], \end{aligned}$$

where *SMB* denotes the portfolio of small minus big firms while *HML* denotes the portfolio of high minus low book to market equity. We then use a VAR that includes the return of SMB and HML portfolios to back out the change in the discount rates of these two portfolios. As reported in Appendix Table E.4, we find that tariffs announcements increase the expected returns of SMB; that is, it increases the discount rate of small firms relative to big firms.

This implies that, relative to the CAPM, our Fama-French 3-factor model returns an estimate for firm level discount rates that is higher for small firms (firms with $\beta_{SMB,f} > 0$) and lower for big firms (firms with $\beta_{SMB,f} < 0$). These changes would average out if we were doing a value-weighted average of firms in our sample. However, because we overweight smaller firms, this leads to a lower aggregate deviation in firm discount rates by 1.1 percentage points. As a result, the overall decline in welfare is mechanically reduced by 1.1 percentage points.

Second, we assume that the interest rate paid on firm debt is equal to the yields on *BAA* bonds rather than the risk-free rate on debt; that is, we replace the first equation in (16) by

$$E_0 [\hat{R}_{ft}^D] = E_0 [\hat{R}_{\text{risk-free},t}] + E_0 [CS_t],$$

where CS_t denotes the credit spread (the difference between the yield on *BAA* bonds and the risk-free rate). In term of methodology, this simply means that we need to augment our measure of the deviation in future risk-free rates by the deviation in future credit spread, as estimated by the VAR. As reported in Table 8, we find that our measure of welfare remains substantially the same; that is, our VAR estimates relatively little deviation in credit spread following announcement shocks.

5.3 Treatment Effects

An important finding in this paper is that firms that were not directly exposed to China also experienced substantial declines in the expected present discounted value of cash flow. We know from Figure 5 that the returns of exposed firms were lower than those of unexposed firms, but we explore whether we can identify a similar effect when we look at cash flows. We continue to measure a firm's cash flow by using Proposition 5 and define cash-flow of a firm (CF_{ft}) to be the first term on the right-hand side of the equation in the proposition. We can obtain a sense of how important the impact of the trade war is on firms in general vs. the differential impact of tariffs on "exposed" vs. "unexposed" firms by comparing our estimates to a "naive" difference-in-difference estimate that would only take into account the differential deviation in firm values and discount rates between firms exposed to China and the rest. We find that the treatment effect accounts for less than a third of the total effect.

Event Study To estimate the size of the treatment effect, we use an event study, where we project firm-level deviations in cash-flow on a set of our three firm-level characteristics associated with China exposure (importer dummy, exporter dummy, as well Chinese revenue shares), allowing for different coefficients for each announcement day and each exposure type.

$$CF_{ft} \equiv \sum_{t=0}^{\infty} (1 - \rho) \rho^k E_0 [\hat{r}_{ft}] = \alpha_t + \sum_j \sum_i \gamma_{ij} Z_{if} D_{jt} + \epsilon_{ft}, \quad (22)$$

where the left-hand side variable is the expected present discounted value of firm cash flow which can be measured using Proposition 5, which is estimated using the method described in Sections 4.2 and 4.3; α_t is a day fixed effect; D_{jt} is a dummy variable that is one if day t is the same as announcement day j ; $Z_{if} \in \{\text{Importer, Exporter, China Revenue Share}\}$ is a measure of firm f 's exposure to China; γ_{ij} is parameter to be estimated; and ϵ_{ft} is an iid error term.

Table 9 presents the results for each of the six U.S. tariff events, and Table 10 presents the estimated coefficients from the same regression for the five Chinese tariff retaliation events. The estimated coefficients under each event date correspond to the $\hat{\gamma}_{ij}$ in equation (22). Thus, columns 2-7 of both tables are estimated jointly in one regression. The coefficients should be interpreted as the effect of the announcement on the expected cash flows of exposed firms relative to unexposed firms. For example, the coefficient of -0.22 on the China importer dummy in column 3 of Table 9 implies that on the March 1, 2018 steel and aluminum announcement day, firms that imported from China experienced declines in their expected cash flows that were on average 0.22 percentage points lower than other firms. The numbers in column 1 provide our estimate of the cumulative impact over all U.S. events and all days in the event windows ($\sum_j \hat{\gamma}_{ij}$). We can see from the first column of this table that the cumulative impact of the U.S. announcements was to lower the expected cash flows of U.S. importers by 2.03 percentage points relative to firms that did not import from China. Similarly, the relative fall in expected cash flows of exporters were 1.06 percentage points more than those of non-exporters, and firm's selling in China saw their expected cash flows fall by 0.070 percentage point for every percentage point of revenue they obtained from China. The coefficient on China Revenue Share implies that a firm with the average sales exposure to China (four percent of revenue) experienced a fall in expected cash flow of 0.28 percentage points lower than a firm with no sales in China across all of the U.S. events.

The cumulative impact of the events, shown in the first column of table 9, indicates that in general U.S. tariff announcements had large, negative, and significant impacts on the cash flows of importers, exporters, and firms selling in China. Although the effects are not precisely measured for every event and measure of exposure, 16 of the 18 event-day coefficients are negative, which indicates that U.S. tariff announcements typically had negative effects on the expected cash flows of firms exposed to China relative to unexposed firms. When we sum across all events, the cumulative effect is negative and significant for each type of exposure. Interestingly, U.S. tariff announcements caused negative impacts on expected cash flows not only for importing firms but also for firms exporting or selling in China more generally. These negative coefficients on the exporter

or sales variables are likely due to three (not mutually exclusive) reasons. The first is that exporters may have anticipated that U.S. tariffs would provoke Chinese retaliatory tariffs, thereby lowering the abnormal return of exporters. Second, market participants may have anticipated that U.S. tariffs would also provoke Chinese retaliatory non-tariff barriers that could lower revenues obtained either by exporting or multinational sales. Third, it is also possible that U.S. tariffs weakened the Chinese economy, which could lower expected profits for U.S. firms selling there.

Table 9: Impact of US Tariff Announcements on Cash Flows

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Cumulative	23Jan18	1Mar18	22Mar18	19Jun18	06May19	01Aug19
China Importer	-1.94*** (0.26)	-0.25*** (0.07)	-0.32*** (0.11)	-0.27*** (0.08)	-0.12 (0.10)	-0.52*** (0.07)	-0.47*** (0.14)
China Exporter	-1.20*** (0.40)	-0.20** (0.08)	0.15 (0.16)	-0.23** (0.09)	-0.43*** (0.11)	-0.20* (0.11)	-0.29 (0.28)
China Revenue Share	-6.09*** (1.79)	-0.63* (0.36)	-2.89*** (0.74)	-1.41*** (0.40)	-1.65*** (0.45)	-2.31*** (0.44)	2.79** (1.19)

Note: The dependent variable is residualized cash-flow (CF_{ft}), which is constructed by summing $\hat{\Pi}_{f0}$ (constructed using equation 14) and the change in the discount rate (which is based on the change in the VAR variables on announcement days after controlling for economic surprises). The dependent variable is the cash flow CF_{ft} of a firm f 's stock return on trading day t multiplied by 100. This table uses a 1-day window around each event. China Importer is a dummy that equals 1 if the firm or any of its subsidiaries or suppliers import from China. China Exporter is a dummy that equals 1 if the firm or subsidiaries export to China. China Revenue Share is the share of the firm's revenue that comes from sales in China reported in percentage points. Column 1 presents the cumulative of the coefficient on each of the U.S. event days. Standard errors are in parenthesis. Asterisks correspond to the following levels of significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Turning to the Chinese announcements, column 1 of Table 10 shows that Chinese retaliation on average significantly lowered expected cash flows for firms selling in China (either by exporting or through multinationals) and for firms importing from China. We do not see an effect on exporting per se, but this result may reflect the fact that export revenues are captured in the China Revenue Share variable so we may have a multicollinearity problem. Interestingly, we also see that tariff announcements also lowered returns of firms importing from China, perhaps because of the tit-for-tat retaliation structure of the trade war in which Chinese retaliation provoked more U.S. tariffs. Overall, Chinese retaliation announcements led to a significant 0.56 percentage point drop in the expected cash flows of firms importing from China and another 2.5 percentage point drop for every percentage point increase in a firm's sales in China. The results are economically significant as well. Since Bernard et al. (2007) found that 79 percent of U.S. importers also export, it is worth considering the impact of the trade war on a firm exposed to China through multiple channels. We estimate that a firm that imported from and exported to China and obtained 4 percent of its revenue from sales to China would have had its expected cash flows lowered by 4.0 percent when we sum across all event days. The large magnitude of this result suggests that the tariff announcement had a sizable negative impact on the expected cash flows of exposed firms.

Table 10: Impact of Chinese Tariff Announcements on Cash Flows

	(1)	(2)	(3)	(4)	(5)	(6)
	Cumulative	23Mar18	15Jun18	02Aug18	13May19	23Aug19
China Importer	-0.46** (0.20)	0.03 (0.08)	-0.02 (0.07)	0.20* (0.11)	-0.29*** (0.09)	-0.37*** (0.08)
China Exporter	0.02 (0.30)	0.16 (0.10)	-0.06 (0.11)	-0.50*** (0.15)	0.36*** (0.13)	0.06 (0.13)
China Revenue Share	-4.62*** (1.60)	-0.89 (0.64)	-0.16 (0.38)	1.52* (0.79)	-4.04*** (0.75)	-1.05*** (0.36)

Note: The dependent variable is residualized cash-flow (CF_{ft}), which is constructed by summing $\hat{\Pi}_{f0}$ (constructed using equation 14) and the change in the discount rate (which is based on the change in the VAR variables on announcement days after controlling for economic surprises). This table uses a 1-day window around each event. China Importer is a dummy that equals 1 if the firm or any of its subsidiaries or suppliers import from China. China Exporter is a dummy that equals 1 if the firm or subsidiaries export to China. China Revenue Share is the share of the firm's revenue that comes from sales in China reported in percentage points. Column 1 presents the cumulative of the coefficient on each of the Chinese event days. Standard errors are in parenthesis. Asterisks correspond to the following levels of significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

To compare the magnitude of treatment effect relative to the aggregate effect, we then estimate an aggregate welfare effect using only the deviations in firm values and discount rates predicted by these firm-level characteristics (without taking into account the intercept). We obtain that this aggregate welfare effect of -0.90 percentage points, which is approximately a third of our aggregate welfare baseline result. This reflects the fact that, due to spillover effects, it is important to take into account the overall negative effect of tariffs announcements on all firms, not just the differential one with respect to Chinese exposure.

6 Conclusion

There are many challenges facing a researcher trying to assess the welfare impacts of a policy change in general equilibrium. A major contribution of this paper is to provide a rigorous methodology to assess the expected impacts of a policy change based on market reactions to policy announcements. The key ingredient is extracting the expected cash-flow component of stock price movements due to a policy change. Seen through the lens of a specific factors model, we show that the change in cash flow is a sufficient statistic for identifying movements in sales, wages, employment, and total factor productivity. Moreover, it allows us to measure welfare effects from shifts in both expected consumption and consumption uncertainty.

Our estimates are large compared to conventional measures. For example, [Amiti et al. \(2019\)](#) found that the welfare loss due the trade war was 0.4 percent of GDP. There are two main reasons why our estimates are larger than those of conventional analyses. The first explanation is that we derive welfare using a specific factors setup to model the economy, but conventional analyses use frameworks based on neoclassical or increasing returns. The second reason is that our welfare captures any potential effect of the trade war on

the growth rate of the economy, which may generate large changes in welfare, as in [Perla et al. \(2021\)](#).

More generally, our estimates could also reflect the fact that new tariffs affect the expectations of agents about a host of other variables: the survival of the world trading system, technological spillovers, U.S. policy, and uncertainty to name a few. Conventional analyses may be correct in identifying the impact of tariffs when seen through the lens of a particular model, but these models may underestimate the losses by not allowing for the existence of other, possibly more important channels. Thus, our paper suggests a useful path for further research is to examine some of the wider implications of trade wars.

References

- Alcalá, F. and A. Ciccone (2004). Trade and productivity. *Quarterly Journal of Economics* 119(2), 613–646.
- Amiti, M. and J. Konings (2007). Trade liberalization, intermediate inputs, and productivity: Evidence from Indonesia. *American Economic Review* 97(5), 1611–1638.
- Amiti, M., S. J. Redding, and D. E. Weinstein (2019). The impact of the 2018 tariffs on prices and welfare. *Journal of Economic Perspectives* 33(4), 187–210.
- Amiti, M., S. J. Redding, and D. E. Weinstein (2020). Who’s paying for the U.S. tariffs? A longer-term perspective. In *AEA Papers and Proceedings*, Volume 110, pp. 541–46.
- Autor, D. H., D. Dorn, and G. H. Hanson (2013, October). The China Syndrome: Local labor market effects of import competition in the United States. *American Economic Review* 103(6), 2121–68.
- Baker, S. R., N. Bloom, and S. J. Davis (2016). Measuring economic policy uncertainty. *Quarterly Journal of Economics* 131(4), 1593–1636.
- Barrot, J.-N., E. Loualiche, and J. Sauvagnat (2019). The globalization risk premium. *The Journal of Finance* 74(5), 2391–2439.
- Bernanke, B. S. and K. N. Kuttner (2005). What explains the stock market’s reaction to federal reserve policy? *The Journal of finance* 60(3), 1221–1257.
- Bernard, A. B., J. B. Jensen, S. J. Redding, and P. K. Schott (2007). Firms in international trade. *Journal of Economic perspectives* 21(3), 105–130.
- Bloom, N., M. Draca, and J. Van Reenen (2016). Trade induced technical change? the impact of chinese imports on innovation, it and productivity. *The review of economic studies* 83(1), 87–117.
- Brandt, L., J. Van Biesebroeck, L. Wang, and Y. Zhang (2017). WTO accession and performance of chinese manufacturing firms. *American Economic Review* 107(9), 2784–2820.
- Brandt, L., J. Van Biesebroeck, L. Wang, and Y. Zhang (2019). WTO accession and performance of chinese manufacturing firms: Corrigendum. *American Economic Review* 109(4), 1616–21.
- Breinlich, H. (2014). Heterogeneous firm-level responses to trade liberalization: A test using stock price reactions. *Journal of International Economics* 93(2), 270–285.
- Breinlich, H., E. Leromain, D. Novy, T. Sampson, and A. Usman (2018). The economic effects of brexit: Evidence from the stock market. *Fiscal Studies* 39(4), 581–623.
- Caldara, D., M. Iacoviello, P. Molligo, A. Prestipino, and A. Raffo (2019). The economic effects of trade policy uncertainty. *Journal of Monetary Economics* forthcoming.
- Caliendo, L., M. Dvorkin, and F. Parro (2019). Trade and labor market dynamics: General equilibrium analysis of the china trade shock. *Econometrica* 87(3), 741–835.
- Campbell, J. Y. and R. J. Shiller (1988). The dividend-price ratio and expectations of future dividends and discount factors. *Review of Financial Studies* 1(3), 195–228. Campbell, John

- Y. Shiller, Robert J. 1465-7368.
- Campbell, J. Y. and T. Vuolteenaho (2004). Bad beta, good beta. *American Economic Review* 94(5), 1249–1275. Campbell, JY Vuolteenaho, T.
- Cavallo, A., G. Gopinath, B. Neiman, and J. Tang (2021). Tariff pass-through at the border and at the store: Evidence from us trade policy. *American Economic Review: Insights* 3(1), 19–34.
- Corden, W. M. (1966). The structure of a tariff system and the effective protective rate. *Journal of Political Economy* 74(3), 221–237.
- Crowley, M. A., N. Meng, and H. Song (2019). Policy shocks and stock market returns: Evidence from chinese solar panels. *Journal of the Japanese and International Economies* 51, 148–169.
- Dix-Carneiro, R. and B. K. Kovak (2017). Trade liberalization and regional dynamics. *American Economic Review* 107(10), 2908–46.
- Ethier, W. (1977). The theory of effective protection in general equilibrium: Effective-rate analogues of nominal rates. *Canadian Journal of Economics*, 233–245.
- Fajgelbaum, P. D., P. K. Goldberg, P. J. Kennedy, and A. K. Khandelwal (2020). The return to protectionism. *Quarterly Journal of Economics* 135(1), 1–55.
- Feyrer, J. (2019). Trade and income-exploiting time series in geography. *American Economic Journal: Applied Economics* 11(4), 1–35.
- Fisman, R., Y. Hamao, and Y. Wang (2014). Nationalism and economic exchange: Evidence from shocks to Sino-Japanese relations. *The Review of Financial Studies* 27(9), 2626–2660.
- Flaaen, A., A. Hortaçsu, and F. Tintelnot (2020, July). The production relocation and price effects of us trade policy: The case of washing machines. *American Economic Review* 110(7), 2103–27.
- Frankel, J. A. and D. H. Romer (1999). Does trade cause growth? *American economic review* 89(3), 379–399.
- Greenland, A., M. Ion, J. Lopresti, and P. Schott (2024). Using equity market reactions to infer exposure to trade liberalization. *forthcoming in the Journal of International Economics*.
- Grossman, G. M. and J. A. Levinsohn (1989). Import competition and the stock-market return to capital. *American Economic Review* 79(5), 1065–1087.
- Gürkaynak, R. S., B. Sack, and J. H. Wright (2007). The us treasury yield curve: 1961 to the present. *Journal of monetary Economics* 54(8), 2291–2304.
- Gürkaynak, R. S., B. Sack, and J. H. Wright (2010, January). The tips yield curve and inflation compensation. *American Economic Journal: Macroeconomics* 2(1), 70–92.
- Handley, K. and N. Limão (2017). Policy uncertainty, trade, and welfare: Theory and evidence for China and the United States. *American Economic Review* 107(9), 2731–2783.
- Hanson, S. G. and J. C. Stein (2015). Monetary policy and long-term real rates. *Journal of*

- Financial Economics* 115(3), 429–448.
- Hartigan, J. C., P. R. Perry, and S. Kamma (1986). The value of administered protection: a capital market approach. *The Review of Economics and Statistics*, 610–617.
- Hsieh, C.-T. and P. J. Klenow (2009). Misallocation and manufacturing TFP in china and india. *Quarterly Journal of Economics* 124(4), 1403–1448.
- Huang, Y., C. Lin, S. Liu, and H. Tang (2023). Trade networks and firm value: Evidence from the U.S.-China trade war. *Journal of International Economics* 145.
- Jones, R. W. (1975). Income distribution and effective protection in a multicommodity trade model. *Journal of Economic Theory* 11(1), 1–15.
- Knoblach, M. and F. Stöckl (2020). What determines the elasticity of substitution between capital and labor? a literature review. *Journal of Economic Surveys* 34(4), 847–875.
- Knox, B. and A. Vissing-Jorgensen (2022). A stock return decomposition using observables.
- Kovak, B. K. (2013). Regional effects of trade reform: What is the correct measure of liberalization? *American Economic Review* 103(5), 1960–76.
- Lewis, D. J., C. Makridis, and K. Mertens (2019). Do monetary policy announcements shift household expectations? *FRB of New York Staff Report* (897).
- Lewis, D. J. I. (2020). Announcement-specific decompositions of unconventional monetary policy shocks and their macroeconomic effects. *FRB of New York Staff Report* (891).
- Martin, I. (2017). What is the expected return on the market? *The Quarterly Journal of Economics* 132(1), 367–433.
- Martin, I. W. (2013). Consumption-based asset pricing with higher cumulants. *Review of Economic Studies* 80(2), 745–773.
- Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. *econometrica* 71(6), 1695–1725.
- Moser, C. and A. K. Rose (2014). Who benefits from regional trade agreements? the view from the stock market. *European Economic Review* 68, 31–47.
- Perla, J., C. Tonetti, and M. E. Waugh (2021). Equilibrium technology diffusion, trade, and growth. *American Economic Review* 111(1), 73–128.
- Pierce, J. R. and P. K. Schott (2016). The surprisingly swift decline of US manufacturing employment. *American Economic Review* 106(7), 1632–1662.
- Topalova, P. (2010). Factor immobility and regional impacts of trade liberalization: Evidence on poverty from india. *American Economic Journal: Applied Economics* 2(4), 1–41.
- Topalova, P. and A. Khandelwal (2011). Trade liberalization and firm productivity: The case of india. *Review of economics and statistics* 93(3), 995–1009.

Online Appendix to “Trade Protection, Stock-Market Returns, and Welfare” (For Online Publication)

Mary Amiti
Federal Reserve Bank of New York

Matthieu Gomez
Columbia University

Sang Hoon Kong
Columbia University

David E. Weinstein
Columbia University, CEPR, and NBER

April 22, 2024

Contents

A Proofs of Propositions	2
A.1 Proof of Proposition 1	2
A.2 Proof of Proposition 2	4
A.3 Proof of Proposition 3	5
A.4 Proof of Proposition 4	7
A.5 Proof of Corollary 1	10
A.6 Proof of Proposition 5	11
B Model Extensions	13
B.1 Adding Growth	13
C Data and Measurement	14
C.1 Event Dates	14
C.2 Summary of Data Sources	14
C.3 Construction of China-Exposure Variables	20
C.4 China Revenue Share	21
C.5 Construction of factor share variables	21
C.6 Sample Statistics	22
D Details on Reweighting the Compustat-CRSP sample	23
D.1 Baseline method.	23
D.2 Alternative approach	24
E Estimating Changes in Discount Rates	25
E.1 Additional Discount-Rate Figures	25
E.2 VAR	27
F Treatment Robustness	29

Introduction

This online appendix contains supplementary theoretical and empirical results. Section A presents the proofs of the propositions in the theory section, as well as model extensions. Section B provides a generalization of this framework that allows for growth. Section C turns to data and measurement issues. We present the sources for each event in Section C.1. Section C.2 provides a list of all the variables and the data sources used. Sections C.3 and C.4 provide more details on the data sources and construction of the China-exposure variables, and Section C.5 presents details on the construction of the factor share variables. Section C.6 presents sample statistics.

Next, we provide additional details for the welfare calculations. Section D describes how we reweight our sample of publicly listed firms using the size distribution of U.S. firms. Section E provides details of the procedure to estimate the changes in discount rates.

Finally, we provide additional robustness tables in Sections F and G

A Proofs of Propositions

In this section, we provide details on the derivations for the proofs of each proposition.

A.1 Proof of Proposition 1

Proposition. 1 *If the elasticity of substitution between labor and the specific factor for all firms is constant and the expenditures on intermediate inputs are a constant fraction of sales, the log change in wages equals the employment-share weighted average of the log changes in cash flow, i.e.,*

$$\hat{w}_t = \sum_f \frac{L_f}{L} \hat{r}_{ft},$$

and the log change in employment in each firm equals $\hat{L}_{ft} = \sigma \left(\hat{r}_{ft} - \sum_{f'} \frac{L_{f'}}{L} \hat{r}_{f't} \right)$.

Proof. Totally differentiating equations (2) and (3) yields:

$$\hat{y}_{ft} = -\hat{a}_{Vft}, \quad (\text{A1})$$

and

$$\sum_f \frac{L_f}{L} (\hat{a}_{Lft} - \hat{a}_{Vft}) = \hat{L}, \quad (\text{A2})$$

where we have used the fact that in the baseline equilibrium $L_{ft} = L_f$. Substituting equation (4) into equation (A2) yields

$$-\sum_f \frac{L_f}{L} \sigma (\hat{w}_t - \hat{r}_{ft}) = \hat{L}, \quad (\text{A3})$$

or

$$\hat{w}_t = \sum_f \frac{L_f}{L} \hat{r}_{ft} - \frac{\hat{L}}{\sigma} \quad (\text{A4})$$

If the supply of labor is fixed, we have $\hat{L} = 0$, which establishes that

$$\hat{w}_t = \sum_f \frac{L_f}{L} \hat{r}_{ft}. \quad (\text{A5})$$

Substituting equation (A1) into equation (4) yields

$$-\hat{y}_{ft} - \hat{a}_{Lft} = \sigma (\hat{w}_t - \hat{r}_{ft}) \quad (\text{A6})$$

or

$$\hat{L}_{ft} = \sigma (\hat{r}_{ft} - \hat{w}_t) = \sigma \left(\hat{r}_{ft} - \sum_{f'} \frac{L_{f'}}{L} \hat{r}_{f't} \right). \quad (\text{A7})$$

□

A.1.1 Extension of Proposition 1 to Model Endogenous Aggregate Employment Rates

Starting with equation (A4) and defining \hat{P} to be the change in the consumer price level, we now can add an upward sloping labor-supply curve by defining the log change in employment relative to some base level L as

$$\hat{L}_t = \hat{L}_t^s = \tilde{\sigma} \hat{w}_t,$$

where $\tilde{\sigma} > 0$ denotes the slope of the labor-supply curve. Substituting the expression for \hat{L}_t^s into equation (A4) gives us

$$\begin{aligned} \hat{w}_t &= \sum_f \frac{L_f}{L} \hat{r}_{ft} - \frac{\tilde{\sigma} \hat{w}_t}{\sigma} \\ \hat{w}_t &= \sum_f \frac{L_f}{L} \hat{r}_{ft} - \frac{\tilde{\sigma}}{\sigma} \sum_f \frac{L_f}{L} \hat{r}_{ft} \\ \hat{w}_t &= \left(1 - \frac{\tilde{\sigma}}{\sigma}\right) \sum_f \frac{L_f}{L} \hat{r}_{ft}, \end{aligned}$$

which proves that wages will rise with changes in cash flow as long as $\tilde{\sigma} < \sigma$, i.e., the labor-supply response cannot be too large. Substituting this expression into equation (A7) gives us

$$\hat{L}_{ft} = \sigma (\hat{r}_{ft} - \hat{w}_t) = \sigma \left(\hat{r}_{ft} - \left(1 - \frac{\tilde{\sigma}}{\sigma}\right) \sum_f \frac{L_f}{L} \hat{r}_{ft} \right).$$

This expression continues to show that the relative employment of a firm increases when it sees relatively higher returns to its specific factor. Thus, the relationship between log change in firm employment and returns to its specific factor in Proposition 1 is robust to allowing for an upward sloping labor supply curve.

A.2 Proof of Proposition 2

Proposition. 2 *The log change in the ERP for a firm (\hat{p}_{ft}^e) can be expressed as a linear function of the log changes in cash flows*

$$\hat{p}_{ft}^e = \theta_{Vf} \hat{r}_{ft} + \theta_{Lf} \sum_{f'} \frac{L_{f'}}{L} \hat{r}_{f't}$$

and is equivalent to the log change in its revenue total factor productivity

$$\widehat{TFPR}_{ft} \equiv \hat{p}_{ft} + \widehat{TFP}_{ft} = \hat{p}_{ft}^e,$$

where $\widehat{TFP}_{ft} \equiv \hat{y}_{ft} - \theta_{Lf} \hat{L}_{ft} - \theta_{Vf} \hat{V}_{ft}$ is the log change in the firm's total factor productivity. The log changes in revenue and markup for a firm can also be expressed as linear functions of the log changes in cash flows:

$$\hat{p}_{ft} + \hat{y}_{ft} = (\theta_{Lf} \sigma + \theta_{Vf}) \hat{r}_{ft} + \theta_{Lf} (1 - \sigma) \sum_{f'} \frac{L_{f'}}{L} \hat{r}_{f't}.$$

Proof. In order to prove the first sentence in the proposition, we first totally differentiate the unit-cost equation to obtain

$$\omega_{Lft} \hat{a}_{Lft} + \omega_{Vft} \hat{a}_{Vft} + \sum_i \omega_{ift} \hat{a}_{ift} = 0.$$

Using this result after totally differentiating equation (1) and dividing both sides by p_{ft} , we obtain

$$\omega_{Lft} \hat{w}_t + \omega_{Vft} \hat{r}_{ft} + \sum_i \omega_{ift} \hat{q}_{it} = \hat{p}_{ft}. \quad (\text{A8})$$

If we divide both sides by $(1 - \sum_i \omega_{ift})$ and rearrange, we obtain:

$$\hat{p}_{ft}^e \equiv \frac{\hat{p}_{ft} - \sum_i \omega_{ift} \hat{q}_{it}}{1 - \sum_i \omega_{ift}} = \theta_{Vft} \hat{r}_{ft} + \theta_{Lft} \hat{w}_t, \quad (\text{A9})$$

where θ_{Lft} and θ_{Vft} are the shares of labor and the specific factor in value added in time t . Remembering that ω_{ift} , θ_{Vft} , and θ_{Lft} are not time varying gives us the first line of the proposition.

We prove the second line of the proposition by using Proposition 1 to rewrite equation (A9) as

$$\hat{p}_{ft}^e = \theta_{Vf} \hat{r}_{ft} + \theta_{Lf} \sum_{f'} \frac{L_{f'}}{L} \hat{r}_{f't}.$$

In order to show the equivalence between the log changes in a firm's ERP and revenue productivity, we first multiply both sides of equation (1) by firm output (y_f) to obtain

$$p_{ft} y_{ft} = L_{ft} w_t + V_{ft} r_{ft} + \sum_i m_{ift} q_{it},$$

where m_{ift} is the amount of intermediates of type i used in production. Since we have assumed that the share of *total* expenditures on intermediate inputs in sales doesn't change across periods (i.e., $\sum_i \omega_{ift} = \sum_i \omega_{if}$), we can rewrite this equation as

$$p_{ft}y_{ft} \left(1 - \sum_i \omega_{if}\right) = L_{ft}w_t + V_f r_{ft},$$

where the left-hand side is value added. Totally differentiating this expression and recalling that $\sum_i \omega_{ift}$ is fixed yields

$$(dp_{ft}y_{ft} + p_{ft}dy_{ft}) \left(1 - \sum_i \omega_{if}\right) = L_{ft}dw_t + V_f dr_{ft} + w_t dL_{ft} + r_{ft} dV_{ft}.$$

Dividing through by $p_{ft}y_{ft} (1 - \sum_i \omega_{if})$ produces

$$\hat{p}_{ft} + \hat{y}_{ft} = \theta_{Lf} \hat{w}_t + \theta_{Lf} \hat{L}_{ft} + \theta_{Vf} \hat{r}_{ft} + \theta_{Vf} \hat{V}_{ft}. \quad (\text{A10})$$

We can then subtract off $\theta_{Lf} \hat{L}_{ft} + \theta_{Vf} \hat{V}_{ft}$ from both sides of this equation to show that the log change in a firm's revenue productivity is equal to the log change in its ERP:

$$\widehat{\text{TFPR}}_{ft} \equiv \hat{p}_{ft} + \hat{y}_{ft} - \theta_{Lf} \hat{L}_{ft} - \theta_{Vf} \hat{V}_{ft} = \theta_{Vf} \hat{r}_{ft} + \theta_{Lf} \hat{w}_t = \hat{p}_{ft}^e.$$

To express the log change of a firm's revenue as a function of log change in cash flows, we use Proposition 1, the fact that $\hat{V}_{ft} = 0$ in equation (A10), and the result that each firm in the baseline specification hires the same number of workers in each period to arrive at

$$\hat{p}_{ft} + \hat{y}_{ft} = (\theta_{Lf} \sigma + \theta_{Vf}) \hat{r}_{ft} + \theta_{Lf} (1 - \sigma) \sum_{f'} \frac{L_{f'}}{L} \hat{r}_{f't}. \quad (\text{A11})$$

□

A.3 Proof of Proposition 3

Proposition. 3 *The vectors of log changes in firm output prices (\hat{p}_t), output (\hat{y}_t), and TFP ($\widehat{\text{TFP}}_t$) can be expressed as linear functions of the vectors of log changes in cash flows (\hat{r}_t) and imported intermediate input prices (\hat{q}_t^*):*

$$\begin{aligned} \hat{p}_t &= \mathbf{A}_1 \hat{r}_t + \mathbf{A}_2 \hat{q}_t^* \\ \hat{y}_t &= \mathbf{A}_3 \hat{r}_t - \mathbf{A}_2 \hat{q}_t^* \\ \widehat{\text{TFP}}_t &= \mathbf{A}_4 \hat{r}_t - \mathbf{A}_2 \hat{q}_t^*, \end{aligned}$$

where the elements of matrices \mathbf{A}_1 , \mathbf{A}_2 , \mathbf{A}_3 , and \mathbf{A}_4 only depend on the baseline factor shares in revenue and value-added (ω_f, θ_f), shares of total employment (L_f/L), and the elasticity of substitution between labor and the specific factor (σ).

Proof. We begin by noting that for domestic firms, one firm's input price is another firm's output price. Without loss of generality, we can order firms so that the first F firms are domestic and the remaining F^* firms are foreign. For domestic firms, we have $\hat{q}_{it} = \hat{p}_{it}$. Equation (A8) can be rearranged as

$$\omega_{Vf}\hat{r}_{ft} + \omega_{Lf} \sum_f \frac{L_f}{L} \hat{r}_{ft} + \sum_{i=F+1}^{F+F^*} \omega_{if} \hat{q}_{it} = \hat{p}_{ft} - \sum_{i=1}^F \omega_{if} \hat{p}_{it},$$

where we have used Proposition 1 to substitute out \hat{w}_t .

We can write this more compactly in matrix form as $\omega_1 \hat{r}_t + \omega_2 \hat{q}_t^* = \omega_3 \hat{p}_t$, where \hat{r} and \hat{p} are $F \times 1$ vectors of log changes in the shadow prices of the specific factors and prices; \hat{q}_t^* a $F^* \times 1$ vector whose elements are the \hat{q}_i of the foreign firms; ω_1 is a $F \times F$ matrix defined as

$$\omega_1 \equiv \begin{bmatrix} \omega_{V1} + \frac{\omega_{L1}L_1}{L} & \frac{\omega_{L1}L_2}{L} & \cdots & \frac{\omega_{L1}L_F}{L} \\ \frac{\omega_{L2}L_1}{L} & \omega_{V2} + \frac{\omega_{L2}L_2}{L} & & \vdots \\ \vdots & & \ddots & \vdots \\ \frac{\omega_{LF}L_1}{L} & \cdots & \cdots & \omega_{VF} + \frac{\omega_{LF}L_F}{L} \end{bmatrix};$$

ω_2 is a $F \times F^*$ matrix defined as

$$\omega_2 \equiv \begin{bmatrix} \omega_{F+1,1} & \omega_{F+2,1} & \cdots & \omega_{F+F^*,1} \\ \omega_{F+1,2} & \omega_{F+2,2} & & \vdots \\ \vdots & & \ddots & \vdots \\ \omega_{F+1,F} & \cdots & \cdots & \omega_{F+F^*,F} \end{bmatrix};$$

and ω_3 is a $F \times F$ matrix defined as

$$\omega_3 \equiv \begin{bmatrix} 1 - \omega_{11} & -\omega_{12} & \cdots & -\omega_{1F} \\ -\omega_{21} & 1 - \omega_{22} & & \vdots \\ \vdots & & \ddots & \vdots \\ -\omega_{F1} & \cdots & \cdots & 1 - \omega_{FF} \end{bmatrix}.$$

Thus, we have $\hat{p}_t = \mathbf{A}_1 \hat{r}_t + \mathbf{A}_2 \hat{q}_t^*$, where $\mathbf{A}_1 \equiv \omega_3^{-1} \omega_1$ and $\mathbf{A}_2 \equiv \omega_3^{-1} \omega_2$.

Next, we rearrange equation (A11) to express the log change in output as

$$\hat{y}_{ft} = (\theta_{Lf}\sigma + \theta_{Vf}) \hat{r}_{ft} + \theta_{Lf} (1 - \sigma) \sum_{f'} \frac{L_{f'}}{L} \hat{r}_{f't} - \hat{p}_{ft}.$$

We express this in matrix form as $\hat{y}_t = \Theta_1 \hat{r}_t - \hat{p}_t = \mathbf{A}_3 \hat{r}_t - \mathbf{A}_2 \hat{q}_t^*$, where

$$\Theta_1 \equiv \begin{bmatrix} \theta_{L1}\sigma + \theta_{V1} + \frac{\theta_{L1}(1-\sigma)L_1}{L} & \frac{\theta_{L1}(1-\sigma)L_2}{L} & \cdots & \frac{\theta_{L1}(1-\sigma)L_F}{L} \\ \frac{\theta_{L2}(1-\sigma)L_1}{L} & \theta_{L2}\sigma + \theta_{V2} + \frac{\theta_{L2}(1-\sigma)L_2}{L} & & \vdots \\ \vdots & & \ddots & \vdots \\ \frac{\theta_{LF}(1-\sigma)L_1}{L} & \cdots & \cdots & \theta_{LF}\sigma + \theta_{VF} + \frac{\theta_{LF}(1-\sigma)L_F}{L} \end{bmatrix}$$

and $\mathbf{A}_3 = \Theta_1 - \mathbf{A}_1$.

Finally, we use the first result in Proposition 2 to derive the following expression for the vector of log changes in TFP:

$$\widehat{\text{TFP}}_t = \hat{p}_t^e - \hat{p}_t = \mathbf{A}_4 \hat{r}_t - \mathbf{A}_2 \hat{q}_t^*,$$

where $\mathbf{A}_4 \equiv \Theta_2 - \mathbf{A}_1$ and

$$\Theta_2 \equiv \begin{bmatrix} \theta_{V1} + \frac{\theta_{L1L1}}{L} & \frac{\theta_{L1L2}}{L} & \dots & \frac{\theta_{L1LF}}{L} \\ \frac{\theta_{L2L1}}{L} & \theta_{V2} + \frac{\theta_{L2L2}}{L} & & \vdots \\ \vdots & & \ddots & \vdots \\ \frac{\theta_{LFL1}}{L} & \dots & \dots & \theta_{VF} + \frac{\theta_{LFLF}}{L} \end{bmatrix}.$$

□

A.4 Proof of Proposition 4

We start with a lemma that relates the consumption-metric welfare effect to weighted average of deviations in consumption, where weights are given by the household's stochastic discount factor.

Lemma 1. *The consumption-equivalent welfare effect of the deviation path $(\hat{C}_t)_{t=0}^\infty$*

$$\mathcal{C} = \frac{\sum_{t=0}^\infty \mathbb{E}_0 [M_{0 \rightarrow t} C_t \hat{C}_t]}{\sum_{t=0}^\infty \mathbb{E}_0 [M_{0 \rightarrow t} C_t]}$$

where $M_{0 \rightarrow t}$ denotes the household's Stochastic Discount Factor (SDF)

Proof. Denote \mathcal{W}_0 the welfare of the household at time t . Totally differentiating with respect to the deviation path for consumption $(\hat{C}_t)_{t=0}^\infty$ gives:

$$d\mathcal{W}_0 = \mathbb{E}_0 \left[\sum_{t=0}^\infty \frac{\partial \mathcal{W}_0}{\partial C_t} C_t \hat{C}_t \right].$$

where $\partial \mathcal{W}_0 / \partial C_t$, a stochastic derivative, corresponds to the effect of increasing consumption in states realized at time t for welfare at time 0.

The consumption-metric welfare effect \mathcal{C} is defined as the constant log deviation of consumption that yields the same welfare change; that is

$$\mathbb{E}_0 \left[\sum_{t=0}^\infty \frac{\partial \mathcal{W}_0}{\partial C_t} C_t \mathcal{C} \right] = \mathbb{E}_0 \left[\sum_{t=0}^\infty \frac{\partial \mathcal{W}_0}{\partial C_t} C_t \hat{C}_t \right].$$

Solving for \mathcal{C} gives:

$$\mathcal{C} = \frac{\mathbb{E}_0 \left[\sum_{t=0}^\infty \frac{\partial \mathcal{W}_0}{\partial C_t} C_t \hat{C}_t \right]}{\mathbb{E}_0 \left[\sum_{t=0}^\infty \frac{\partial \mathcal{W}_0}{\partial C_t} C_t \right]}.$$

To conclude, notice that, for any available asset i with return $R_{0 \rightarrow t, i}$ between 0 and t , an optimizing agent must be indifferent between consuming a bit more today and investing a bit more in asset i between 0 and t , which implies

$$\frac{\partial \mathcal{W}_0}{\partial C_0} = \mathbb{E}_t \left[\frac{\partial \mathcal{W}_0}{\partial C_t} R_{i, 0 \rightarrow t} \right].$$

Hence, $\frac{\partial \mathcal{W}_0 / \partial C_t}{\partial \mathcal{W}_0 / \partial C_0}$ corresponds to the household's SDF, $M_{0 \rightarrow t}$, and dividing the numerator and denominator of our expression for \mathcal{C} proves the lemma. \square

Proposition. 4 *The consumption-equivalent welfare effect of the deviation path $(\hat{C}_t)_{t=0}^\infty$ is*

$$\mathcal{C} = (1 - \rho) \sum_{t=0}^{\infty} \rho^t \mathbb{E}_0 \left[\frac{C_t^{1-\gamma}}{\mathbb{E}_0 [C_t^{1-\gamma}]} \hat{C}_t \right],$$

where $\rho \equiv 1 - C_t/W_t$ denotes the consumption-to-wealth ratio, which is constant in the baseline economy.

Proof. Denote $M_{t \rightarrow t+k}$ the household SDF between t and $t+k$ and $W_t = \mathbb{E}_t[\sum_{k=0}^{\infty} M_{t \rightarrow t+k} C_{t+k}]$ the present value of consumption (or, equivalently, total wealth). As shown, for instance, in [Martin \(2013\)](#), a household with Epstein-Zin preferences has a SDF of the form:

$$M_{t \rightarrow t+k} = \left(\beta^k \left(\frac{C_{t+k}}{C_t} \right)^{-1/\psi} \right)^\theta \left(R_{W, t \rightarrow t+k}^{-1} \right)^{1-\theta}, \quad (\text{A12})$$

where $\theta \equiv (1-\gamma)/(1-1/\psi)$ and $R_{W, t+1} \equiv \frac{W_{t+1}}{W_t - C_t}$ denotes the return on the wealth portfolio between t and $t+1$ and $R_{W, t \rightarrow t+k} = R_{W, t+1} \dots R_{W, t+k}$ denotes the cumulative return on the wealth portfolio between t and $t+k$. In the special case where $\psi = 1/\gamma$ (separable preferences), Equation A12 gives the familiar expression $M_{t \rightarrow t+k} = \beta^k (C_{t+k}/C_t)^{-\gamma}$.

This expression for the SDF can be simplified when log consumption is i.i.d (which is the case on the baseline path) Indeed, in this case, we can guess (and verify later) that the consumption-to-wealth ratio is constant over time, in which case the return on the wealth portfolio simplifies to:

$$\begin{aligned} R_{W, t+1} &= \frac{W_{t+1}}{W_t - C_t} \\ &= \frac{W_t}{W_t - C_t} \times \frac{W_{t+1}}{W_t} \\ &= \frac{1}{\rho} \frac{C_{t+1}}{C_t}, \end{aligned}$$

where the last line uses the definition of $\rho \equiv 1 - C_t/W_t$. Combining with (A12) allows us to simplify the expression for the SDF along the baseline path:

$$\begin{aligned} M_{t \rightarrow t+k} &= \left(\beta^k \left(\frac{C_{t+k}}{C_t} \right)^{-1/\psi} \right)^\theta \left(\rho^k \frac{C_t}{C_{t+k}} \right)^{1-\theta} \\ &= \beta^{\theta k} \rho^{(1-\theta)k} \left(\frac{C_{t+k}}{C_t} \right)^{-\gamma}, \end{aligned} \quad (\text{A13})$$

where the second line uses the fact that $\theta(1 - 1/\psi) = (1 - \gamma)$. We now verify that the consumption-to-wealth ratio is indeed constant along the baseline path. Using the definition of total wealth, we get

$$\begin{aligned}
W_t &= \mathbb{E}_t \left[\sum_{k=0}^{\infty} M_{t \rightarrow t+k} C_{t+k} \right] \\
&= C_t \sum_{k=0}^{\infty} \beta^{\theta k} \rho^{(1-\theta)k} \mathbb{E}_t \left[\left(\frac{C_{t+k}}{C_t} \right)^{1-\gamma} \right] \\
&= C_t \sum_{k=0}^{\infty} \beta^{\theta k} \rho^{(1-\theta)k} \mathbb{E}_t \left[\left(\frac{C_{t+k}}{C_{t+k-1}} \right)^{1-\gamma} \left(\frac{C_{t+k-1}}{C_{t+k-2}} \right)^{1-\gamma} \dots \left(\frac{C_{t+1}}{C_t} \right)^{1-\gamma} \right] \\
&= C_t \sum_{k=0}^{\infty} \beta^{\theta k} \rho^{(1-\theta)k} \mathbb{E}_t \left[\left(\frac{C_{t+k}}{C_{t+k-1}} \right)^{1-\gamma} \right] \mathbb{E}_t \left[\left(\frac{C_{t+k-1}}{C_{t+k-2}} \right)^{1-\gamma} \right] \dots \mathbb{E}_t \left[\left(\frac{C_{t+1}}{C_t} \right)^{1-\gamma} \right] \\
&= C_t \sum_{k=0}^{\infty} \beta^{\theta k} \rho^{(1-\theta)k} \mathbb{E}_0 \left[\left(\frac{C_1}{C_0} \right)^{1-\gamma} \right]^k \\
&= C_t \sum_{k=0}^{\infty} \left(\beta^{\theta} \rho^{1-\theta} \mathbb{E}_0 \left[\left(\frac{C_1}{C_0} \right)^{1-\gamma} \right] \right)^k \\
&= C_t \frac{1}{1 - \beta^{\theta} \rho^{1-\theta} \mathbb{E}_0 \left[\left(\frac{C_1}{C_0} \right)^{1-\gamma} \right]},
\end{aligned}$$

where the fourth and fifth lines use the fact that consumption growth is independently and identically distributed across periods along the baseline path and the last line uses the formula for the infinite sum of a geometric sequence. Hence, we have proven that the wealth-to-consumption ratio W_t/C_t is constant along the baseline path.

Finally, we can combine this equation with the definition of $\rho = 1 - C_t/W_t$ to solve for ρ in terms of the household preferences and of the distribution of consumption growth:

$$\begin{aligned}
\rho &= \beta^{\theta} \rho^{(1-\theta)} \mathbb{E}_0 \left[\left(\frac{C_1}{C_0} \right)^{1-\gamma} \right] \\
\implies \rho &= \beta \mathbb{E}_0 \left[\left(\frac{C_1}{C_0} \right)^{1-\gamma} \right]^{\frac{1}{\theta}}.
\end{aligned}$$

Plugging this into (A13) gives a simplified expression for the SDF along the baseline path:

$$\begin{aligned}
M_{0 \rightarrow t} &= \beta^t \left(\frac{C_t}{C_0} \right)^{-\gamma} \mathbb{E}_0 \left[\left(\frac{C_t}{C_0} \right)^{1-\gamma} \right]^{1/\theta-1} \\
&= \rho^t \frac{\left(\frac{C_t}{C_0} \right)^{-\gamma}}{\mathbb{E}_0 \left[\left(\frac{C_t}{C_0} \right)^{1-\gamma} \right]}.
\end{aligned}$$

Combining this formula for the SDF with the expression for the welfare effect \mathcal{C} obtained

in Lemma 1 gives:

$$\begin{aligned} \mathcal{C} &= \frac{\sum_{t=0}^{\infty} \mathbb{E}_0 \left[\rho^t \frac{\left(\frac{C_t}{C_0}\right)^{1-\gamma}}{\mathbb{E}_t \left[\left(\frac{C_t}{C_0}\right)^{1-\gamma} \right]} \hat{C}_t \right]}{\sum_{t=0}^{\infty} \mathbb{E}_0 \left[\rho^t \frac{\left(\frac{C_t}{C_0}\right)^{1-\gamma}}{\mathbb{E}_0 \left[\left(\frac{C_t}{C_0}\right)^{1-\gamma} \right]} \right]} \\ &= (1 - \rho) \sum_{t=0}^{\infty} \rho^t \mathbb{E}_0 \left[\frac{\left(\frac{C_t}{C_0}\right)^{1-\gamma}}{\mathbb{E}_0 \left[\left(\frac{C_t}{C_0}\right)^{1-\gamma} \right]} \hat{C}_t \right], \end{aligned}$$

where the second line obtains after simplifying the denominator in the first line to $\sum_{t=0}^{\infty} \rho^t = 1/(1 - \rho)$. \square

A.5 Proof of Corollary 1

Corollary. 1 *The consumption-equivalent welfare effect of the deviation path $(\hat{C}_t)_{t=0}^{\infty}$ due to higher-order terms is:*

$$\begin{aligned} \mathcal{C}^{\text{higher-order}} &= \frac{1 - \gamma}{2} \sum_{t=1}^{\infty} (1 - \rho) \rho^t d(\text{Var}_0 \ln C_t) \\ &\quad + \frac{(1 - \gamma)^2}{3!} \sum_{t=1}^{\infty} (1 - \rho) \rho^t d(\text{Skewness}_t[\ln C_t] \cdot \text{Var}_0[\ln C_t]^{3/2}) \\ &\quad + \frac{(1 - \gamma)^3}{4!} \sum_{t=1}^{\infty} (1 - \rho) \rho^t d(\text{Excess Kurtosis}_0[\ln C_t] \cdot \text{Var}_0[\ln C_t]^2) \\ &\quad + \dots \end{aligned}$$

Proof. First, note that one can rewrite the expression for welfare given in Proposition 4 as:

$$\mathcal{C} = (1 - \rho) \sum_{t=0}^{\infty} \rho^t \frac{d \ln \mathbb{E}_0 [C_t^{1-\gamma}]}{1 - \gamma}.$$

The *cumulant-generating function* (CGF) of a random variable g is defined as the function $\theta \rightarrow \ln \mathbb{E} [e^{\theta g}]$. It is well known that the CGF can be expanded it as a power series in θ :

$$\ln \mathbb{E} [e^{\theta g}] = \sum_{l=1}^{\infty} \frac{\theta^l}{l!} \kappa_l,$$

where κ_l corresponds to the the l th *cumulant* of the variable g . In particular, the first cumulant corresponds to the mean of g and the second cumulant corresponds to its variance. Applying this definition with $g = \ln C_t$ and $\theta = 1 - \gamma$ gives:

$$\ln \mathbb{E}_0 [C_t^{1-\gamma}] = \sum_{l=1}^{\infty} \frac{(1 - \gamma)^l}{l!} \kappa_{l,0 \rightarrow t},$$

where $\kappa_{l,0 \rightarrow t}$ denotes the l -th cumulant of log consumption at time t from the point of view of time 0. Combining the last two equations gives:

$$\begin{aligned}
\mathcal{C} &= (1 - \rho) \sum_{t=0}^{\infty} \rho^t \frac{1}{1 - \gamma} \sum_{l=1}^{\infty} \frac{(1 - \gamma)^l}{l!} d\kappa_{l,0 \rightarrow t} \\
&= (1 - \rho) \sum_{t=0}^{\infty} \rho^t d\kappa_{1,0 \rightarrow t} + (1 - \rho) \sum_{t=0}^{\infty} \rho^t \frac{1}{1 - \gamma} \sum_{l=2}^{\infty} \frac{(1 - \gamma)^l}{l!} d\kappa_{l,0 \rightarrow t} \\
&= \underbrace{(1 - \rho) \sum_{t=0}^{\infty} \rho^t \mathbb{E}_0 [\hat{C}_t]}_{\text{deviations in expected log consumption}} + \underbrace{(1 - \rho) \sum_{t=1}^{\infty} \rho^t \sum_{l \geq 2} \frac{(1 - \gamma)^{l-1}}{l!} d\kappa_{l,0 \rightarrow t}}_{\text{deviations in higher-order moments}},
\end{aligned}$$

where the last line uses the fact that the deviation of the average log consumption (its first cumulant) can be written as the average deviation of log consumption. Finally, one can obtain the equation in the main text by expressing the second, third, and fourth cumulants using the definition of variance, skewness and excess kurtosis. \square

A.6 Proof of Proposition 5

Proposition. 5 *Around a baseline path in which the cash flow-to-firm value ratio, $r_{ft}V_f/\Pi_{ft}$ is equal to the constant consumption-to-wealth ratio, C_t/W_t , we have:*

$$\hat{\Pi}_{f0} = (1 - \rho) \sum_{t=0}^{\infty} \rho^t \mathbb{E}_0 [\hat{r}_{ft}] - \sum_{t=1}^{\infty} \rho^t \mathbb{E}_0 [\hat{R}_{ft}]$$

Proof. Differentiating the present value relationship (11) gives

$$\begin{aligned}
\hat{\Pi}_{f0} &= \frac{1}{\Pi_{f0}} \mathbb{E}_0 \left[\sum_{t=0}^{\infty} \frac{r_{ft}V_f}{R_{f1} \dots R_{ft}} \left(\hat{r}_{ft} - \sum_{s=1}^t \hat{R}_{fs} \right) \right] \\
&= \frac{1}{\Pi_{f0}} \mathbb{E}_0 \left[\sum_{t=0}^{\infty} \frac{r_{ft}V_f}{R_{f1} \dots R_{ft}} \hat{r}_{ft} \right] - \frac{1}{\Pi_{f0}} \sum_{t=1}^{\infty} \mathbb{E}_0 \left[\left(\sum_{s=t}^{\infty} \frac{r_{fs}V_f}{R_{f1} \dots R_{fs}} \right) \hat{R}_{ft} \right] \\
&= \frac{1}{\Pi_{f0}} \mathbb{E}_0 \left[\sum_{t=0}^{\infty} \frac{r_{ft}V_f}{R_{f1} \dots R_{ft}} \hat{r}_{ft} \right] - \frac{1}{\Pi_{f0}} \sum_{t=1}^{\infty} \mathbb{E}_0 \left[\frac{1}{R_{f1} \dots R_{ft}} \mathbb{E}_t \left[\sum_{s=t}^{\infty} \frac{r_{fs}V_f}{R_{ft+1} \dots R_{fs}} \right] \hat{R}_{ft} \right] \\
&= \sum_{t=0}^{\infty} \mathbb{E}_0 \left[\frac{r_{ft}V_f}{\Pi_{ft}} \frac{\Pi_{ft}/\Pi_{f0}}{R_{f1} \dots R_{ft}} \hat{r}_{ft} \right] - \sum_{t=1}^{\infty} \mathbb{E}_0 \left[\frac{\Pi_{ft}/\Pi_{f0}}{R_{f1} \dots R_{ft}} \hat{R}_{ft} \right]
\end{aligned}$$

where the second line uses the fact that $\Pi_{ft} = \mathbb{E}_t \left[\sum_{s=t}^{\infty} \frac{r_{fs}V_f}{R_{ft+1} \dots R_{fs}} \right]$, following (11). We then use the assumption that, on the baseline path $r_{ft}V_f/\Pi_{ft}$ is constant and equal to C_t/W_t (if not, all of our equalities should be understood as being at the first-order around this baseline path, as in [Campbell and Shiller \(1988\)](#)).¹ In particular, using the definition of ρ above, we can write $(\Pi_{ft} - r_{ft}V_f)/\Pi_{ft} = \rho$, which implies:

$$R_{ft+1} = \frac{\Pi_{ft+1}}{\Pi_{ft} - r_{ft}V_f} = \frac{1}{\rho} \frac{\Pi_{ft+1}}{\Pi_{ft}}$$

¹The underlying assumption is that, on the baseline path, consumption growth is i.i.d. and the cash flow of each firm grows at the same rate as aggregate consumption.

Plugging this into the previous equation gives:

$$\hat{\Pi}_{f0} = (1 - \rho) \sum_{t=0}^{\infty} \rho^t \mathbf{E}_0 [\hat{r}_{ft}] - \sum_{t=1}^{\infty} \rho^t \mathbf{E}_0 [\hat{R}_{ft}]$$

□

B Model Extensions

B.1 Adding Growth

The baseline model that we analyze does not allow for growth, but we can easily change it to a model in which productivity rises by ϕ each period. We demonstrate that the only effect of increasing productivity in this setup is to cause output, wages, and payments to the specific factor to rise by ϕ each period. We do this by showing that if output grows at a rate ϕ and prices do not change, then all factor and product markets will clear, and firms will continue to earn zero profits. We then show that if output grows at a rate ϕ , firms have no incentive to change prices, which means that we have identified an equilibrium. We model growth in our setup by assuming that firm output in each period is given by

$$y_{ft} = h\left(\phi^t V_f, \phi^t L_{ft}, m_{ift}\right),$$

where $\phi \geq 1$ is some parameter that determines TFP growth. Since labor and the specific factor are paid the value of their marginal product, we can write the wage and rental rate equations as

$$w_t = \phi^t h_L p_{ft} \quad \text{and} \quad r_{ft} = \phi^t h_V p_{ft}.$$

Thus, if firms do not change their employment levels and prices do not change, we will have $\Delta \ln w_t = \Delta \ln r_{ft} = \phi$. This result implies that real incomes will rise by ϕ , which means that if demand is homothetic and prices do not change, output will rise by ϕ . We also know from Proposition 1 that each firm will continue to employ the same number of workers as in period 0 if wages and rental rates rise by the same amount.

The new factor market clearing conditions in each time period will be

$$\sum_f \frac{a_{Lf0}}{\phi^t} (\phi^t y_{f0}) = L, \quad \text{and}$$

$$\frac{a_{Vf0}}{\phi^t} (\phi^t y_{f0}) = V_f.$$

An important implication of these equations is that if markets clear in period 0, they will also clear in period t .

Finally, we show that an equilibrium featuring no changes in prices from those in period 0 will also satisfy the zero-profit condition. In order to do this we first show that the unit-input requirement for materials doesn't change because separability of the production function means that

$$a_{ift} = \frac{m_{ift}}{y_{ft}} = \frac{a_{if0} y_{f0}}{y_{ft}} = a_{if0}.$$

One implication of this result is that intermediate input use grows at the same rate as output growth, i.e., $\Delta \ln m_{ift} = \Delta \ln y_{ft} = \phi$. If output in period t is given by $\phi^t y_{ft}$ and prices do not change, then the zero-profit condition (equation 1) can be written as

$$a_{Lft} w_t + a_{Vft} r_{ft} + \sum_i a_{ift} q_{it} = p_{ft}$$

$$\frac{a_{Lf0}}{\phi^t} (\phi^t w_0) + \frac{a_{Vf0}}{\phi^t} (\phi^t r_{f0}) + \sum_i a_{if0} q_{it} = p_{ft}$$

$$a_{Lf0} w_0 + a_{Vf0} r_{f0} + \sum_i a_{if0} q_{it} = p_{ft}.$$

Since we know that this equation holds in period 0, we know that if $q_{it} = q_{i0}$, then $p_{ft} = p_{f0}$. Intermediate input prices will not change if labor and specific factor productivity growth affects all firms equally because intermediate input usage, consumer demand, and supply will all grow at a rate of ϕ .

C Data and Measurement

C.1 Event Dates

The following table presents the event dates (i.e., the date of the first news report of each increase in tariffs), the date that new tariffs would be implemented, event group, and the news link of each event. The earliest event date was identified via Factiva and Google Search.

Table C.1: Details on Event Dates

Event Date	Implementation Date	Event Group	News Link
23jan2018*	07feb2018	US	Washington Post
01mar2018*	23mar2018	US	Reuters
22mar2018	23mar2018	US	NYT
23mar2018	02apr2018	China	CNBC
29may2018	07jun2018	US	NPR
15jun2018	07jun2018	China	NPR
19jun2018	24sep2018	US	WSJ
2aug2018	24sep2018	China	Reuters
6may2019**	05oct2019	US	DW
13may2019	01jun2019	China	CNBC
1aug2019	01aug2019	US	CNBC
23aug2019	01aug2019	China	CNBC

Note: Event dates with the first news release on a weekdays after trading hours (4:00 PM EST) are flagged by an asterisk (*). Event dates with the first news release on a weekend are flagged by two asterisks (**). In these instances, the trading day for the event is the first trading day after the news release.

C.2 Summary of Data Sources

Variable	Construction
Book Leverage	<p><i>Source: CRSP-Compustat Annual Merged Dataset (2017)</i></p> <p>Book leverage is total debt including current [dt] divided by assets (total) [at], dt/at</p>
Cash Flow to Asset Ratio	<p><i>Source: CRSP-Compustat Annual Merged Dataset (2017)</i></p> <p>The Cash Flow-to-Asset Ratio is operating income after depreciation [oiadp] plus interest and related expense (total) [xintq] all divided by assets (total) [at]; $(oiadp + xintq)/at$</p>
China Importer/ Exporter	<p><i>Source: FactSet Geographic Revenue Exposure datasets that report a firm's share of revenue by country in 2017</i></p> <p>The first dataset reports revenue share from major markets (including China) for 3,134 firms (identified by PERMNO). If we cannot match in our firm sample to this dataset, we try using a second dataset which reports the China revenue share for 10,118 tickers. If we cannot match a firm using either PERMNO or the ticker to one of the Datamyne datasets, we assume that its China revenue share is zero. More details in Section C.4.</p>
China Revenue Share	<p><i>Source: Datamyne dataset of the value and quantity of exports to and imports from China (via sea) by U.S. firms in 2017, Supply chain data from Capital IQ</i></p> <p>We combine the Datamyne dataset with supply chain data to determine whether each firm imported from or exported to China (via sea) in 2017 either directly or through a subsidiary/supplier. Refer to Section C.3 for details on variable construction.</p>

Variable	Construction
Economic Surprise Variables (ES_t)	<p><i>Source: Daniel Lewis based on Lewis et al. (2019)</i></p> <p>The difference between a macroeconomic data release value and the Bloomberg median of economists' forecast on the previous day. The 65 series we use to construct our economic surprise variables are ISM manufacturing, ISM non-manufacturing, ISM prices, construction spending, durable goods new orders, factory orders, initial jobless claims, ADP payroll employment, non-farm payrolls, unemployment rate, total job openings, consumer credit, non-farm productivity, unit labor costs, retail sales, retail sales less auto, federal budget balance, trade balance, import price index, building permits, housing starts, industrial production, capacity utilization, business inventories, Michigan consumer sentiment, PPI core, PPI, CPI core, CPI, Empire State manufacturing index, Philadelphia Fed BOS, GDP (advance estimate), GDP (second estimate), GDP price index, personal income, personal spending, PCE price index, core PCE price index, wholesale inventories, new home sales, CB consumer confidence, leading economic index, employment cost index, Wards total vehicle sales, continuing claims retail sales ex auto and gas, NAHB housing market index, change in manufacturing payrolls, MNI Chicago, PMI pending home sales, Richmond Fed manufacturing index, Dallas Fed manufacturing index, existing home sales, Chicago Fed national activity index, capital goods (non-defense ex air), NFIB small business optimal index, Cap goods ship. ex air, KC Fed manufacturing activity, Markit U.S. manufacturing purchasing managers index, Case-Shiller home price index, and Markit U.S. services purchasing managers index, federal funds shock, forward guidance shock, asset purchase shock, and the Federal Reserve information shock.</p>
Equity Premium Bound (EPB_t)	<p><i>Source: OptionMetrics, dataset with prices of actively traded option on the S&P 500 (ticker SPX)</i></p> <p>We follow Martin (2017) method for constructing EPB_t.</p>

Variable	Construction
Firm	<p><i>Source: CRSP-Compustat Annual Merged Dataset (2017)</i></p> <p>A firm is defined by its Compustat Global Company Key or GVKEY. In our sample, the GVKEY codes map one-to-one to the unique identifier and permanent identifier to security or PERMNO in CRSP. As such, we are able to use PERMNO (permno) and GVKEY (gvkey) interchangeably across datasets.</p>
Firm Employment L_f	<p><i>Source: CRSP-Compustat Annual Merged Dataset (2017)</i></p> <p>We define 2017 firm employment as employment (in thousands) [emp] times one thousand; emp \times 1000</p> <p>The employment variable in Compustat includes the following items: all part-time and seasonal employees; and all employees of consolidated subsidiaries, both domestic and foreign. The employment variable excludes: consultants, contract workers, and employees of unconsolidated subsidiaries</p>
Firm Returns ($\ln R_t$)	<p><i>Source: CRSP U.S. Stock Database 01/2015-12/2019</i></p> <p>We define log firm returns as the <i>log</i> of one plus net returns [ret]; $\ln(1 + \mathbf{ret})$</p>
Labor and Specific-Factor Shares (θ_{L_f} and θ_{V_f})	<p><i>Source: Compustat and BEA Input-Output table</i></p> <p>Firm cash flow as a share of revenue is calculated by dividing accounting cash flows with gross sales [sale] in 2017, obtained from Compustat. We use the BEA's 450-by-450 industry (6-digit NAICS) IO table in 2012 to construct labor and materials shares of revenue. In Section C.4, we describe how we combine all of these shares to construct the labor and specific-factor shares of value added (θ_{L_f} and θ_{V_f}).</p>

Variable	Construction
κ_f	<p>Source: CRSP-Compustat Annual Merged Dataset (2017)</p> <p>κ_f is defined as the ratio between the market value of equity and the market value of assets. The market value of equity (or market capitalization) is defined below. The market value of assets is the sum of the market value of equity and the value of debt, constructed as total assets [at] minus stockholder equity [seq] minus cash and short-term investments [che]; at – seq – che. If cash and short-term investments is missing, we replace it by zero</p>
Market Value of Equity	<p>Source: CRSP-Compustat Annual Merged Dataset (2017)</p> <p>The 2017 Market Value of Equity of a firm is equal “Market Value (total, fiscal)” [mkval], when this variable is unavailable we use the <i>product of</i> annual price close (fiscal) [prcc_f] and common shares outstanding [cscho]; prcc_f × cscho</p>
Profit	<p>Source: CRSP-Compustat Annual Merged Dataset (2017)</p> <p>Profit is “operating income after depreciation” [oiadp] minus “interest and related expense (total)” [xint]; oiadp – xint</p>
Property Plant and Equipment (PPE) per worker (PPE per Worker _f)	<p>Source: CRSP-Compustat Annual Merged Dataset (2017)</p> <p>PPE per worker is property, plant and equipment (gross total) [ppegt] divided by employees [emp]; ppegt/emp</p>
	<ol style="list-style-type: none"> 1. 2. 3. 4.

Variable	Construction
Treasury Yield (1- to 30-Month Maturity)	<p>1. Maturity: 3, 4, and 12 months <i>Source: Board of Governors of the Federal Reserve System, {3-Month, 6-Month, 1-Year} Treasury Bill Secondary Market Rate, Discount Basis; retrieved from FRED, Federal Reserve Bank of St. Louis</i></p> <p>We obtain the nominal yields with the following maturities from FRED: 3-Month [DTB3], 6-Month [DTB6], and 12-Month [DTB1YR].</p> <p>2. Maturity: all remaining maturities up to 30 months <i>Source: daily US yield curve data up to 2019 dataset from Gürkaynak et al. (2007); dataset retrieved from Refet Gürkaynak's website</i></p> <p>The US yield curve dataset was published alongside Gürkaynak et al. (2007) and is updated regularly. At the time of writing, the dataset reports nominal and real yields up until October 25, 2019 at different monthly maturities ranging from one to thirty months. Nominal yields in the paper refers to is "Zero-Coupon Yield (Continuously Compounded)" [SVNY_{xx}]</p>
Real Yields (1- to 30-Month Maturity)	<p><i>Source: daily US TIPS curve data up to 2019 dataset from Gürkaynak et al. (2010); dataset retrieved from Refet Gürkaynak's website</i></p> <p>The US yield curve dataset was published alongside Gürkaynak et al. (2010) and is updated regularly (data up to 10/25/2019). Real yields is "TIPS Yield Zero Coupon (Continuously Compounded)" [TIPSY_{xx}]</p>
Tobin's Q	<p><i>Source: CRSP-Compustat Annual Merged Dataset (2017)</i></p> <p>Tobin's Q is market capitalization <i>plus</i> book value of total assets [at] <i>minus</i> book value of common equity [ceq], <i>all divided</i> by the book value of total assets [at].</p>
U.S. Import Value	<p><i>Source: U.S. Census Bureau, U.S. Trade Representative (USTR), and U.S. International Trade Commission (USITC)</i></p> <p>We obtain 2017 and 2019 U.S. import values for each good (HTS10) and exporting country from the U.S. Census Bureau.</p>

Variable	Construction
U.S. Firm-size Distribution (Goods and Services)	<p><i>Source: U.S. Census Bureau, "Number of Firms, Number of Establishments, Employment, and Annual Payroll by Small/Large Enterprise Employment Sizes for the United States and States, NAICS Sectors: 2017" dataset</i></p> <p>The dataset reports reports the number of employees by industry (NAICS2) and employment bin. We use this dataset to compute the employment share of each of each employment bin and sector in the whole economy, where sector refers to goods (NAICS: 11, 21, 22, and 31-33²) and services (remaining 2-digit sectors). We use the following employment bins: 0-499, 500-4999, 5000-19999, 20000+</p>
U.S. Tariff Rates	<p><i>Source: U.S. Trade Representative (USTR), and U.S. International Trade Commission (USITC).</i></p> <p>In the paper, the tariff rate in year y for an industry and exporting country refers to the tariff rate in effect in December of year y. We use the December of 2017 and 2019 tariff rates applied to each product (HTS10) and exporting country reported by USTR and USITC.</p>

C.3 Construction of China-Exposure Variables

We consider three ways in which firms were exposed to China: importing, exporting, and foreign sales (either through exporting or subsidiaries). It is important to capture indirect imports that are ultimately purchased by U.S. firms because many firms do not import directly from China but instead obtain Chinese inputs through their subsidiaries or the U.S. subsidiaries of foreign firms. In order to identify the supply chains, we use DUNS numbers from Dun & Bradstreet to merge importers from Datamyne with a list of firms and their subsidiaries from Capital IQ. We use a firm-name match to link firms, subsidiaries, and their suppliers that are reported in Datamyne, Compustat, Bloomberg, and FactSet and identify which firms are trading with China directly or indirectly through their network of suppliers. After matching firms with identical names in two or more datasets, we manually compared firms with similar names to identify whether they are matches. We define "China Revenue Share" to be the share of a firm's revenues in 2018 (either obtained through sales of subsidiaries or exports) that arise from sales in China as reported in FactSet.

²11 - Agriculture, Forestry, Fishing and Hunting; 21 - Mining, Quarrying, and Oil and Gas Extraction; 22 - Utilities; 23 - Construction; 31-33 - Manufacturing

The Datamyne data used to identify U.S. firms that import from China or export to China have a number of limitations. First, the product level reported is more aggregated than that in the Harmonized Tariff System 8-digit level at which U.S. tariffs are set. While some of the Datamyne data are at the Harmonized System (HS) 6-digit level, much of it is at the far more aggregated HS2-digit level, making it impossible to know what share of a firm’s trade was affected by tariffs. We therefore use a binary exposure measure. Our “China Import” dummy is 1 if the firm or its supply network imported from China in 2017 and zero otherwise. We also construct a “China Export” dummy analogously for exports. Second, the Datamyne data only cover seaborne trade. The U.S. Census data reveal that in 2017, 62 percent of all imports from China and 58 percent of exports to China were conducted by sea. So although we capture over half of the value of U.S.-China trade, the China import and export dummies are likely to miss some U.S. firms that trade with China. On the export side, any exporters that are not reflected in the export dummy are included in the China revenue share variable. To check for missing importers, we also include a robustness check where we replace the importer dummy with a large firm dummy equal to 1 for all firms with more than 1000 employees from Compustat.

C.4 China Revenue Share

The China revenue share variable is from FactSet. There are two potential issues we note. First, firms sometimes report geographic revenue shares for units that are more aggregate than countries (e.g., Asia/Pacific). In these cases, FactSet imputes the undisclosed revenue share for a country using that country’s GDP weight within a more aggregate geographic unit for which the data are disclosed (e.g., China’s GDP share within Asia/Pacific region). FactSet provides a confidence factor that ranges from 0.5 to 1, with 1 indicating no imputation. Fortunately, within our sample of firms, the mean confidence factor for the China revenue share is 0.996 with a range of 0.98 to 1, and our China revenue share variable comes mostly from direct disclosures.

C.5 Construction of factor share variables

In order to construct the labor and specific-factor share variables (θ_{L_f} and θ_{V_f}), we set $r_f V_f / (p_f y_f)$ equal to the firm’s operating income after depreciation less interest expenses, divided by sales as reported in Compustat in 2017 and kept firms for which this value was positive.³ Because Compustat does not separately report the compensation of employees and materials cost by firm, we need to use industry-level data in order to infer $w L_f / (p_f y_f)$ and $\sum_i \omega_{if}$. To do this, we set $LSHARE_f$ and $MSHARE_f$ equal to the compensation of employees divided by output and intermediate-input expenses divided by output in the NAICS 6-digit industry containing the firm, as reported in the 2012 450×450 Bureau of Economic Analysis Input-Output table (the most recently available disaggregated IO table). Since we are using data from two different sources to compute the shares, they may not sum to 1. Therefore, in order to preserve this property, we set $w L_f / (p_f y_f) = \Theta_f LSHARE_f$ and $\sum_i \omega_{if} = \Theta_f MSHARE_f$, where

³Operating income after depreciation equals firm revenue less cost of goods sold, sales, general and administrative expenses and depreciation. Labor costs appear in the cost of goods sold and the market and administration expenses lines. We also tried an alternative measure of $r_f V_f$ in which we did not subtract interest expenses, but it only had small effects on the results.

$$\Theta_f = \frac{\left(1 - \frac{r_f V_f}{p_f y_f}\right)}{\text{LSHARE}_f + \text{MSHARE}_f}.$$

Once we constructed these variables we used equation (7) to construct θ_{L_f} and θ_{V_f} .

C.6 Sample Statistics

Table C.3: Descriptive Statistics

	N	Mean	SD	p25	p50	p75
Ratio of Equity to Total Assets κ	2,390	0.73	0.24	0.57	0.76	0.97
China Importer Dummy	2,390	0.32	0.47	0.00	0.00	1.00
China Exporter Dummy	2,390	0.04	0.21	0.00	0.00	0.00
China Revenue Share	2,357	0.03	0.10	0.00	0.00	0.03

Note: The panel used for make this table is identified at the firm level. This table excludes firms that are are incorporated outside of the United States. The China Importer and China Exporter dummies equal 1 for firms that import or export to China as recorded in Datamyne. China Revenue Share is the share of a firm's revenues that come from China (from Factset). The Large Company Dummy is 1 when a firm has at least 1,000 employees, sourced from Compustat.

D Details on Reweighting the Compustat-CRSP sample

We now detail how we reweight the sample of firms in our Compustat-CRSP sample to approximate the distribution of firms in the U.S. across sectors and employment size. We first describe the method used in our baseline results, that uses a non parametric approach. We then describe an alternative method, used as a robustness exercise, that uses a more parametric approach with a finer employment grid.

D.1 Baseline method.

We start by dividing the set of firms in our sample into 18 sectors (defined by their first 2-digits NAICS code) and four employment bins (0-500, 501-5,000, 5,001-20,000, 20,001+). For the sectors corresponding to the NAICS codes 11, 61, 62, 81, we only use two employment bins, below or above 20000, to ensure that there are enough firms within each bin.

We compute the average deviation in firm value in sector s and employment bin b for event j as:

$$\hat{\Pi}_{sb0}^j \equiv \sum_{f' \in \Omega_{sbj}} \frac{L_f}{\sum_{f' \in \Omega_{sbj}} L_{f'}} \Pi_{f0}^j.$$

where Ω_{sbj} denotes the set of firms in sector s and employment bin b with a non missing return on event j and $\Pi_{fj} = \kappa_{f \in f,j}$ denotes the change in firm value over the day in which event j happens. We then compute the overall deviation in firm value in sector s and employment bin b as the sum of the average deviation on all tariff announcement days j in our sample

$$\hat{\Pi}_{sb0} \equiv \sum_{j=1}^J \hat{\Pi}_{sb0}^j.$$

The average deviation in firm value in sector s is given by

$$\hat{\Pi}_{s0} \equiv \sum_{b \in \Omega_s^B} \frac{L_{sb}}{\sum_{b' \in \Omega_s^B} L_{sb'}} \hat{\Pi}_{sb0},$$

where Ω_s^B is the set of employment bins b in sector s and L_{sb} denotes the overall employment in bin b and sector s in the U.S. economy, provided by the Statistics of U.S. Businesses (SUSB, U.S. Census Bureau). As a final step, we compute the overall deviation in firm value for the whole economy as

$$\hat{\Pi}_0 \equiv \sum_{s \in \Omega^S} \frac{VA_s}{C} \hat{\Pi}_{s0},$$

where Ω^S denotes the set of sectors, VA_s is the value added of sector s and C is personal consumption expenditures, all obtained from the BEA.

D.2 Alternative approach

Under this alternative methodology, we divide the set of firms in our sample into 18 sectors (defined by their first 2-digits NAICS code) and a finer grid of ten employment bins (defined by nine employment thresholds 500, 750, 1000, 1500, 2000, 2500, 5000, 10000, and 20000). With this finer employment grid, some {sector s , employment bin b , announcement j } cells have zero or very few firms. To handle this issue, we first regress, within each event and sector, the deviation in firm value on log employment and log employment squared. We then use the predicted values from this regression to construct the average deviation in firm value for each {sector s , employment bin b , announcement j } cell. The final step is similar to the previous method: we obtain the overall deviation in firm value in the economy by taking an employment weighted average within each sector, and then a value-added weighted average across sectors.

E Estimating Changes in Discount Rates

E.1 Additional Discount-Rate Figures

Similarly to Table 1, Appendix Table E.1 reports the change in nominal yields, real yields, and in the equity premium bound event-by-event. This shows that our results are not driven by some outlier event: almost all announcements tend to decrease real yields and increase the equity premium bound.

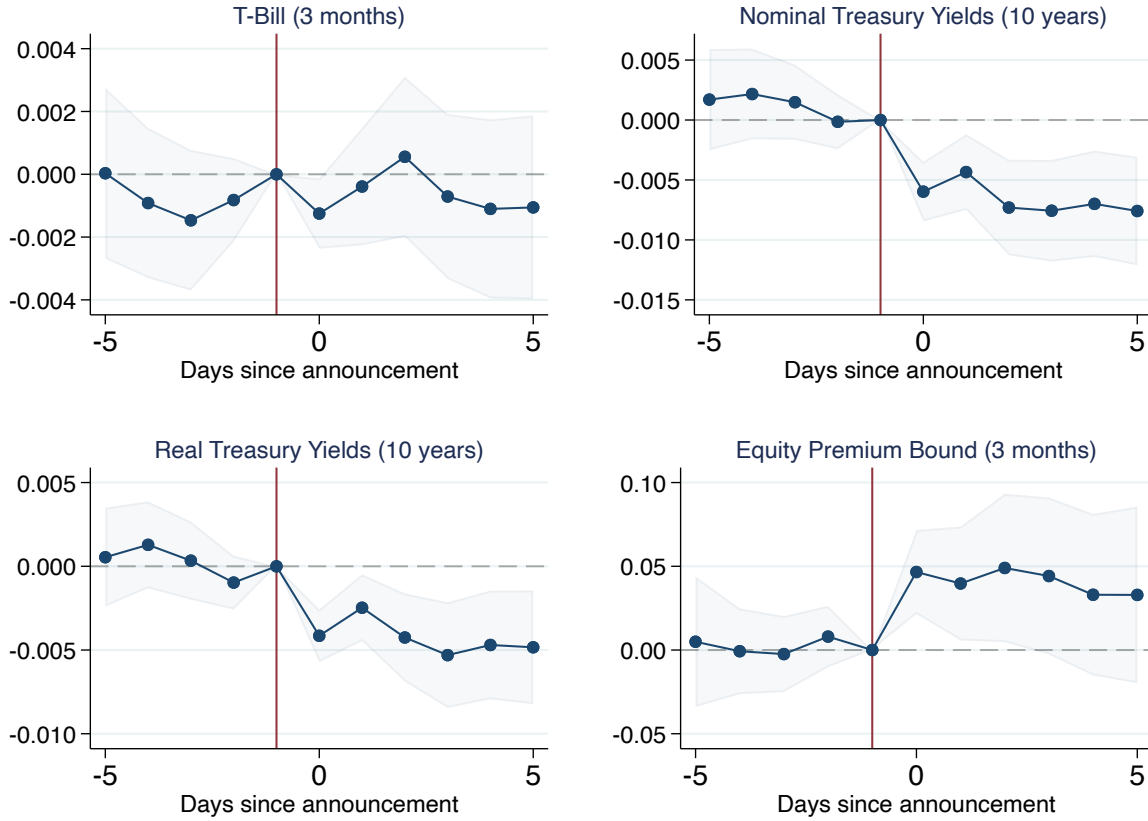
Table E.1: Change in Discount Rates on Trade War Event Days

Event Date	Δ T-Bill (3m) (x100)	Δ Nominal Yields (10y) (x100)	Δ Real Yields (10y) (x100)	Δ EPB (12m) (x100)
23jan2018	-0.01	-0.03	-0.03	0.02
01mar2018	-0.03	-0.06	-0.04	0.23
22mar2018	-0.02	-0.07	-0.05	0.35
23mar2018	0.02	-0.00	0.00	0.29
15jun2018	0.00	-0.01	-0.02	0.07
19jun2018	0.00	-0.03	-0.03	0.10
02aug2018	-0.01	-0.02	-0.01	-0.04
06may2019	0.01	-0.03	-0.03	0.11
13may2019	-0.02	-0.07	-0.04	0.29
01aug2019	-0.01	-0.13	-0.05	0.12
23aug2019	-0.03	-0.09	-0.08	0.45
Cumulative	-0.10	-0.54	-0.36	1.98

Note: The table reports the daily change in each variable on each announcement day. We obtain the daily yield-to-maturity on 3-months T-Bill from FRED, the daily nominal and real yield-to-maturity on 10-years Treasuries from [Gürkaynak et al. \(2007\)](#), and the daily equity premium bound from OptionMetrics, using the methodology of [Martin \(2017\)](#).

Similarly to Figure 3, Appendix Figure E.1 reports the dynamic effect of announcements on these variables over a five days window. This figure shows that the change in these variables is concentrated on the days of the announcements, which seems to refute the idea that the market under or overreacted during these days.

Figure E.1: The Dynamics of Discount Rates around Trade War Events



Note: This figure plots the cumulative change in each variable from the day before the announcement. Formally, we estimate the following regression on all trading days between 2017 and 2019: $\Delta Y_t = \alpha + \sum_{s=-4}^5 \beta_s D_{s,t} + \sum_{d=1}^D \gamma_d \times ES_{d,t} + \epsilon_{t,r}$, where $D_{s,t} = 1$ if day t is s days after an announcement; $D_{s,t} = 0$ otherwise and $ES_{d,t}$ denotes the surprise in macroeconomic releases. We then plot the cumulative change in Y_t from the eve of the announcement to the horizon s as $11 \sum_{k=s+1}^{-1} \hat{\beta}_k$ if $s < -1$ and $11 \sum_{k=0}^s \hat{\beta}_k$ if $s > -1$. Shaded areas correspond to the 95 percent confidence-interval computed using robust standard errors.

E.2 VAR

We now discuss more precisely how we construct the set of variables used in the VAR discussed in (18). The log risk-free rate $\ln R_{\text{risk-free}, t}$ corresponds to the annualized yield of 3-month T-Bills (DTB3 in FRED) minus the growth of the CPI price index (CPIAUCSL in FRED) in the previous year. The excess market return $\ln R_{EM, t}$ corresponds to the log return of CRSP value-weighted stock market minus the risk-free rate implied by the yield of 3-month T-Bills. The term spread TS is the annualized yield-to-maturity of ten-year treasuries (SVENY10 in Gürkaynak et al. (2007)) minus the annualized yield of 3-month T-Bills. The equity premium bound, EPB, corresponds to the annualized equity premium for the 3-month horizon constructed using the methodology of Martin (2017), using data from OptionMetrics. The value spread, VS , is the log difference in log book to market value equity between the top 10 percent and the bottom 10 percent of firms ranked by book to market equity, constructed using data from Fama-French library. The credit spread, CS , is the difference between the yield of BAA bonds, from Moody's Seasoned Baa Corporate Bond Yield, and the log risk-free rate. The log price-dividend ratio, $\ln PD$, is the logarithm of a smoothed average price-dividend ratio, constructed as the the dividends distributed by the value-weighted CRSP portfolio in the past year divided by its current price. In some robustness tests, we also add the return of the small-minus-big portfolio SMB (i.e., a portfolio long small firms and short big firms) and the return of the high-minus-low portfolio HML (i.e., a portfolio long high book-to-market equity and short low book-to-market equity) from Fama-French data library.

Table E.2: Effect of Trade War Events on Asset Prices dx_0 (One-Day Window)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	$\log R_{\text{risk-free}}$	$\log R_{EM}$	TS	EPB	VS	CS	$\log PD$	SMB	HML
Event	-0.000** (0.000)	-0.125*** (0.040)	-0.005*** (0.001)	0.046*** (0.013)	0.092*** (0.030)	-0.001*** (0.000)	-0.127*** (0.039)	0.016 (0.015)	-0.041** (0.017)
N	753	754	753	753	753	753	753	754	754

Note: The table reports the sum of β_j in the regression (21). The sample includes all trading days from 2017 to 2019. Robust standard errors in parentheses.

Table E.3: Effect of Trade War Events on Asset Prices dx_0

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	$\log R_{\text{risk-free}}$	$\log R_{EM}$	TS	EPB	VS	CS	$\log PD$	SMB	HML
Event	-0.000 (0.000)	-0.112* (0.066)	-0.003 (0.002)	0.039 (0.024)	0.051 (0.048)	-0.000 (0.000)	-0.130** (0.066)	0.027 (0.031)	-0.023 (0.029)
N	753	754	753	753	753	753	753	754	754

Note: The table reports the sum of β_j in the regression (21), using three-day windows around announcement. The sample includes all trading days from 2017 to 2019. Robust standard errors in parentheses.

Table E.4: Robustness Exercises for Changes in Future Discount Rates

Specification	Deviations in Discount Rates $\rho \mathbf{B}(I - \rho \mathbf{B})^{-1} d\mathbf{x}_0$			
	Risk-free Rate	Excess Returns	SMB	HML
	$\sum \rho^t \mathbf{E}_0 [\hat{R}_{\text{risk-free},t}]$	$\sum \rho^t \mathbf{E}_0 [\hat{R}_{EM,t}]$	$\sum \rho^t \mathbf{E}_0 [\hat{R}_{SMB,t}]$	$\sum \rho^t \mathbf{E}_0 [\hat{R}_{HML,t}]$
Baseline	-0.021	0.089		
Without TS	-0.017	0.090		
Without EPB	-0.013	0.083		
Without VS	0.003	0.076		
Without CS	-0.008	0.084		
Without log PD	-0.023	0.047		
FF 3-Factor Model	-0.009	0.074	0.026	0.006
3-Days Window	-0.005	0.088		

Note: The table reports $\rho \mathbf{B}(I - \rho \mathbf{B})^{-1} d\mathbf{x}_0$, where \mathbf{x}_0 is reported in Table E.2 (using a one-day window) and Table E.3 (using a three-day window).

F Treatment Robustness

Table F.1: Effect of Tariff Announcements on the Components of Cash Flow and Stock Returns

	Deviation in ...					
	Discount-Rate (1)	Asset-Value (2)	logR (3)	Discount-Rate (4)	Asset-Value (5)	logR (6)
China Importer	0.36*** (0.10)	-2.31*** (0.28)	-2.54*** (0.35)	0.25*** (0.07)	-0.71*** (0.22)	-0.32 (0.28)
China Exporter	-0.53*** (0.16)	-0.67 (0.47)	-2.17*** (0.70)	-0.35*** (0.11)	0.37 (0.37)	-0.52 (0.60)
China Revenue Share	7.11*** (0.98)	-13.20*** (2.03)	-11.33*** (2.10)	4.49*** (0.72)	-9.12*** (2.11)	-6.18*** (2.09)
N	26,807	26,807	26,807	26,807	26,807	26,807
Events	U.S.	U.S.	U.S.	China	China	China

Note: All dependent variables are multiplied by 100. A firm f 's deviation discount rate on trading day t corresponds to the term $\sum_{t=1}^{\infty} \rho^t E_0[\hat{R}_{ft}]$ in the theory section. A firm's asset value on a trading day t is market value plus debt. The deviation in a firm f 's cash flow on the day t , denoted by \hat{r}_{ft} , is the sum of its deviation in the discount rate and deviation in asset value. This table uses a 1-day window around each event, enforces a balanced panel of firms, and drops firms in the financial sector. China Importer is a dummy that equals 1 if the firm or any of its subsidiaries or suppliers import from China. China Exporter is a dummy that equals one if the firm or subsidiaries export to China. China Revenue Share is the share of the firm's revenue that comes from sales in China, reported in percentage points. Columns 1-3 presents the cumulative of the coefficients on each of the U.S. event days; and columns 4-6 are the cumulative of the coefficients on each of the China event dates. Standard errors are in parenthesis. Asterisks correspond to the following levels of significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

G Future Observables

Table G.1: Relationship between Changes in Returns and Future Observables (with Controls Reported)

	(1)	(2)	(3)	(4)
	$\ln(L_{ft})$	$\ln(\text{Sales}_{ft})$	$\ln(\text{Profit}_{ft})$	$\ln(\text{Sales}/L)_{ft}$
Post \times $\ln R_f$	0.07*** (0.01)	0.12*** (0.02)	0.23*** (0.04)	0.04** (0.02)
Post \times PPE per Worker $_f$	-0.01 (0.01)	-0.00 (0.01)	-0.00 (0.02)	0.00 (0.01)
Post \times $\ln(\text{Mkt. Val. of Equity}_f)$	-0.01 (0.01)	0.02* (0.01)	0.03** (0.01)	0.02*** (0.01)
Post \times $\frac{\text{Cash Flows}}{\text{Assets}}_f$	0.02*** (0.01)	-0.07*** (0.01)	-0.39*** (0.03)	-0.08*** (0.01)
Post \times Book Leverage $_f$	-0.04*** (0.01)	-0.02** (0.01)	0.05*** (0.02)	0.01* (0.01)
Post \times Tobin's Q $_f$	0.07*** (0.01)	0.08*** (0.01)	0.09*** (0.02)	0.01 (0.01)
Firm FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
R^2	0.976	0.962	0.915	0.873
Observations	17032	16760	11940	16736

Note: Data is at the firm-annual level for the period 2013 to 2021, from Compustat and CRSP. Profit is defined as operating income after depreciation less interest and related expenses. We follow [Greenland et al. \(2024\)](#)'s specification in defining $\ln R_f$ as the log of one plus the average return on 5 days surrounding the tariff-announcement dates across all event dates in 2017-2019; however, instead of using abnormal returns, we just simply use the actual return. In this table, $\ln R_f$ is then multiplied by 100. The Post dummy takes a value of one in 2019, 2020, and 2021. All columns include the following control values at the start of the sample (i.e. 2013) interacted with the Post dummy as covariates: Property, Plant, and Equipment (PPE) per worker, market capitalization, cash-flow-to-asset ratio, book leverage and Tobin's Q. The controls are winsorized at the 1 percent level and then demeaned and divided by their standard deviation. See [Appendix C.2](#) for details on variable constructions. Standard errors are in parenthesis. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.