Trade Policy Uncertainty and Chinese Exports During the US-China Trade War*

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Abstract

We evaluate the impact of trade policy uncertainty on Chinese exports to the US during the US-China trade war. Exploiting variations in uncertainty after tariff announcements across different products, we find that uncertainty significantly reduces Chinese exports to the US. Products with relative increases in uncertainty have on average 6 log points lower exports after the announcement. This result is robust when we take into account the stockpiling behavior during the announcement period. We further explore the underlying mechanisms and find that uncertainty reduces exports only for high-sunk-cost industries, possibly by deterring firm-level entry. Finally, we find that uncertainty not only discourages exports of targeted products, but also spills over to related products that are not directly targeted.

JEL Codes: F1, F13, F14

Key Words: Trade Policy Uncertainty; the US-China Trade War

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1 Introduction

Starting in 2018, the US implemented a series of trade policies that substantially increased the trade barriers for Chinese exports into the US, initiating the so-called "US-China Trade War". The average tariffs on imports from China rose from 3.1% in January 2018 to 21% in January 2020 (Bown (2021)). The escalation of the trade war led to high levels of uncertainty about trade policy. Figure 1 shows the news-based trade policy uncertainty index (solid blue line) developed by Baker et al. (2016), alongside the timing of each tariff announcement (vertical lines).[1] As we can observe, trade policy uncertainty (TPU, hereafter) increased significantly during the trade war episode and reached its peak in August 2019.[2] Recent research has demonstrated that changes in TPU might be equally important as changes in tariffs in explaining trade flows (Handley and Limão (2017); Feng et al. (2017)). Therefore, understanding how the increased policy uncertainty affects US-China trade during the trade war episode is crucial for researchers and policymakers to evaluate the overall consequences of the trade war on the economy. Nevertheless, despite the unprecedented level of uncertainty and its importance, most existing studies primarily focus on the effects of tariffs during this period (e.g., Fajgelbaum et al. (2019)), with little attention on the uncertainty of tariffs.[3] This partly reflects the dual challenges of disentangling the effect of trade policy uncertainty from that of tariffs within the context of the trade war, as well as accurately measuring the time-varying trade policy uncertainty.

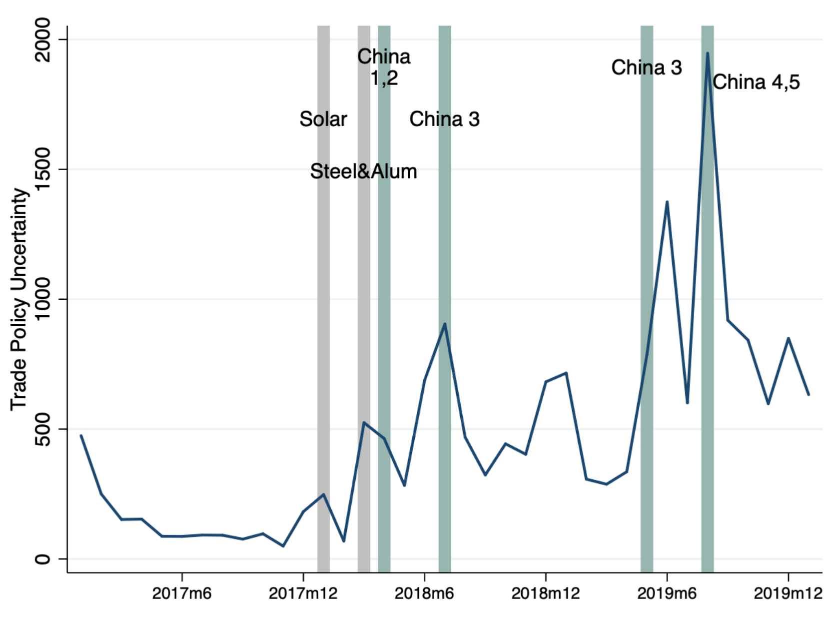
This paper aims to fill this gap by evaluating the impact of trade policy uncertainty (TPU, hereafter) on Chinese exports to the US during the trade war episode. We tackle these challenges by focusing on a specific period between each tariff announcement and its actual implementation. This period, referred to as the "announcement period", is characterized by increasing uncertainty about future tariffs and, more importantly,

[1]The US Trade Policy Uncertainty Index is one of the category-specific Economic Policy Uncertainty (EPU) indexes developed in Baker et al. (2016).

[2]In August 2019, the U.S. announced tariffs on $300 billion worth of imports from China.

[3]One exception is Benguria et al. (2020), which uses textual analysis to measure TPU for listed Chinese firms in China and investigates the impact of firm-level TPU on various outcomes.

Figure 1: Trade Policy Uncertainty and Import Tariff Waves



Notes: TPU news-based index is from Baker et al. (2016), which captures the frequency of articles in American newspapers that included policy-related economic uncertainty and also trade policy-related words. Two grey vertical lines denote the timing of the announcement of tariff waves targeting solar panels & washing machines, and steel & aluminum. Green vertical lines represent tariff waves on Chinese exports, which are categorized into 5 waves with detailed definitions in section 2.

constant tariff levels, allowing us to disentangle the impact of uncertainty from that of tariffs.[4]

We measure changes in trade policy uncertainty after the tariff announcement following the framework proposed by Handley and Limão (2017; 2022). Their framework emphasizes two key elements of uncertainty: the probability of imposing higher tariffs and the changes in tail risk.[5] The tail risk is measured by the ratio between potential worst-case and current tariff levels, capturing exporters' profit loss if the worst-case tariffs are realized. Under the context of the trade war, we assume that the probability of imposing higher tariffs (the first element of TPU) rises *uniformly* for all products targeted in the same wave following the tariff announcement. However, the tail risk

[4]This increasing uncertainty is illustrated by Figure 1, in which the TPU news index rises when each new wave of tariffs is announced (green vertical line) and decreases after the tariffs take effect.

[5]This framework of trade policy uncertainty has been widely used in the literature. For example, Graziano et al. (2021) applies this framework to the Brexit context.

of each product (the second element of TPU) could change in *different* directions. In particular, we argue that at the time of tariff announcement, firms update their belief about the worst-case tariff level to the announced level. Hence, change in tail risk for each product is determined by the difference between the *prior* and *updated* belief about the worst-case tariff. Specifically, we assume that the prior belief about the worst-case tariff is the column-2 tariff rates, while the updated belief is the announced tariff level.[6] Consequently, the overall changes in uncertainty can vary across different products, even within the same wave following the tariff announcement.

We employ a difference-in-difference strategy to identify the effects of TPU on Chinese exports to the US, exploiting the variations in uncertainty changes following tariff announcements across products. Based on our identifying assumptions, a product experienced a relative increase in TPU if its updated belief about worst-case tariff is higher than the prior belief. Therefore, we can identify the impact of TPU by comparing changes in exports of these two groups of products. It's worth noting that while tariffs remain constant during the announcement period, the anticipation of tariffs could cause firms to stockpile before tariffs come into effect (Alessandria et al. (2024)). As a result, this anticipation effect may confound the effect of uncertainty. To mitigate this issue, we introduce an interaction term between the announcement dummy and the anticipated magnitude of tariff increases, allowing us to control for the anticipation effect.

We find that uncertainty significantly reduces Chinese exports to the US. Products with increased tail risk experience, on average, 6 log points lower exports after the announcement than products with decreased tail risk. The results remain consistent when we substitute the tail risk dummy with changes in the value of tail risk: a standard deviation increase in tail risk corresponds to a 4 log point reduction in exports. To address the concern that the trade war tariffs might be endogenous, we further control for wave-specific time-varying shocks by adding the wave-time fixed effect. By doing so, our identification essentially exploits the variation in uncertainty across products within

[6] The column-2 tariff rates were set by the U.S. in the 1930 Smoot-Harley Tariff Act and were the tariff rates Chinese exporters potentially faced before the WTO accession.

the same wave. Our results remain robust. In addition, our estimates indicate that the anticipation effect is more pronounced for products expecting larger tariff increases. Our results are not driven by the pre-existing trend of products with different changes in TPU and are robust to different measurements of tail risks.

We examine the underlying mechanisms that drive our baseline results. Firstly, we split industries into high- and low-sunk-cost industries and find that uncertainty reduces exports only in high-sunk-cost industries, suggesting that uncertainty reduces firm entry through the sunk-cost channel. Secondly, the anticipation effect is more pronounced for more storable goods, and exports of these storable products are more responsive to tariff increases, indicating a larger de-stockpiling effect after tariffs are realized.

Finally, we explore the spillover effect of uncertainty by analyzing its impact on non-targeted products. We split these products into a "treated" group if they are in the same broad product category as the targeted products, and a control group otherwise. We find that uncertainty not only dampens the exports of targeted products, but also spills over to related products that are not directly targeted.

Related Literature This paper contributes to the literature on trade policy uncertainty by introducing a novel approach to identifying the impact of uncertainty during the US-China trade conflicts. Pioneering work by Handley and Limão (2017) and Pierce and Schott (2016) use China's WTO accession to evaluate how a decrease in trade policy uncertainty affects multiple outcomes such as trade patterns and employment. Subsequent work examines the consequences of increases in uncertainty in other events, such as Brexit (Steinberg (2019); Graziano et al. (2021)) or in other trade policies, such as anti-dumping duties (Crowley et al. (2018)). Our work complements existing empirical work by utilizing the changes in firms' beliefs about (worst-case) tariffs, which lead to variations in TPU across products, thus providing new insights into measuring and identifying trade policy uncertainty.

This paper also adds to the growing literature on evaluating the consequences of the US-China trade war. Existing research has examined how the increased tariffs affect various outcomes including prices and welfare (Amiti et al. (2019); Fajgelbaum et al.

(2019); Cavallo et al. (2021)); supply chain and exports (Handley et al. (2020)); investment and stock market(Huang et al. (2023)). Our paper emphasizes the importance of rising trade policy uncertainty during this event. Closely related to our work, Benguria et al. (2020) constructs the TPU index for Chinese listed firms using textual analysis of earnings calls report during the trade war and evaluates its impact on firm-level outcomes. Our paper complements this work by providing a systematic approach to identify the effect of TPU on a broader sample of Chinese exports during this period.

Lastly, this paper is related to recent literature that examines firms' behavior in anticipation of policy changes (Khan and Khederlarian (2021); Alessandria et al. (2024)). For instance, Alessandria et al. (2024) find evidence of anticipatory stockpiling behavior for China's MFN status renewal during the 1990s. Similarly, we identify robust anticipatory stockpiling behavior during the trade war period and disentangle the effects of anticipation and uncertainty.

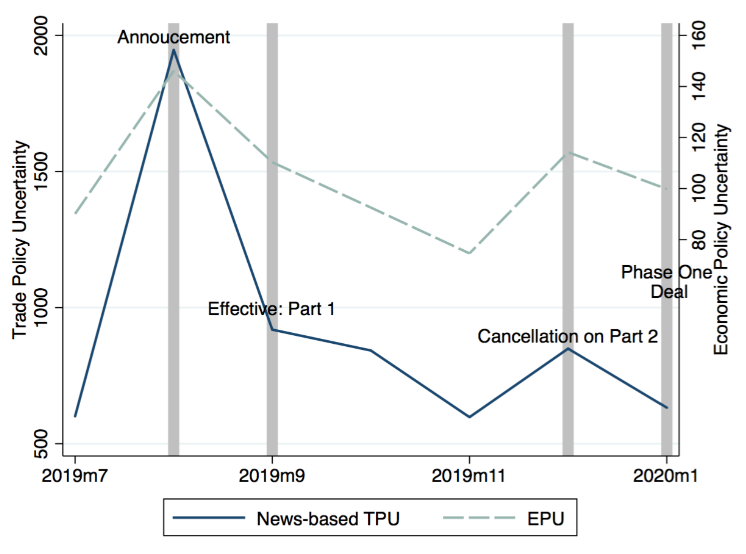
2 Background

The US-China trade war began in April 2018, when the Trump administration announced a 25 percent tariff on $50 billion of Chinese exports. Over a two-year period (2018-2019), the US implemented five waves of tariffs on Chinese exports, covering $522 billion worth of goods, which constitute around 90% of total Chinese exports to the US in 2017. Despite the cancellation of the last wave of tariffs due to the US-China Phase One deal, the remaining tariffs still covered 63% of total imports from China. In response, China retaliated against the US by imposing several rounds of tariffs on American goods.

This paper focuses on the five waves of US tariffs on Chinese exports and the associated trade policy uncertainty. Specifically, the five waves of tariffs are listed as follows:

- **wave 1**: 25 percent tariffs on $34 billion Chinese exports, announced on April 3,

Figure 2: Trade Policy Uncertainty During Wave 4/5



Notes: The two waves are announced at the same time, Aug 2019. Wave 4 went into effect on Sep 1, 2019, and wave 5 was scheduled to take effect on Dec 15, 2019, until it was canceled in December 2019.

2018, effective on July 6, 2018.

- **wave 2**: 25 percent tariffs on $16 billion Chinese exports, announced on April 3, 2018, effective on August 23, 2018.
- **wave 3**: 10 percent tariffs on $200 billion Chinese exports, announced on July 10, 2018, effective on Sep 24, 2018, increased to 25 percent on May 10, 2019.
- **wave 4**: 15 percent tariffs on $112 billion Chinese exports, announced on August 1, 2019, effective on September 1, 2019.
- **wave 5**: 15 percent tariffs on $160 billion Chinese exports, announced on August 1, 2019, planned to take effect on December 15, 2019, and canceled in December 2019.

Note that there is usually a few months gap between each tariff announcement and its implementation. We focus on the rising uncertainty during this "announcement" period. To see it more clearly, Figure 2 illustrates how the TPU news index evolved during the last two waves (wave 4 and 5): uncertainty peaked at the time of the tariff announcement and declined sharply when the tariffs took effect.[7] Intuitively, when the U.S. announces new tariffs, the probability of higher tariffs increases while there are also chances the announced tariffs would be canceled if both sides reach an agreement.[8] The tariff announcement raises the probability of higher tariffs (usually 10 or 25 percent additional tariffs) for products in this wave, thus causing high levels of tariff uncertainty. However, after the additional tariffs take effect, the products enter a high-tariff state. While uncertainty remains regarding whether these tariffs would be escalated or canceled, the overall chances of higher tariffs decrease.

3 TPU Measurement

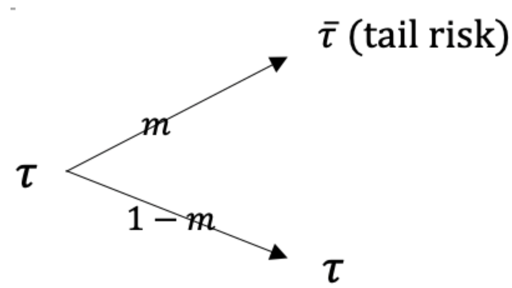
We characterize and measure changes in TPU after tariff announcement following Handley and Limao(2017, 2022)'s theoretical framework. This framework models trade policy uncertainty as a policy regime change. The policy regime is characterized by the probability of tariff shock γ and the policy distribution H conditional on the policy shock.

We apply this framework to the US-China trade war setting. Specifically, we focus on how the tariff announcement changed the policy regime $\{\gamma, H\}$. In each tariff announcement, the USITC published a product list that specifies which HS8 product was subject to the additional tariffs, as well as the additional tariff level and its effective date. Therefore, a tariff announcement first indicates a uniform increase in the probability of tariff shock (γ) for all HS8 products included in this wave. Second, conditional on the policy shock, the announcement changes the tariff distribution (H) for each product in this wave. In particular, we argue that the announcement changes the tail risk of distribution H, and we exploit the variation in changes in riskiness across products to

[7] During these waves, a minor uncertainty increase occurred in December when President Trump canceled the last wave of tariffs, followed by a decrease upon the announcement of the Phase-One deal with China.

[8] Indeed, the 5th wave of announced tariffs was canceled before its implementation as the US and China reached the phase-one deal.

Figure 3: Tariff Distribution under Uncertainty



identify the impact of TPU.

To see it more clearly, suppose before the tariff announcement, firms have a prior belief on the tariff distribution, denoted as H^{pre}. We discretize the pre-war distribution as two mutually exclusive states: MFN and worst-case tariff $\bar{\tau}$. The worst-case tariffs determine the level of potential profit loss for exporters, and we denote it as the tail risk. As shown in Figure 3, the tariffs could switch to the potential worst-case state $\bar{\tau}$ with a probability of m or remain constant at the level of the MFN tariff with a probability of $1 - m$. The announcement changed the tariff distribution, specifically, exporters' beliefs about the worst-case tariff from $\bar{\tau}$ to a new level $\bar{\tau}^{new}$. Next, we discuss how we determine exporters' beliefs on the worst-case tariffs before and after the tariff announcement.

We argue that a potential candidate for the prior belief on worst-case tariffs is the column-2 tariff rates. The column-2 tariff rates were set by the U.S. in the 1930 Smoot-Harley Tariff Act and are the tariff rates Chinese exporters potentially faced before the WTO accession. In fact, according to a report by USCBC, three of the leading Republican presidential candidates and some congressmen proposed revoking China's PNTR status and re-imposing column-2 tariffs during the pre-war period. In addition, the column-2 tariff is a proxy for the optimal tariff in a non-cooperative scenario, as in the trade-war case (Broda et al. (2008)). Moreover, using pre-war period (2014m1-2017m12) trade data, we show that column-2 tariffs are the relevant prior belief about the worst-case scenario for Chinese exporters during this period, especially after the 2016 presidential election. The results are reported in Appendix A.

Firms update their belief on the tariff distribution after the announcement, which is denoted as H^{war}. It is intuitive to assume the updated worst-case tariffs are equal to the announced tariff levels, which are the current tariffs plus 10 or 25 percent additional tariffs depending on the specific wave.[9] Therefore, the tariff announcement changes exporters' belief on the worst-case tariff, leading to changes in the riskiness of tariff distribution. More specifically, we follow Handley and Limão (2017)'s specification in measuring the product-level tail risk, and construct the changes in riskiness for product v as follows:

$$\Delta risk_v = risk_v^{war} - risk_v^{pre} = (1 - (\frac{\tau_v^{war}}{\tau_v^{mfn}})^{-\sigma}) - (1 - (\frac{\tau_v^{pre}}{\tau_v^{mfn}})^{-\sigma}) \tag{1}$$

$$= \frac{(\tau_v^{pre})^{-\sigma} - (\tau_v^{war})^{-\sigma}}{(\tau_v^{mfn})^{-\sigma}} \tag{2}$$

Product v's tail risk is a function of current applied tariff level and the potential worst case tariff. In our setting, the applied tariffs (MFN) remain constant after the tariff announcement. Therefore, the product-level change in tail risk depends on the difference between the prior (column 2) and updated beliefs about worst-case tariffs. The distribution of changes in tail risk across products is reported in Appendix B.

To sum up, the overall changes in TPU depend on two elements: (1) the likelihood of tariff increase; and (2) the changes in tail risk. After the tariff announcement, the probability of imposing higher tariffs (the first element of TPU) increases *uniformly* for all products in this wave, while the tail risk of each product (the second element of TPU) changes in *different* directions even within the same wave. We therefore exploit the variations in overall uncertainty, in particular, the variations in tail risk, across products to identify the impact of TPU.

[9] In practice, we use the actually implemented war tariff as the updated worst-case scenario and test the robustness of the results to other threat tariff levels.

4 Identification Strategy

We exploit the variation in uncertainty across products after tariff announcements to identify the effect of uncertainty on Chinese exports to the US. In particular, we estimate the following equation:

$$\begin{aligned}\ln exp_{vt} =& \alpha + \beta_1 Announce_{vt} \times \Delta Risk_v + \beta_2 Announce_{vt} + \beta_3 Announce_{vt} \times \Delta \ln \tau_v^{war} \\ &+ \beta_4 Effect_{vt} + \beta_5 \ln \tau_{vt} + \delta_v + \delta_t + \epsilon_{vt}\end{aligned}$$

where $\ln exp_{vt}$ is log exports of product v (HS10) in month t, and $Announce_{vt}$ is a dummy variable that equals one after the tariffs on product v are announced and before the tariffs are realized. We interact $Announce_{vt}$ dummy with the product-level changes in tail risk, which is constructed as in equation (1). The parameter of interest is β_1, which captures the effect of changes in tail risk on exports for products included in the same tariff announcement.

The sign of β_2, which measures the differences in average exports before and after the announcement for products with zero changes in risk, is ambiguous. On the one hand, it captures the effect of increased uncertainty after the tariff announcement, which might dampen exports. On the other hand, the announcement could cause firms to stockpile before the tariffs actually take effect. This anticipatory stockpiling behavior is prevalent among firms during high uncertainty periods (Alessandria et al. (2024)). To further disentangle the effect of uncertainty and anticipation, we add the interaction of the announcement dummy with the expected increase in tariffs $\Delta \ln \tau_v^{war}$, which is constructed using the (normalized) difference between the announced tariff rate and the current MFN tariff rate. The interaction term captures the magnitude of the stockpiling motive as a larger expected increase in tariffs would lead firms to stockpile more.

We also control for product-level changes in tariffs and an effect dummy, which is equal to one after the tariffs took effect. This dummy variable identifies the differences in average exports between the pre-war and the after (tariff) realization period beyond the tariff effect, for example, the changes in uncertainty after tariffs came into effect, or the decline in exports due to de-stockpiling behavior. Lastly, we include the product (HS10) and time-fixed effects to control for unobserved product characteristics and other time-varying shocks.

4.1 Data

We combine data from several data sources. The monthly trade data is obtained from the US Census Bureau. The tariffs data, which includes MFN and column-2 tariff rates at the HS8 level as well as additional tariffs on Chinese exports during the US-China Trade War, is obtained from USITC.[10] Note that USITC tariff schedules include ad valorem and specific tariff rates. We only use the ad valorem rates because the specific rates remain nearly constant during this period. Exploiting this information, we construct monthly tariffs for Chinese exports at the HS10 level. To measure the changes in risk $\Delta Risk_v$, we use column-2 and MFN tariff rates in 2017. Among the 2,737 HS6s exported from China to the U.S., 2,620 HS6s are hit by tariffs during the US-China Trade War, and they account for about 94% of the total Chinese exports to the U.S. in 2017[11].

We construct the announcement and effect dummies from the timeline of the trade war, as summarized by Peterson Institute for International Economics(PIIE).[12] Note that if the announcement/effective date is after the 15th of a month, we count the next month as the starting month. For example, the second wave of tariffs took effect on Aug 23, 2018, and the starting month is September 2018.

Table 1 presents the summary statistics. It is worth mentioning that almost all affected products experienced a one-time increase in tariffs except products in the third

[10]The list of products that are subject to additional tariffs can be found in Chapter 99 of USITC tariff schedules. The additional tariffs are mostly at the HTS8 level, with some exemptions on HS10 products within HTS8.

[11]This takes into account five waves of tariffs on Chinese exports. As the 5th wave of tariffs were cancelled, the remaining tariffs still account for 67% of total exports to the US.

[12]The timeline is available on PIIE's website.

wave. For third-wave products, there was a 10 percent increase in tariffs in September 2018 (announced in June 2018) and a subsequent increase to 25 percent in May 2019 (announced in the same month). However, as there is no gap between announcement and implementation in the second announcement, the 2019 announcement period is not captured in the regression.

Table 1: Summary Statistics

	Mean	SD	Median	N
Export (log)	12.28	2.53	12.36	340,408
Changes in Risk ($\Delta Risk_v$)	-0.23	0.22	-0.26	340,408
Risk Dummy (D_v^{risk})	0.13	0.34	0	340,408
Anticipated Tariff Increase ($\Delta \ln \tau_v^{war}$)	0.12	0.05	0.09	340,408
Announce(Binary)	0.07	0.25	0	340,408
Effective(Binary)	0.28	0.28	0	340,408

4.2 Baseline Results

Table 2 reports the baseline results using the sample of HS10-level exports. All standard errors are clustered at the HS10 level. In column 1, we interact *Announce* with a risk dummy D_v^{risk}, which equals to one if the product experienced an increase in tail risk after the tariff announcement.[13] The significantly negative sign before the interaction term suggests that compared with products with a decrease in risk, products that experience risk increases have, on average, 6 log points lower exports after the announcement. That is, higher uncertainty due to higher tail risk significantly reduces Chinese exports to the U.S.

Additionally, we find a strong stockpiling effect during the announcement period as the coefficient before the announcement dummy is positive and significant. To further

[13] Approximately 25% of HS10s have an increase in risk.

validate this result, we add the interaction between the announcement dummy and the anticipated tariff increases in column 2. We find that the stockpiling effect is more pronounced for products with larger anticipated increases in tariffs. More importantly, the results on uncertainty are robust to adding the anticipation term.

According to column 2, a product with an increase in risk ($D_v^{risk} = 1$) and an average expected increase in tariffs would have 2.5% lower exports after the tariff announcement. Although the anticipation effect could lead to more exports during the announcement period, the increased uncertainty reduces exports and outweighs the effect of stockpiling. However, for products with decreases in risk ($D_v^{risk} = 0$), the overall exports increase during the announcement period, indicating that anticipatory stockpiling plays a significant role.

In column 3, we replace the risk dummy with the actual changes in tail risk. The result remains consistent: products with larger increases in uncertainty experienced lower exports to the U.S. Specifically, a one standard deviation increase in risk would lead to around 4 log points decline in exports. In the last column, we sharpen our identification by adding wave-time fixed effects. We thus compare products with different changes in risk within one wave, which partially addresses the concern that the trade war tariffs are endogenous. The effect of uncertainty is still significant and stable in magnitude. As there is little variation in tariff changes within one wave, the coefficients before the anticipation effect and tariffs become insignificant.

4.3 Pre-Trend Test

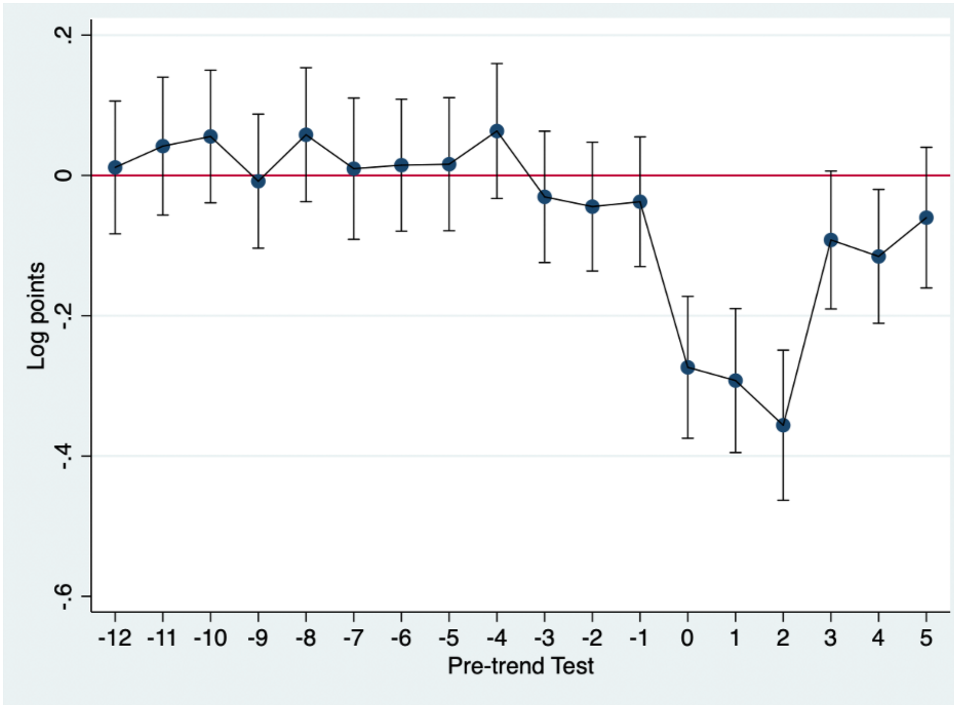
In the baseline, we identify the effect of uncertainty on Chinese exports to the US by comparing products with different changes in tail risk before and after the announcement. For this identification strategy to be valid, the underlying assumption is that the products with risk increases (treatment group) and those with risk decreases (untreated group) are on a parallel trend before the event (tariff announcement). Figure 4 plots the coefficients on the interaction of the risk dummy and time periods before and

Table 2: TPU and Exports: Baseline Results

	(1)	(2)	(3)	(4)
Announce	0.067***	0.035***	-0.012	
	(0.010)	(0.011)	(0.013)	
Announce $\times D_v^{risk}$	-0.063**	-0.060**		
	(0.021)	(0.021)		
Announce $\times \Delta Risk_v$			-0.165***	-0.133***
			(0.034)	(0.044)
Announce $\times \Delta \ln \tau_v^{war}$		0.074***	0.087***	0.177
		(0.008)	(0.008)	(0.130)
Effect	0.091***	0.075***	0.075***	
	(0.016)	(0.016)	(0.016)	
Tariffs($\ln \tau_{vt}$)	-2.333***	-2.285***	-2.283***	-0.444
	(0.104)	(0.104)	(0.104)	(1.289)
HS10 FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Wave*Time FE	No	No	No	Yes
N	341276	340408	341276	340408
R-Squared	0.875	0.875	0.875	0.876

Notes: ***p<0.001, **p<0.005, *p<0.01. The standard error is clustered at the HS10 level. The anticipated tariff increase ($\Delta \ln \tau_v^{war}$) is normalized.

Figure 4: Pre-trend Test



after the tariff announcement. As we can see, there are no significant differences in exports between products with risk increases and risk decreases in 12 months before the tariff announcements. However, when additional tariffs were announced (period 0), products with higher tail risk immediately experienced significantly lower exports, and this negative effect lasts for at least 4 months after the tariff announcement.

4.4 Robustness

4.4.1 Other Risk Measurement

We consider alternative measures for changes in tail risk, in particular, other possible values on worst-case tariffs before and after each tariff announcement. First, there are other possible values on the updated worst-case tariffs, given the Trump administration's frequent adjustment to threatened tariff levels around each announcement period.

Take the third wave for example, the US initially announced a 10% additional tariff in July 2018, subsequently considering a 25% tariff one month later. In September, the Trump administration finalized a 10% tariff but threatened to increase it to 25% in the following year. Therefore, 25% tariffs might represent firms' true beliefs about the worst-case scenario. We test this possibility by constructing the tail risk measure using 25% instead of 10% for the third wave. As we can observe in columns 1 and 2 of Table 3, the interactions with the tail risk dummy and risk value remain significant. In columns 3 and 4, we use 10% instead of 15% to construct tail risk for waves 4 and 5 as the U.S. first announced a 10% additional tariff on August 1, 2019, and then increased it to 15% on August 15. The results remain robust. Lastly, firms might uniformly update their belief to 25% once the first waves were announced. Thus, we construct the risk value using 25% for all waves and the results are still robust (columns 5 and 6). These results indicate that our conclusion is insensitive to other worst-case values, which is consistent with our hypothesis that the identification comes from variation in column 2 within each wave instead of different threat tariffs across waves.

Additionally, we test whether exporters have other prior beliefs on the worst-case tariffs instead of the column-2 tariff rates. To this end, we use the optimal non-cooperative tariffs estimated by Nicita et al. (2018) to calculate the risk measure. As reported in Table 4, the results become insignificant, indicating the optimal non-cooperative tariffs are unlikely to be firms' prior beliefs on the worst-case scenario.

In Table 5, we consider different approaches to constructing the risk measure, such as using log differences of the war and column-2 tariffs. The results remain robust in columns 1 and 2. We then show that the results are not driven by the extreme value of column-2 tariffs by dropping products with over 100 column-2 tariffs (Columns 3-4).

4.4.2 Subsamples

In Table 6, we first drop observations of wave 4 because the announcement period is only one month, which might be too short for exporters to respond. We then keep waves that occurred in 2018 because there might be a spillover effect from the first few waves

Table 3: Robustness: Other Updated Beliefs

	(1)	(2)	(3)	(4)	(5)	(6)
	Wave 3: 25%		Wave 4/5: 10%		All Waves: 25%	
Announce	0.042**	0.005	0.037**	-0.028	0.042**	0.017
	(0.013)	(0.014)	(0.013)	(0.018)	(0.013)	(0.013)
Announce $\times D_v^{risk}$	-0.054**		-0.079***		-0.051**	
	(0.018)		(0.023)		(0.019)	
Announce $\times \Delta Risk_v$		-0.229***		-0.209***		-0.172***
		(0.038)		(0.039)		(0.038)
Announce $\times \Delta \ln \tau_v^{war}$	0.070***	0.074***	0.074***	0.091***	0.071***	0.073***
	(0.009)	(0.009)	(0.009)	(0.010)	(0.009)	(0.009)
Effective	0.075***	0.075***	0.075***	0.075***	0.075***	0.075***
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
Tariffs($\ln \tau_{vt}$)	-2.281***	-2.266***	-2.284***	-2.274***	-2.284***	-2.281***
	(0.152)	(0.152)	(0.152)	(0.152)	(0.152)	(0.152)
HS10 FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
N	340408	340408	340408	340408	340408	340408
R-Squared	0.875	0.875	0.875	0.875	0.875	0.875

Table 4: Robustness: Other Prior Belief

	(1)	(2)	(3)	(4)
Announce	0.067***	0.035**	0.034	
	(0.010)	(0.011)	(0.017)	
Announce $\times D_v^{risk}$	-0.019	-0.013		
	(0.029)	(0.029)		
Announce $\times \Delta Risk_v$			0.001	0.015
			(0.027)	(0.028)
Announce $\times \Delta \ln \tau_v^{war}$		0.073***	0.073***	0.178*
		(0.008)	(0.008)	(0.089)
Effect	0.097***	0.081***	0.081***	
	(0.017)	(0.017)	(0.017)	
Tariffs	-2.231***	-2.181***	-2.182***	1.574
	(0.111)	(0.111)	(0.111)	(1.104)
HS10 FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Wave*Time FE	No	Yes	No	Yes
N	286936.000	286548.000	286548.000	286548.000
R-Squared	0.873	0.873	0.873	0.874

Table 5: Robustness: Other Risk Measurement

	(1)	(2)	(3)	(4)
	log-difference		drop extreme value	
Announce	-0.019		-0.013	
	(0.014)		(0.013)	
Announce $\times \Delta Risk_v$	-0.280***	-0.213***	-0.170***	-0.138***
	(0.53)	(0.51)	(0.034)	(0.035)
Announce $\times \Delta \ln \tau_v^{war}$	0.087***	0.179*	0.087***	0.185*
	(0.008)	(0.084)	(0.008)	(0.084)
Effective	0.076***		0.076***	
	(0.016)		(0.016)	
Tariffs($\ln \tau_{vt}$)	-2.287***	-0.437	-2.289***	-0.433
	(0.104)	(1.034)	(0.104)	(1.034)
HS10 FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Wave*Time FE	No	Yes	No	Yes
N	340202	340202	340202	340202
R-Squared	0.875	0.876	0.875	0.876

or the 2018 announcement changed the prior belief for later waves. We continue to find a significant impact of uncertainty.

Table 6: Robustness: Subsamples

	(1)	(2)	(3)	(4)
	drop wave 4		2018 waves	
Announce	-0.016		-0.020	
	(0.017)		(0.035)	
Announce $\times \Delta Risk_v$	-0.128***	-0.107**	-0.045	-0.075*
	(0.036)	(0.038)	(0.036)	(0.037)
Announce $\times \Delta \ln \tau_v^{war}$	0.073***	0.297**	0.057***	0.347***
	(0.010)	(0.107)	(0.015)	(0.101)
Effective	-0.047		-0.018	
	(0.026)		(0.051)	
Tariffs($\ln \tau_{vt}$)	-1.744***	-0.912	-1.483***	-0.775
	(0.124)	(1.279)	(0.136)	(1.299)
HS10 FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Wave*Time FE	No	Yes	No	Yes
N	245810	245810	221121	221121
R-Squared	0.878	0.879	0.873	0.874

4.4.3 Belief Update Timing

In the baseline, we assume that firms update their beliefs about worst-case tariffs when the tariffs on these specific products are announced. However, it is possible that when the first wave was announced in April 2018, the belief on the worst-case scenario was immediately updated to an additional 25% for all products. Table 7 shows the results after we change the belief update timing for subsequent waves. As we can see, the main results became not significant, suggesting it is more reasonable to assume firms update beliefs when tariffs on their specific products are officially announced.

Table 7: Robustness: Other Belief Update Timing

	(1)	(2)	(3)	(4)
Announce$\times D_v^{risk}$	0.011	0.026		
	(0.013)	(0.014)		
Announce $\times \Delta Risk_v$			0.014	-0.004
			(0.026)	(0.028)
Effective	0.090***	0.078***	0.071**	
	(0.023)	(0.022)	(0.023)	
Announce $\times \Delta \ln \tau_v^{war}$		0.083***	0.081***	0.128
		(0.008)	(0.008)	(0.127)
Tariffs($\ln \tau_{vt}$)	-2.452***	-2.328***	-2.331***	-0.387
	(0.146)	(0.144)	(0.144)	(1.297)
HS10 FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Wave*Time FE	No	No	No	Yes
N	341276	340408	340408	340408
R-Squared	0.875	0.875	0.875	0.876

5 Mechanism

In the previous section, we examine the effect of TPU on export value and find that the stockpiling effect confounds the effect of uncertainty. This section further explores the mechanism that drives our baseline results.

Theoretically, with regard to how an increase in the likelihood of tariff shock affects international trade, existing literature identifies two main channels. The first channel, as outlined in Handley and Limão (2017), suggests that higher TPU can reduce export entry as potential entrants choose to "wait and see". The critical element in their model is the *irreversible sunk cost* exporters must pay before exporting. To empirically test this mechanism in the context of the trade war, we divide the sample into industries with high and low sunk costs.[14] In Table 8, uncertainty significantly reduces exports in industries with relatively high sunk costs. In contrast, the effect is not statistically significant for industries with low sunk costs. This result provides support for the sunk cost channel: uncertainty is relevant when there exist large sunk costs. We further investigate whether the increased uncertainty affects the number of HS10 products within each HS8, which might provide direct evidence of export entry. Table 9 shows that the number of HS10 products does not significantly differ across products with varying levels of tail risk. However, the number of HS10 products does decrease after the tariff announcement (column 1), indicating a role for overall uncertainty in reducing product-level entry. Combined with previous results, it suggests that uncertainty reduces exports within HS10 for high sunk-cost industries, possibly by deterring firm-level entry. Unfortunately, we cannot directly test firm-level entry and exit due to data limitations.

The second channel, recently proposed by Alessandria et al. (2024), argues that increases in the likelihood of tariffs would lead to temporary stockpiling as importers anticipate higher future tariffs. During the trade war, the incidence of tariffs surged following the announcement of additional tariffs and the associated product list. The

[14] We estimate the sunk cost for each HS4 industry by exploiting the persistence of exporting at the HS10 level following Handley and Limão (2017). If one industry exhibits more persistence in exporting, we interpret it as having a relatively high sunk cost.

Table 8: Mechanism: Sunk Cost Channel

	(1)	(2)	(3)	(4)
	High Sunk Cost		Low Sunk Cost	
Announce	0.026	-0.025	0.047	0.010
	(0.017)	(0.023)	(0.034)	(0.042)
Announce $\times D_v^{risk}$	-0.053		-0.063	
	(0.032)		(0.069)	
Announce $\times \Delta Risk_v$		-0.183***		-0.114
		(0.055)		(0.098)
Announce $\times \Delta \ln \tau_v^{war}$	0.089***	0.102***	0.071*	0.080**
	(0.012)	(0.013)	(0.028)	(0.029)
Effective	0.100***	0.100***	0.089	0.089
	(0.030)	(0.030)	(0.049)	(0.049)
Tariffs($\ln \tau_{vt}$)	-2.303***	-2.301***	-2.447***	-2.444***
	(0.208)	(0.208)	(0.355)	(0.355)
HS10 FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
N	211512	211512	40217	40217
R-Squared	0.877	0.877	0.854	0.854

Table 9: Mechanism: Number of HS10 Products

	(1)	(2)	(3)	(4)
	High Sunk Cost		Low Sunk Cost	
Announce	-0.006*	-0.004	-0.004	-0.002
	(0.002)	(0.003)	(0.004)	(0.005)
Announce $\times D_v^{risk}$	0.003		-0.000	
	(0.005)		(0.007)	
Announce $\times \Delta Risk_v$		0.005		0.009
		(0.009)		(0.013)
Announce $\times \Delta \ln \tau_v^{war}$	0.004*	0.004*	0.003	0.003
	(0.002)	(0.002)	(0.002)	(0.003)
Effective	-0.002	-0.002	0.002	0.002
	(0.004)	(0.004)	(0.006)	(0.006)
Tariffs($\ln \tau_{vt}$)	-0.097***	-0.097***	-0.048	-0.048
	(0.021)	(0.021)	(0.034)	(0.034)
HS10 FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
N	121759	121759	31480	31480
R-Squared	0.944	0.944	0.922	0.922

Notes: The number of observations is larger in high sunk-cost industries because they have more persistent exporting behavior.

increased likelihood of future tariffs provides incentives for firms to stockpile before the announced tariffs come into effect. To examine this anticipation channel, we categorize industries based on their storability, as we expect the stockpiling effect to be more pronounced for products with higher storability.[15] As demonstrated in Table 10, the stockpiling effect is indeed larger for more storable goods, suggesting that importers are more responsive to the expected tariff increases. Additionally, the elasticity of tariffs is larger for more storable goods, indicating a larger de-stockpiling effect for these goods after the tariffs take effect.

6 Spillover Effect

In the previous analysis, we focused on identifying the effect of uncertainty on products that are included in the tariff list. However, the effect of uncertainty might extend beyond these products. For example, when additional tariffs were announced, products that are closely related to the targeted products may also have updated their beliefs about the incidence of tariff shock. To identify this spillover effect, we analyze the non-targeted products when the third wave was announced. The advantage of using the third wave is that it is the largest wave containing a wide range of products, and there are also plenty of products not being targeted yet.

To achieve this, we split the non-targeted products into two groups. The "treated" group includes products in the same HS4 or HS2 product categories as the products targeted in the third wave. The control group includes the remaining products. As shown in Table 11, products in the same HS4 category as the targeted products experienced a significant decline in exports after the tariff announcement, compared to those unrelated products. If we interpret the tariff announcement as a relative increase in the probability of tariff shock for related products, this result indicates that the increased uncertainty

[15]The storability for each HS6 product is estimated as the inverse HHI index across time following Alessandria et al. (2024). If a product exports frequently after controlling for other variables, we interpret this product as less storable. Due to this reason, the less storable products have more observations with the same number of products.

Table 10: Mechanism: Stockpiling Channel

	(1)	(2)	(3)	(4)
	More Storable		Less Storable	
Announce	0.013	-0.116	0.043**	0.028
	(0.079)	(0.096)	(0.016)	(0.022)
Announce $\times D_v^{risk}$	-0.238		0.015	
	(0.149)		(0.029)	
Announce $\times \Delta Risk_v$		-0.362		-0.062
		(0.225)		(0.049)
Announce $\times \Delta \ln \tau_v^{war}$	0.124	0.161*	0.063***	0.068***
	(0.066)	(0.069)	(0.011)	(0.012)
Effective	0.283*	0.284*	0.051	0.051
	(0.119)	(0.119)	(0.030)	(0.030)
Tariffs($\ln \tau_{vt}$)	-4.487***	-4.481***	-1.990***	-1.990***
	(0.918)	(0.918)	(0.190)	(0.190)
HS10 FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
N	10149	10149	193986	193986
R-Squared	0.743	0.743	0.894	0.894

reduces exports for related but non-targeted products, thus confirming the spillover effect. Additionally, the stockpiling motive for these products is not strong enough to outweigh the uncertainty effect as the exports is significantly lower after tariff announcement. The spillover results remain robust even when we include a year-month fixed effect (column 2). In columns 3-4, we test if the spillover effect exists for products in related HS2 categories and find a similar and even larger effect. These results provide evidence that the dampening effect of uncertainty goes beyond the directly affected products, and our baseline estimate provides a lower bound for the overall impact of uncertainty.

Table 11: Spillover Effect

	(1)	(2)	(3)	(4)
	Related HS4		Related HS2	
Announce=1 #Treat=1	-0.086***	-0.086***	-0.266***	-0.266***
	(0.023)	(0.023)	(0.024)	(0.024)
Announce=1	0.060***		0.167***	
	(0.014)		(0.016)	
Effective=1 # Treat=1	0.029	0.029	-0.032	-0.032
	(0.021)	(0.021)	(0.018)	(0.018)
Effective=1	0.075***		0.098***	
	-0.011		-0.012	
HS10 FE	Yes	Yes	Yes	Yes
Month FE	Yes	No	Yes	No
Year-Month FE	No	Yes	No	Yes
N	141100	141100	141100	141100
R-Squared	0.873	0.873	0.873	0.873

7 Conclusion

This study examines the impact of trade policy uncertainty on Chinese exports to the US during the period of trade war. By analyzing the time period between tariff announcement and implementation, we find that uncertainty significantly reduces exports. Additionally, firms stockpile before the tariffs take effect, and this anticipation effect is more prominent for products that expect a larger tariff increase. We also test the robustness of our results by using different specifications and uncertainty measurements.

We investigate the mechanisms that drive the uncertainty and anticipation effects. We divide industries into high and low-sunk-cost industries and find that uncertainty reduces exports within HS10 only for high-sunk-cost industries, possibly by deterring firm-level entry. We also observed that the anticipation and de-stockpiling effect are more substantial for more storable products. However, due to data limitations, we couldn't directly examine the firm-level adjustment behavior, which we leave to future research. Finally, we show that the trade-dampening effect of uncertainty spills over to the non-targeted but related products, suggesting that our baseline result is a lower bound estimate for the overall impact of uncertainty.

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A Pre-War Period

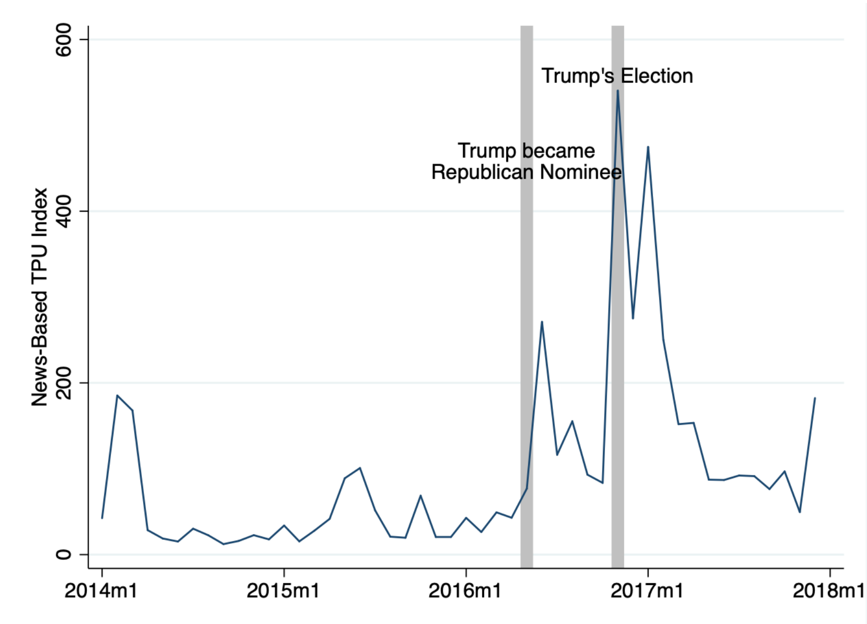
Before we formally estimate the effect of TPU on exports during the trade war episode, we first examine the product-level uncertainty, in particular, firms' prior beliefs about worst-case tariffs during the pre-war period. This analysis is important as it gives us information on how the arrival of trade war changed uncertainty for each product.

To do so, we exploit the variation in trade policy uncertainty over time during the pre-war period (2014m1-2017m12), in particular, the changes in uncertainty around the 2016 US presidential election. During Trump's presidential campaign, he frequently threatened to withdraw from current trade agreements, for example NAFTA, and impose tariffs on imports from specific countries such as Mexico and China (Handley and Limão, 2017b). These threats substantially increased uncertainty on trade policy, specially after he won the presidential election in Nov, 2016. Figure 5 plots the news-based trade policy uncertainty index constructed by Baker et al (2016) during the Pre-War period. As we can see, the uncertainty was at a very low level before Trump's campaign and there was an increase when Trump became the Republican Presidential Candidate in May 2018. Furthermore, the TPU Index increased dramatically after Trump' election as the US president.

Based on these facts, we can reasonably identify the effect of uncertainty by comparing the exports before and after Trump's election. In addition, we explore the variations in uncertainty faced by different product and examine the proper proxy for the worst-case tariffs. One potential worst-case scenario is the column-2 tariffs, which are the tariffs imposed on countries with non-Normal Trade Relation (non-NTR) with the US. Before China's accession to WTO, the Congress voted annually to renew China's MFN status. If the MFN status were not renewed, the US would impose non-NTR tariffs on Chinese exports. Therefore, the column-2 tariffs are widely used as Chinese exporters' worst case tariffs during the WTO accession period.

Following Handley and Limão (2017), we construct the uncertainty variable for

Figure 5: News-based TPU Index during the Pre-War Period



Notes: The news-based TPU index is constructed by Baker et al (2016).

each HS6 product using the column-2 and MFN tariff rates in 2016.[16] Both column-2 and MFN tariffs are calculated as the ad valorem equivalent(AVE) tariff rates.[17] The hypothesis is that if the uncertainty increased after Trump's election, we would expect the exports are lower for higher uncertainty products after the election. To test this hypothesis, we run the following estimation

$$log(exp_{it}) = \beta Risk_i^{pre} \times Election_t + \ln \tau_{it} + \delta_i + \delta_t + \epsilon_{it} \tag{3}$$

$$Risk_i^{pre} = 1 - (\frac{\tau_2}{\tau_{mfn}})^{-3} \tag{4}$$

where on the left hand side is the monthly (log) exports of product i (HS6) to the US during 2014m1-2017m12. On the right hand side, we include the interaction between

[16]There is little variation in column-2 tariffs across years. The reason of not using column-2 in previous years like in Pierce and Schott (2016) is its limited coverage of new HTS8s in recent years. More specifically, about 1/4 of HTS8s in the sample period are not covered in 2001 HTS schedule. The column-2 tariffs for these HTS8s are therefore missing. Both tariff rates are at HTS8-level and the risk at HS6 product level is calculated as the simple average of risk at HS8 level.

[17]According to WTO, AVE=ad valorem rate + specific rate/unit price.

industrial *tail risk* and an *election* dummy, which equals to one after November 2016 and zero otherwise. If the uncertainty about trade policy increased after Trump's election, we expect β to be negative as higher risk industries have disproportionately lower exports after uncertainty increased. In addition, we include the product and time fixed effects to control for time-invariant product-specific characteristics and unobserved economic and policy shocks.

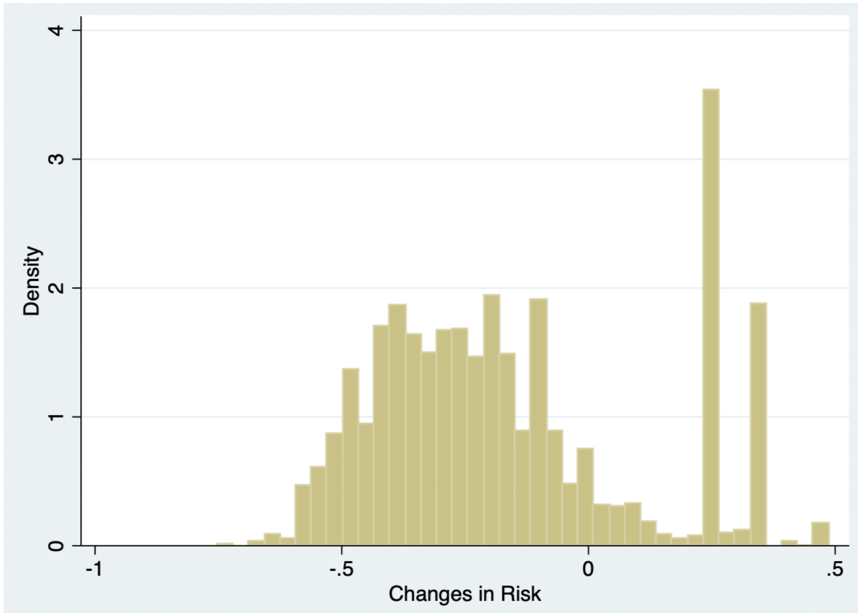
Table 12 reports the regression results. As we can see in column 1, the industries with higher uncertainty indeed experienced lower exports after Trump's election, thus confirming that column-2 is the relevant prior belief about worst-case tariffs during the pre-war period. The effect is robust after controlling for sector(HS2) by time fixed effects in column 2. We replace the election dummy with uncertainty news index in column 3-4. The results are still robust.

Table 12: Imports and Uncertainty During the Pre-War Period

	(1)	(2)	(3)	(4)
$Risk_i^{Pre} \times Election_t$	-0.049*	-0.061*		
	(0.021)	(0.031)		
$Risk_i^{Pre} \times News_t$			-0.023**	-0.000
			(0.011)	(0.017)
Tariffs	-5.995***	-2.004	-5.684***	-1.737
	(1.188)	(1.276)	(1.180)	(1.274)
HS6 FE	Yes	No	Yes	No
HS2 × Time FE	No	Yes	No	Yes
Time FE	Yes	No	Yes	No
N	157430	157278	157430	157278
R-Squared	0.899	0.904	0.899	0.904

Notes: ***p<0.001, **p<0.005, *p<0.01. Election dummy equals to one after Nov 2016. HS6-level Risk is calculated using the simple average of mfn and column-2 tariffs within a HS6. The parameter before interaction of risk with news index includes the current and two months lagged effect of news index.

Figure 6: Distribution of Changes in Tail Risk across Products



Notes: The change in tail risk is constructed for each HS-8 products using differences between the pre-war (column 2) and updated beliefs about worst-case tariffs.

In sum, we find that the higher trade policy uncertainty caused by Trump's election led to lower exports for high-uncertainty industries. More importantly, these results suggest that column-2 is the relevant prior belief about worst-case tariffs before the trade war.

B Distribution of Changes in Tail Risk

We construct changes in tail risk for each HS8 product using the following equation:

$$\Delta risk_v = risk_v^{war} - risk_v^{pre} = \frac{(\tau_v^{col2})^{-\sigma} - (\tau_v^{war})^{-\sigma}}{(\tau_v^{mfn})^{-\sigma}} \tag{5}$$

As we can see in Figure 6, most products experienced declines in tail risk, suggesting column-2 tariff rate is often higher than announced war tariff rate.