

Input Trade and Policy Uncertainty: Theory and Evidence from Chinese Firms

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Motivation

- ▶ Why are trade agreements valuable?
- ▶ Leading theories:
 1. Terms-of-trade (e.g., Bagwell and Staiger, 1999).
 2. Commitment
 - ▶ May affect domestic political economy, such that governments can achieve greater liberalization (e.g., Maggi and Rodríguez-Clare, 2007).
 - ▶ May affect firms' trade behavior, such that the trade and welfare impact of trade liberalization is enhanced (e.g., Handley and Limão, 2017).

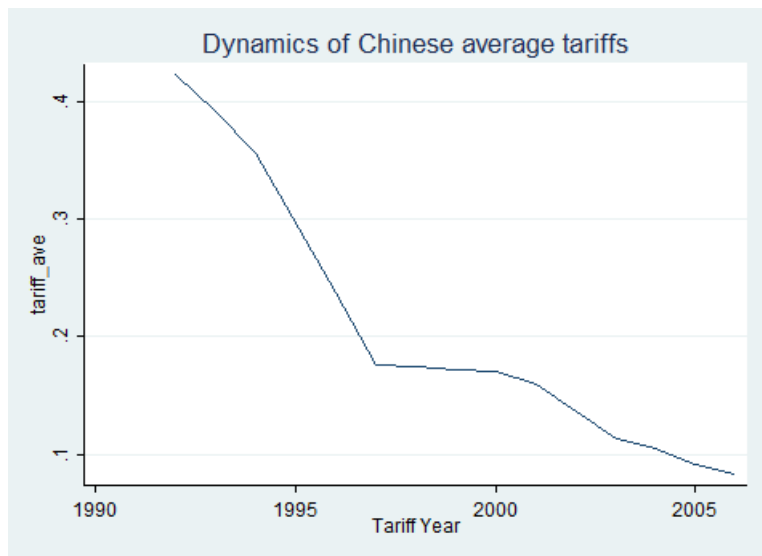
Case of China

- ▶ China's accession to the WTO in 2001 is often cited as an inflection point, commencing a period of spectacular growth in China's manufacturing trade.
- ▶ Growing literature seeks to understand the channels by which China's WTO entry may have produced this outcome.
- ▶ Leading hypotheses:
 1. China cuts tariffs → Chinese firms intensify use of imported intermediates → Boom in TFP and Trade
 2. China's WTO entry → reduced trade policy uncertainty (TPU) in foreign markets → Chinese firms make sunk cost investments in exporting and technology adoption → Boom in TFP and Trade

Empirical Support

1. Support for the first story (i.e., China's tariff cuts)
 - ▶ Amiti, Dai, Feenstra and Romalis (2017)
 - ▶ Brandt, Van Biesebroek, Wang and Zhang (2017)
 - ▶ Yu (2015)
 - ▶ Feng, Li and Swenson (2016)
 2. Support for the second story (i.e., TPU abroad)
 - ▶ Handley and Limão (2017)
 - ▶ Pierce and Schott (2016)
 - ▶ Feng, Li and Swenson (2017)
- ▶ But what if TPU is part of the first story as well? Could the perceived permanence of China's tariffs matter?

China's Tariffs Pre- and Post-WTO



Context and chronology pre-WTO period

- 86-01 3 presidencies – including death and succession of Deng Xioping
- 1989 Tiananmen Square Protests
- 90-92 House revokes 3 MFN times (90-92). Pres. Bush vetoes bill placing substantial conditions on MFN in 1992.
- 95-96 Taiwan Strait Crisis provoked by Lee Teng-Hui's visit to U.S.
- 1997 Hong Kong returned to Chinese sovereignty
- 1999 US bombs Chinese embassy in Serbia, Clinton signs agreement in November with China for permanent MFN, both houses of Congress must approve
- 2000 US Congress passes US-China Relations Act, effective Oct 10, 2000, but contingent on China's WTO accession and reserve right to invoke Article XIII and opt-out of granting PNTR
- 2001 US spy plane collides with Chinese fighter jet, protracted WTO negotiations require Congress to vote to extend MFN again in summer of 2001.

What we do

- ▶ This paper focuses on the import behavior (first story) of firms in the presence of TPU.
- ▶ We build a dynamic model of firm-level import decisions in the presence of uncertainty over the direction of an entire vector of tariffs.
 - ▶ Key assumption: sunk costs (e.g., search and/or adoption) associated with expanding the extensive margin of imports.
- ▶ We apply this model to the case of China's WTO accession.

What we do

- ▶ Use Chinese transactions-level trade data from 2000-2006 to examine how the trade policy commitment *by China* upon WTO entry impacted Chinese imports.
- ▶ Why does WTO accession provide a useful TPU shock?
 - ▶ The process was long (1986-2001) and entry was uncertain until 2001.
 - ▶ Accession required prior liberalization by China, which could have been reversed had the process been derailed.
- ▶ We find that the Chinese threat of reversion to high tariffs strongly depresses Chinese imports prior to WTO entry relative to the post-2001 period, controlling for applied tariff levels and numerous fixed effects

Recent Literature on TPU

- ▶ Previous work has focused on decision to export or effect on exports in different contexts.
 - ▶ WTO Bound commitments, Australian export market entry effects, Handley (2014)
 - ▶ Role of PTAs in reducing uncertainty, firm export dynamics for Portugal's EC accession (Handley and Limão (2015)
- ▶ Quantifying TPU in before/after China's WTO accession
 - ▶ Handley and Limão (2017) use Chinese export growth to the US (2000-2005) effects on prices and welfare
 - ▶ Firm data for China: Feng, Li and Swenson (2017) market entry decisions to the US (2000-2002) and effects of anti-dumping uncertainty (Crowley, Song, and Meng, 2016)
- ▶ Leading up to this paper → value of commitments for import decisions and input tariff uncertainty

Model Overview

- ▶ Heterogenous domestic firms import inputs, subject to current applied tariffs.
 - ▶ Let τ_i^t denote the current tariff (one plus the ad valorem rate) on input i .
- ▶ There are many inputs and many varieties of each input available.
- ▶ The firm pays a sunk cost K each time it imports a new variety. Paid only once, not recurring.
- ▶ At any point in time, with probability γ , the vector of tariffs could change.
 - ▶ With probability ψ tariffs become high: $\tau_i^h > \tau_i^t$ for all i .
 - ▶ With $1 - \psi$ tariffs are bound at a low rate: $\tau_i^l \leq \tau_i^t$ for all i .
 - ▶ Trapping states.

Nests

Final demand facing each firm is:

$$q = Ep^{-\sigma}$$

Production requires composites of domestic and imported inputs:

$$y = \varphi x_D^{1-\alpha} x_M^\alpha$$

Import composite is a CES in I different inputs (tariff lines):

$$x_M = \left[\sum_{i=1}^I \mu_i^{\frac{1}{\varepsilon}} x_i^{\frac{\varepsilon-1}{\varepsilon}} \right]^{\frac{\varepsilon}{\varepsilon-1}}$$

Each input x_i is available in a continuum of varieties:

$$x_i = \left[\int_0^1 x_i(\nu)^{\frac{\theta-1}{\theta}} d\nu \right]^{\frac{\theta}{\theta-1}}$$

Assume $\theta > \varepsilon > 1$.

Costs and operating profits

Price of each input variety is normalized to 1. Unit cost of input i is

$$c_i(n_i) = n_i^{\frac{1}{1-\theta}} \delta_i$$

Unit cost of input bundle:

$$c_M(n) = \left[\sum_{i=1}^I \mu_i c_i(n_i)^{1-\varepsilon} \right]^{\frac{1}{1-\varepsilon}}$$

One-period operating profit for firm with productivity φ :

$$\pi(\varphi, n; s) = A\varphi^{\sigma-1} c_M(n)^{-\alpha(\sigma-1)}$$

Optimal Variety Choice (Deterministic Case, $\gamma = 0$)

Long term profit in state $s = \{t, h, l\}$:

$$V^s \equiv \frac{\pi(\varphi, n^s; s)}{1 - \beta} - \sum_{j=1}^l K n_j^s$$

First order condition

$$\pi_{n_i} = \frac{\alpha(\sigma - 1)}{(\theta - 1)} \pi \rho_i \frac{1}{n_i} = (1 - \beta) K$$

where $\rho_i \equiv \frac{c_i x_i}{c_M x_M}$ is the share spent on input i in total imported inputs. Solving gives,

$$n_i^s = B \pi^s \rho_i^s$$

Deterministic case, continued

Closed form solution for the import share of input i :

$$\rho_i = \mu_i^{\frac{\eta}{\varepsilon-1}} (\delta_i^s)^{-\eta} \Delta^\eta$$

where $\lambda, \eta > 0$ and $\Delta \equiv \left[\sum_{j=1}^I \mu_j^{\frac{\eta}{\varepsilon-1}} \delta_j^{-\eta} \right]^{\frac{1}{-\eta}}$ is an overall tariff index. The optimal extensive margin for input i ,

$$n_i^s = \mu_i^{\frac{\eta}{\varepsilon-1}} (\delta_i^s)^{-\eta} \Delta^{\eta-\lambda(\theta-1)} (AB)^{1+\lambda} \varphi^{(\sigma-1)(1+\lambda)}$$

Note that

$$\text{sgn} [\eta - \lambda(\theta - 1)] = \text{sgn} [(\varepsilon - 1) - \alpha(\sigma - 1)]$$

The optimal firm-level spending on input i :

$$c_i^s x_i^s = [(\theta - 1)(1 - \beta)K] n_i^s$$

Monotonicity

- ▶ Desirable property:

$$n_i^h < n_i^t \leq n_i^l$$

for all i .

- ▶ Sufficient condition for monotonicity:

1. $\delta_i^l = \delta_i^t$ for all i

2. $\min \{ \delta_i^h / \delta_i^t \}_{i=1}^l > \left(\max \{ \delta_i^h / \delta_i^t \}_{i=1}^l \right)^{1 - \frac{\lambda(\theta-1)}{\eta}}$

- ▶ Note that 2. is satisfied trivially if $\alpha(\sigma - 1) > \varepsilon - 1 \iff \pi$ is supermodular in n .

Optimal Variety Choice under Uncertainty

Expected present value of profit, excluding the initial sunk costs, in state t :

$$\begin{aligned}\Pi(\varphi, \tilde{n}^t; t) &= \pi(\varphi, \tilde{n}^t; t) + \beta(1 - \gamma)\Pi(\varphi, \tilde{n}^t; t) + \beta\gamma\psi\Pi(\varphi, \tilde{n}^t; h) \\ &\quad + \beta\gamma(1 - \psi) \left[\Pi(\varphi, n^l; l) - \sum_{j=1}^l K(n_j^l - n_j^t) \right]\end{aligned}$$

Solving the above and adding in the initial sunk costs the long-term total profit:

$$\tilde{V} \propto \frac{\pi(\varphi, \tilde{n}^t; t) + u_t \pi(\varphi, \tilde{n}^t; h)}{1 + u_t} - (1 - \beta) K \sum_{j=1}^l \tilde{n}_j^t + \frac{\beta\gamma(1 - \psi)}{1 + u_t} V^l$$

where $u_t = \frac{\beta\gamma\psi}{1 - \beta}$, depends on the likelihood of transition to the high tariff state.

Optimal Variety Choice under Uncertainty, continued

The first order condition

$$\pi_{n_i}(\varphi, \tilde{n}^t; t) U_i^t = (1 - \beta) K$$

where U_i^t is a discount factor given by

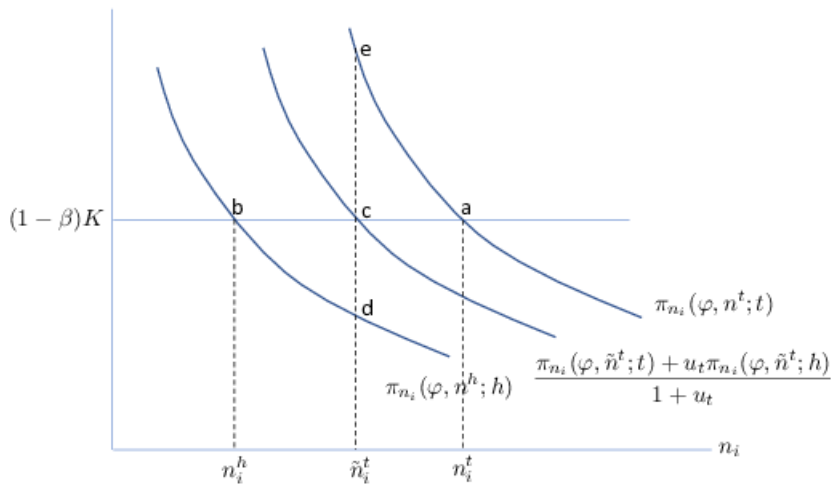
$$U_i^t \equiv \frac{1 + u_t \omega_i^t}{1 + u_t}$$

and

$$\omega_i^t \equiv \frac{\pi_{n_i}(\varphi, \tilde{n}^t; h)}{\pi_{n_i}(\varphi, \tilde{n}^t; t)} < 1$$

Note: $U_i^t \rightarrow 1$ as $u_t \rightarrow 0$

Marginal
Operating Profit



Optimal Variety Choice under Uncertainty, continued

Solving gives the optimal extensive margin and spending level for input i ,

$$\tilde{n}_i^t = n_i^t U_i^{1-\frac{\eta}{1-\theta}} \left(\frac{\tilde{\Delta}^t}{\Delta^t} \right)^{\eta-\lambda(\theta-1)}$$

$$\tilde{c}_i \tilde{x}_i = c_i x_i U_i^{\frac{-\eta}{1-\theta}} \left(\frac{\tilde{\Delta}^t}{\Delta^t} \right)^{\eta-\lambda(\theta-1)}$$

where $\frac{\tilde{\Delta}^t}{\Delta^t} = \left[\sum_{j=1}^I \rho_j^t U_j^{\frac{-\eta}{1-\theta}} \right]^{\frac{1}{-\eta}}$ is an index of $U_j^{\frac{1}{1-\theta}}$, weighted by the deterministic import shares. It measures of the aggregate burden of TPU.

- ▶ Both \tilde{n}_i^t and $\tilde{c}_i \tilde{x}_i$ decrease with the own TPU burden ($U_i^{\frac{1}{1-\theta}}$).
- ▶ If π is supermodular, the aggregate TPU burden amplifies the own effect.

Aggregation to product level

- ▶ It can be shown that ρ_i and U_i are independent of productivity. Thus, assuming all firms face the same parameters,

$$\tilde{C}^t \tilde{X}^t = C^t X^t U_i^{-\frac{\eta}{1-\theta}} \left(\frac{\tilde{\Delta}^t}{\Delta^t} \right)^{\eta-\lambda(\theta-1)}$$

where $C^t X^t$ is the total deterministic import value $c_i^t x_i^t$ integrated over the productivity distribution of firms $F_i(\varphi)$, or

$$C^t X^t \propto \mu_i^{\frac{\eta}{\varepsilon-1}} (\delta_i^t)^{-\eta} \Delta^{\eta-\lambda(\theta-1)} \int \varphi^{(\sigma-1)(1+\lambda)} dF_i(\varphi)$$

Toward Estimation

For estimation purposes, it is more convenient to work with first-order approximations around no uncertainty.

$$\begin{aligned}\ln \tilde{n}_i^t &\approx \ln n_i^t + \left(1 + \frac{\eta}{\theta - 1}\right) (\omega_i^t - 1) \cdot u_t \\ &\quad + \left(\lambda - \frac{\eta}{\theta - 1}\right) \sum_{j=1}^l \rho_j^t (\omega_j^t - 1) \cdot u_t\end{aligned}$$

$$\begin{aligned}\ln \tilde{c}_i \tilde{x}_i &\approx \ln c_i x_i + \left(\frac{\eta}{\theta - 1}\right) (\omega_i^t - 1) \cdot u_t \\ &\quad + \left(\lambda - \frac{\eta}{\theta - 1}\right) \sum_{j=1}^l \rho_j^t (\omega_j^t - 1) \cdot u_t\end{aligned}$$

Loss approximation

Recall that the key measure of loss in the high tariff state is,

$$\begin{aligned}\omega_i^t &\equiv \frac{\pi_{n_i}(\varphi, \tilde{n}^t; h)}{\pi_{n_i}(\varphi, \tilde{n}^t; t)} \\ &= \left(\frac{\delta_i^h}{\delta_i^t}\right)^{1-\varepsilon} \left[\sum_{j=1}^I \tilde{\rho}_j^t \left(\frac{\delta_j^h}{\delta_j^t}\right)^{1-\varepsilon} \right]^{\frac{\alpha(\sigma-1)}{\varepsilon-1}-1}\end{aligned}$$

and can be approximated as,

$$\omega_i^t - 1 \approx (1 - \varepsilon) \ln \left(\frac{\delta_i^h}{\delta_i^t}\right) + [(\varepsilon - 1) - \alpha(\sigma - 1)] \sum_{j=1}^I \rho_j^t \ln \left(\frac{\delta_j^h}{\delta_j^t}\right)$$

Measuring High State Tariffs

- ▶ A firm's true belief for the high state protection level is unknown to us.
- ▶ Thus model it as

$$\ln \delta_i^{h,t} = (1 - h) \ln \delta + h \ln \delta_i^{h,0} + e_{ih}^t$$

- ▶ where
 - ▶ Constant δ
 - ▶ Historical high in the product $\delta_i^{h,0}$
 - ▶ Weights $h \in [0, 1]$
 - ▶ Idyosincratic term $e_{i,h} \sim N(0, \sigma)$ orthogonal to $\delta_i^{h,0}$ and δ_i^t

Econometric specification

Value of Imports of good i by firm v :

$$\ln \tilde{c}_{iv}^t \tilde{x}_{iv}^t = \left(\underbrace{\frac{\theta - 1}{\varepsilon - 1}}_{\text{Certainty}} - \underbrace{(1 - h) u_t}_{\text{Fixed Threat}} \right) \beta_\delta \cdot \ln \delta_i^t + \underbrace{\beta_\delta h u_t \cdot \ln \frac{\delta_i^{h,0}}{\delta_i^t}}_{\text{Variable Threat}}$$

$$+ \underbrace{\beta_\Phi \left[h u_t \cdot \overline{(\delta^h / \delta)}_t - (1 - h) u_t \cdot \overline{(\delta)}_t \right]}_{\text{Aggregate Threat Effects}}$$

$$+ \alpha_v + \alpha_t + \tilde{e}_{ih}^t + r_i^t$$

- ▶ where \bar{X} denotes $\sum_i \rho_i X_i$
- ▶ $\beta_\delta = -\frac{(\varepsilon - 1)^2}{\theta - \varepsilon} < 0$
- ▶ $\beta_\Phi < 0$ if and only if π is supermodular.
- ▶ Aggregate effects subsumed in α_t .

Interpretation of Coefficients

$$\ln \tilde{c}_{iv}^t \tilde{x}_{iv}^t = a_{pre} \ln \delta_i^t + a_{post} \ln \delta_i^t \cdot I_{post} + b_{pre} \ln \frac{\delta_i^{h,0}}{\delta_i^t} + b_{post} \ln \frac{\delta_i^{h,0}}{\delta_i^t} \cdot I_{post} + \dots$$

- 1. Existence of input TPU:** $\hat{b}_{pre} = \beta_\delta h u_{pre} < 0$
 - ▶ This occurs iff $\gamma_{pre} > 0$ (TPU) and $h > 0$ (positive probability of highest historical tariff threat).
- 2. Reduction in input TPU:** $\hat{b}_{post} = \beta_\delta h (u_{post} - u_{pre}) > 0$
 - ▶ This occurs iff $\gamma_{post} < \gamma_{pre}$ and $h > 0$.
- 3. Reduction in TPU \rightarrow increase in applied tariff elasticity:**
 $\hat{a}_{post} = -\beta_\delta (1 - h) (u_{post} - u_{pre}) < 0$
 - ▶ This occurs iff $\gamma_{post} < \gamma_{pre}$ and $h < 1$.
- 4. Estimated Beliefs:**

$$\hat{h} = \frac{\hat{b}_{post}}{\hat{b}_{post} - \hat{a}_{post}}$$

Data

- ▶ Trade data: Chinese transaction-level export/import data in 2000-2006.
 - ▶ Collected by China's General Administration of Customs (CGAC).
 - ▶ For each export or import transaction, the data records the firm (name, ownership, contact information, etc.), product (HS8), country (destination/source), time, value, quantity, custom, transport mode, trade type (ordinary or processing trade), etc.
 - ▶ Concorded to 1996 version of HS6 classification.
 - ▶ Intermediate inputs (69%-76%) defined based on the UN BEC classification.
 - ▶ Firm types: production, SOEs, trade intermediaries (Ahn, Khandelwal and Wei, 2010)
- ▶ Tariff data: Tariffs of China
 - ▶ World Bank WITS at HS6-country-year level.
 - ▶ We use several measures of the Chinese tariff threat on imported inputs, the main one being the ratio of the applied tariff in a given year and the historical maximum tariff dating back to 1992 and for each HS-6 category.

Import Growth in High vs Low TPU Products

Table 1a. Summary statistics by pre-WTO policy uncertainty (HS6-product level)

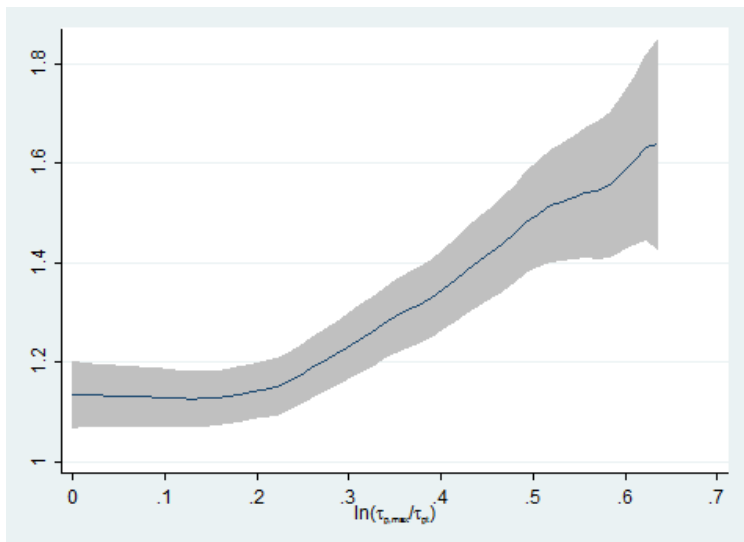
	Uncertainty		Total
	Low ^a	High ^a	
Chinese import value growth ($\Delta \ln$, 2006-2000) ^b	1.13 [1.72]	1.33 [1.64]	1.20 [1.69]
Chinese import variety growth ($\Delta \ln$, 2006-2000) ^b	0.26 [0.51]	0.45 [0.53]	0.32 [0.52]
Change in MFN tariff ($\Delta \ln$, 2006-2000)	-0.06 [0.07]	-0.10 [0.08]	-0.07 [0.08]
Ratio of maximum to MFN tariff (2000)	1.10 [0.07]	1.42 [0.11]	1.21 [0.18]
	3,186	1,575	4,761

a. High refers to high of pre-WTO uncertainty (ranked by $\tau_{p,max}/\tau_{pt}$); Low refers to the rest of the sample.

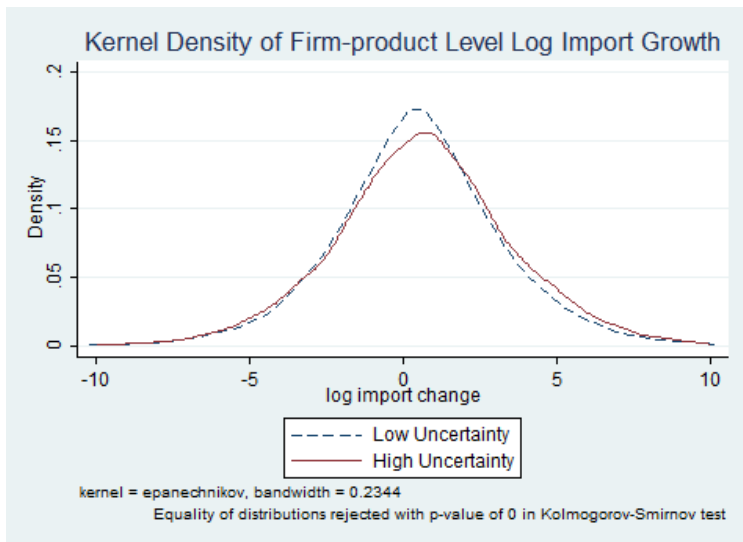
b. Test of mean difference across samples significant at least at 1% level.

Variety refers to distinct HS-8*country pairs within HS-6

Aggregate Import Growth vs Initial Product TPU



Firm Import Growth in Initially High vs Low TPU Products



Estimates: Firm Imports by Product

Table 3. Firm-product-year Level Import Value
Dependent Variable = ln Imports

All Products

Uncertainty	-5.753*** [0.216]	-5.481*** [0.211]	-4.240*** [0.190]	-4.403*** [0.205]
Uncertainty×Post	2.592*** [0.249]	2.461*** [0.246]	1.674*** [0.214]	1.822*** [0.235]
Tariffs (ln)	-2.410*** [0.504]	-2.397*** [0.501]	-0.521 [0.402]	-1.396*** [0.427]
Tariffs(ln)×Post	-6.621*** [0.657]	-6.751*** [0.647]	-4.012*** [0.528]	-5.003*** [0.567]
Fixed Effects	Firm, Year	Firm x Year	FirmxYear, Sector	FirmxYear, SectorXYear
Observations	7,531,534	7,435,142	7,435,142	7,435,142
R-squared	0.252	0.298	0.325	0.325

Note: Standard errors are clustered at hs6-year level;
f-firm, p-product(hs6), s-sector, t-time(year).

Mechanism: Firm Imports of Intermediate Products

Table 4. Firm-product-year Level Import Value
 Dependent Variable = ln Imports
 Intermediates Subsample

Uncertainty	-4.070*** [0.243]	-3.972*** [0.240]	-3.628*** [0.213]	-3.673*** [0.228]
Uncertainty×Post	1.758*** [0.282]	1.695*** [0.280]	1.273*** [0.244]	1.315*** [0.262]
Tariffs (ln)	-0.175 [0.533]	-0.171 [0.531]	-1.581*** [0.451]	-0.942* [0.530]
Tariffs(ln)×Post	-3.773*** [0.696]	-4.169*** [0.679]	-2.997*** [0.573]	-3.941*** [0.682]
Fixed Effects	Firm, Year	Firm x Year	FirmxYear, Sector	FirmxYear, SectorxYear
Observations	4,680,193	4,591,741	4,591,741	4,591,741
R-squared	0.277	0.321	0.338	0.338

Note: Standard errors are clustered at hs6-year level;
 f-firm, p-product(hs6), s-sector, t-time(year).

Mechanism: Firm Intermediates Varieties (HS8×Exp)

Table 8. Firm-product-year Level Import Varieties - Intermediates
 Dependent Variable = $\ln \#$ Varieties (HS8*country)

Uncertainty	-0.0725** [0.0287]	-0.0724** [0.0312]	-0.0121 [0.0313]	-0.0422 [0.0320]
Uncertainty×Post	0.0951*** [0.0337]	0.0957*** [0.0369]	0.0694* [0.0384]	0.0586* [0.0334]
Tariffs (ln)	-0.193*** [0.0515]	-0.191*** [0.0545]	-0.215*** [0.0562]	-0.197*** [0.0678]
Tariffs(ln)×Post	-0.502*** [0.0798]	-0.550*** [0.0838]	-0.346*** [0.0799]	-0.408*** [0.0943]
Fixed Effects	Firm, Year	Firm x Year	FirmxYear, Sector	FirmxYear, SectorXYear
Observations	4,680,193	4,591,741	4,591,741	4,591,741
R-squared	0.171	0.203	0.21	0.21

Note: Standard errors are clustered at hs6-year level;
 f-firm, p-product(hs6), i-product(hs8), s-sector, t-time(year).

Mechanism: Firm Import Probability of Product

Table 12. Firm-product-year Level Import Participation Decision - All Products
 Dependent Variable = D_fpt (binary, 1 if importer, 0 else)

Uncertainty	-0.0772*** [0.00827]	-0.0995*** [0.00913]	-0.0380*** [0.00854]	-0.0212** [0.00869]
Uncertainty×Post	0.0106 [0.00977]	0.0536*** [0.0108]	0.0392*** [0.0105]	0.0180* [0.0109]
Tariffs (ln)	-0.0172 [0.0160]	-0.0520*** [0.0148]	-0.0443*** [0.0150]	-0.0466*** [0.0162]
Tariffs(ln)×Post	-0.215*** [0.0233]	-0.162*** [0.0209]	-0.120*** [0.0204]	-0.125*** [0.0216]
Fixed Effects	Firm, Year	Firm x Year	FirmxYear, Sector	FirmxYear, SectorXYear
Observations	40,413,168	40,099,329	40,099,329	40,099,329
R-squared	0.075	0.296	0.297	0.298

Note: Standard errors are clustered at hs6-year level;
 f-firm, p-product(hs6), s-sector, t-time(year).

Robustness: Firm Imports and Historical Mean as Threat

Table 13b. Firm-product-year Level Import Value - All Products

Dependent Variable = ln Imports

Threat Tariff = $\text{mean}_{\{t' < t\}} t_{\text{pt}}$

Uncertainty	-12.61***	-12.26***	-8.904***	-9.750***
	[0.533]	[0.530]	[0.429]	[0.505]
Uncertainty×Post	8.919***	8.709***	5.706***	6.534***
	[0.587]	[0.589]	[0.468]	[0.556]
Tariffs (ln)	0.755	0.773	-0.824**	0.0163
	[0.512]	[0.508]	[0.390]	[0.425]
Tariffs(ln)×Post	-8.037***	-8.069***	-4.763***	-5.724***
	[0.663]	[0.651]	[0.515]	[0.558]
Fixed Effects	Firm, Year	Firm x Year	FirmxYear, Sector	FirmxYear, SectorxYear
Observations	7,531,534	7,435,142	7,435,142	7,435,142
R-squared	0.244	0.292	0.321	0.321

Note: Standard errors are clustered at hs6-year level;
f-firm, p-product(hs6), s-sector, t-time(year).

Robustness: Production Firm Imports by Product

Table 5. Firm-product-year Level Import Value
 Dependent Variable = ln Imports
 Production Firms Subsample

Uncertainty	-5.418*** [0.250]	-5.166*** [0.246]	-3.816*** [0.229]	-3.937*** [0.234]
Uncertainty×Post	2.339*** [0.288]	2.219*** [0.287]	1.441*** [0.264]	1.538*** [0.271]
Tariffs (ln)	-2.331*** [0.583]	-2.335*** [0.572]	-0.815* [0.474]	-1.835*** [0.491]
Tariffs(ln)×Post	-6.488*** [0.796]	-6.640*** [0.792]	-4.459*** [0.668]	-5.580*** [0.711]
Fixed Effects	Firm, Year	Firm x Year	FirmxYear, Sector	FirmxYear, SectorXYear
Observations	2,643,012	2,615,800	2,615,800	2,615,799
R-squared	0.219	0.261	0.288	0.289

Note: Standard errors are clustered at hs6-year level;
 f-firm, p-product(hs6), t-time(year).

Robustness: Production Firm Imports, Industry \times Time

Table 7. Firm-product-year Level Import Value - All Products
 Dependent Variable = ln Imports
 Production Firms, Alternative FE

Uncertainty	-5.418***	-5.414***	-5.415***	-4.002***	-3.439***	-2.570***
	[0.250]	[0.250]	[0.251]	[0.234]	[0.225]	[0.197]
certainty \times Post	2.339***	2.335***	2.350***	1.531***	1.388***	0.546***
	[0.288]	[0.288]	[0.291]	[0.267]	[0.261]	[0.152]
Tariffs (ln)	-2.331***	-2.332***	-2.325***	-1.802***	-0.235	-0.722**
	[0.583]	[0.583]	[0.582]	[0.483]	[0.452]	[0.333]
Tariffs(ln) \times Post	-6.488***	-6.492***	-6.496***	-4.326***	-3.788***	-2.675***
	[0.796]	[0.796]	[0.801]	[0.675]	[0.635]	[0.389]
Fixed Effects	Firm, Yr	Firm, Yr, Ind	Firm, Ind*Yr	Firm, Ind*Yr, Sector	Firm, Ind*Yr, HS2	Firm, Ind*Yr, HS4
Observations	2,643,012	2,643,012	2,642,998	2,642,998	2,642,998	2,642,982
R-squared	0.219	0.219	0.222	0.251	0.272	0.361

Note: Standard errors are clustered at hs6-year level;
 f-firm, p-product(hs6), v-cic industry, t-time(year).

Robustness: Prod'n Firm Imports of Intermediates (HS2,4 FE)

Table 6. Firm-product-year Level Import Value
 Dependent Variable = ln Imports
 Production Firms and Intermediates Subsample

Uncertainty	-4.186***	-3.075***	-2.974***	-1.944***	-0.870***
	[0.271]	[0.234]	[0.229]	[0.204]	[0.208]
Uncertainty×Post	1.499***	1.167***	1.074***	0.488**	0.746***
	[0.319]	[0.274]	[0.273]	[0.237]	[0.169]
Tariffs (ln)	-0.817	-0.289	-0.183	-2.038***	-2.086***
	[0.722]	[0.538]	[0.527]	[0.428]	[0.309]
Tariffs(ln)×Post	-4.120***	-3.507***	-3.871***	-1.667***	-0.849***
	[0.954]	[0.691]	[0.682]	[0.546]	[0.327]
Fixed Effects	Year	Firm, Year	Firm*Year	Firm*Year, HS2	Firm*Year, HS4
Observations	1,719,192	1,710,950	1,685,399	1,685,399	1,685,386
R-squared	0.031	0.233	0.274	0.304	0.355

Note: Standard errors are clustered at hs6-year level;
 f-firm, p-product(hs6), t-time(year).

WTO Commitments and TPU vs. Applied Tariff Elasticities

Table 16: WTO Commitment Impact on TPU and Applied Tariff Elasticities

	<i>Implied Parameters from Firm Estimates</i>		
Post-WTO Trade Tariff elasticity	-6.39	-4.88	-7.41
Probability of max reversal	0.27	0.25	0.22
	<i>Firm Import Growth from a 1 s.d. increase in:</i>		
TPU pre-WTO	-0.62	-0.51	-0.55
TPU post-WTO	-0.36	-0.33	-0.33
Applied tariff pre-WTO	-0.08	-0.05	-0.10
Applied tariff post-WTO	-0.36	-0.27	-0.41
	<i>Relative Importance of 1 s.d. TPU vs. Applied Tariffs</i>		
TPU tariff equiv pre-WTO	7.94	9.79	5.39
TPU tariff equiv post-WTO	1.01	1.21	0.81
<i>Source:</i>	Table 3	Table 4	Table 5
<i>Firm Sample:</i>	All (customs)	All (customs)	Production match
<i>Product Sample:</i>	All	Intermediates	All

Summary and Conclusions

- ▶ Theory
 - ▶ Input tariff uncertainty reduces imports through the decision to import
 - ▶ broader effects of TPU through index of tariff uncertainty
- ▶ Empirics
 - ▶ Uncertainty reduced import participation in China.
 - ▶ Increase in total imports, intermediate imports and number of imported varieties at the firm level post-accession.
 - ▶ Increased responsiveness to applied tariffs post-accession.
- ▶ Broader contributions
 - ▶ Role for WTO in creating long run commitments to previous liberalization
 - ▶ Impacts on domestic importers of own-country TPU could be important for Brexit, US-China hot/cold trade war, and Nafta renegotiation.

Future Work

▶ Short Run

1. Extend theory to include non-homothetic import demand, i.e., product dropping, as suggested by probit results.
2. Measure tariff indexes, accounting for 1.

▶ Long Run

1. Account for interactions with TPU in output markets
2. Study impacts on other firm performance measures: output, exports, TFP

Summary Statistics by Sector

Table A1. Uncertainty and Import Growth ($\Delta \ln$) by Sector — Summary Statistics

Sector	Import Share (2006)	Mean		Median		Std Dev		C.V.		Min		Max		Obs.
		import	uncertainty	import	uncertainty	import	uncertainty	import	uncertainty	import	uncertainty	import	uncertainty	
1 Animals	0.005	0.76	0.14	0.88	0.13	2.67	0.08	3.53	0.55	-6.17	0.00	10.20	0.41	179
2 Vegetables	0.022	0.74	0.16	0.87	0.15	2.32	0.12	3.14	0.73	-7.93	0.00	7.83	0.42	258
3 Fats & Oils	0.008	0.61	0.07	0.79	0.07	2.64	0.08	4.35	1.03	-4.80	0.00	6.54	0.29	45
4 Prepared Foodstuffs	0.008	1.18	0.21	1.40	0.22	2.04	0.10	1.73	0.49	-9.37	0.00	6.78	0.42	185
5 Minerals	0.246	1.69	0.15	1.43	0.14	2.12	0.12	1.26	0.76	-4.04	0.00	8.34	0.43	147
6 Chemicals	0.093	1.16	0.12	1.17	0.10	1.47	0.10	1.28	0.85	-5.15	0.00	8.66	0.63	774
7 Plastics, Rubber & Articles	0.046	1.31	0.14	1.37	0.13	1.23	0.08	0.94	0.59	-2.81	0.00	6.43	0.41	198
8 Hides, Leather, & Articles	0.003	1.98	0.27	1.89	0.31	1.52	0.14	0.76	0.51	-2.12	0.06	5.73	0.61	73
9 Wood, Straw & Articles	0.011	0.49	0.15	0.55	0.11	1.78	0.14	3.65	0.91	-2.91	0.00	6.19	0.49	81
10 Pulp, Paper & Articles	0.017	0.58	0.12	0.71	0.11	1.33	0.10	2.32	0.81	-3.13	0.00	4.92	0.38	148
11 Textiles & Articles	0.017	1.67	0.33	1.63	0.34	1.65	0.12	0.99	0.36	-3.34	0.00	8.90	0.49	821
12 Footwear, Headgear, other	0.001	1.73	0.40	1.52	0.36	1.53	0.08	0.89	0.21	-1.60	0.18	5.71	0.55	55
13 Stone, Plaster, Cement, other	0.003	0.95	0.20	1.12	0.19	1.23	0.11	1.29	0.53	-3.34	0.00	3.26	0.39	147
14 Precious stones, Metals, Jewellery,...	0.003	2.13	0.14	1.96	0.08	2.14	0.13	1.01	0.98	-3.27	0.00	9.73	0.36	45
15 Base Metals & Articles	0.072	1.43	0.12	1.32	0.06	1.65	0.12	1.15	1.02	-4.39	0.00	9.34	0.44	571
16 Machinery; Elec. Equip.; Electronics	0.329	0.89	0.11	0.94	0.07	1.27	0.11	1.43	0.95	-6.67	0.00	6.41	0.53	804
17 Vehicles, Aircraft, Vessels	0.062	1.04	0.13	1.32	0.06	1.69	0.15	1.63	1.10	-4.04	0.00	7.17	0.53	124
18 Optical, Medical & other instruments	0.050	1.06	0.15	1.26	0.14	1.64	0.14	1.54	1.90	-7.51	0.00	6.79	0.51	238
19 Arms and Ammunition	0.000	0.10	0.33	0.42	0.33	3.96	0.00	37.79	0.00	-6.01	0.33	8.66	0.33	10
20 Miscellaneous Manufactures	0.003	1.30	0.33	1.36	0.32	1.26	0.09	0.97	0.27	-4.44	0.09	5.20	0.47	130
21 Art and Antiques	0.000	1.34	0.14	1.19	0.20	1.78	0.10	1.32	0.70	-1.56	0.00	4.32	0.22	7

Notes: Uncertainty measure is pre-WTO level in 2000. Imports are in log changes. Sectors correspond to the UN defined "Sections", which are coherent groups of HS-2 industries, as described in <http://unstats.un.org/unsd/tradekb/Knowledgebase/HS>.

Summary Statistics

Table 1b. Summary Statistics of Variables in Regressions

	No. of Obs.	Mean	Std. Dev.
A. product-country level			
Imports(ln)	569,807	10.12	3.49
Uncertainty	569,807	0.22	0.16
Applied Tariffs(ln)	569,807	0.10	0.07
B. product level			
Imports(ln)	32,214	14.63	2.85
Number of Products(ln)	32,214	4.31	1.72
Uncertainty	32,214	0.22	0.16
Applied Tariffs (ln)	32,214	0.11	0.08
C. firm-product level			
- ordinary imports			
Imports(ln)	7,572,274	8.03	2.94
Number of Products(ln)	7,572,274	0.19	0.43
Uncertainty	7,572,274	0.20	0.14
Applied Tariffs (ln)	7,572,274	0.09	0.06

Note: f-firm, p-product(hs6), i-hs8, c-country, t-time(year).

Estimates: Aggregate Imports by Product-Exporter

Table 2a. Product-country-year Level Import Value, All Products
Dependent Variable =ln Imports

Uncertainty	-6.998*** [0.192]	-4.767*** [0.183]	-4.621*** [0.213]	-4.131*** [0.179]	-4.303*** [0.210]
Uncertainty×Post	2.825*** [0.213]	2.177*** [0.193]	1.971*** [0.241]	1.800*** [0.189]	2.008*** [0.237]
Tariffs (ln)	-1.594*** [0.368]	-2.175*** [0.351]	-1.260*** [0.390]	-2.462*** [0.334]	-1.427*** [0.377]
Tariffs(ln)×Post	-7.199*** [0.468]	-5.874*** [0.441]	-7.207*** [0.500]	-6.161*** [0.409]	-7.690*** [0.471]
Fixed Effects	Exp*Yr	Exp*Yr, Sector	Exp*Yr, Sector*Yr	Exp*Yr, Sector*Exp	Exp*Yr, Sector*Yr, Sector*Exp
Observations	569,676	569,676	569,676	569,308	569,308
R-squared	0.198	0.233	0.235	0.304	0.305

Note: Standard errors are clustered at hs6-year level ;
p-product(hs6), c-country, s-sector, t-time(year).

Estimates: Aggregate Imports by Product

Table 2b. Product-year Level Import Value, All Products
Dependent Variable = ln Imports

Uncertainty	-8.106***	-4.727***	-4.849***
	[0.231]	[0.236]	[0.272]
Uncertainty×Post	3.418***	2.918***	3.122***
	[0.262]	[0.250]	[0.309]
Tariffs (ln)	-0.294	-0.205	0.37
	[0.431]	[0.440]	[0.479]
Tariffs(ln)×Post	-7.378***	-7.490***	-8.566***
	[0.562]	[0.559]	[0.627]
Fixed Effects	Year	Year, Sector	Sector*Year
Observations	32,214	32,214	32,214
R-squared	0.17	0.296	0.299

Note: Standard errors are clustered at hs6-year level;
p-product(hs6),s-sector, t-time(year).

Mechanism: Firm Input Varieties (HS8×Exp)

Table 8. Firm-product-year Level Import Varieties - All Products
Dependent Variable = ln # Varieties (HS8*country)

Uncertainty	-0.0969*** [0.0234]	-0.0971*** [0.0250]	-0.00756 [0.0257]	0.0224 [0.0288]
Uncertainty×Post	0.118*** [0.0270]	0.117*** [0.0293]	0.0686** [0.0298]	0.0364 [0.0336]
Tariffs (ln)	-0.240*** [0.0487]	-0.253*** [0.0497]	-0.375*** [0.0507]	-0.376*** [0.0534]
Tariffs(ln)×Post	-0.481*** [0.0659]	-0.503*** [0.0674]	-0.334*** [0.0647]	-0.362*** [0.0671]
Fixed Effects	Firm, Year	Firm x Year	FirmxYear, Sector	FirmxYear, SectorXYear
Observations	7,531,534	7,435,142	7,435,142	7,435,142
R-squared	0.162	0.189	0.193	0.193

Note: Standard errors are clustered at hs6-year level;
f-firm, p-product(hs6), i-product(hs8), s-sector, t-time(year).

Robustness: Historical Mean as Threat Tariff (aggregate)

Table 13a. Product-country-year Level Import Value, All Products

Dependent Variable = ln Imports

Threat Tariff = $\text{mean}_{\{t' < t\}} t_{\text{pt}}$

Uncertainty	-14.78***	-9.770***	-9.817***	-8.591***	-9.277***
	[0.607]	[0.486]	[0.613]	[0.446]	[0.580]
Uncertainty×Post	8.704***	6.080***	6.075***	5.251***	6.029***
	[0.636]	[0.496]	[0.659]	[0.455]	[0.619]
Tariffs (ln)	-2.821***	-3.203***	-2.318***	-3.318***	-2.380***
	[0.433]	[0.362]	[0.415]	[0.335]	[0.395]
Tariffs(ln)×Post	-8.090***	-6.215***	-7.499***	-6.528***	-7.899***
	[0.515]	[0.447]	[0.513]	[0.407]	[0.482]
Fixed Effects	ct	ct+s	ct+st	ct+sc	ct+st+sc
Observations	569,676	569,676	569,676	569,308	569,308
R-squared	0.193	0.232	0.233	0.302	0.304

Note: Standard errors are clustered at hs6-year level ;
 p-product(hs6), c-country, s-sector, t-time(year).

Robustness: Prod'n Firm Input Varieties

Table 10. Firm-product-year Level Import Varieties - Intermediates
 Dependent Variable = ln # Varieties (HS8*country)

Production Firms				
Uncertainty	-0.0657*** [0.0239]	-0.0605** [0.0260]	-0.0235 [0.0275]	-0.0163 [0.0235]
Uncertainty×Post	0.0892*** [0.0297]	0.0751** [0.0336]	0.0651* [0.0348]	0.0439* [0.0260]
Tariffs (ln)	-0.282*** [0.0463]	-0.210*** [0.0494]	-0.224*** [0.0550]	-0.276*** [0.0507]
Tariffs(ln)×Post	-0.646*** [0.0910]	-0.491*** [0.0865]	-0.371*** [0.0708]	-0.212*** [0.0545]
Fixed Effects	Firm, Year	Firm x Year	FirmxYear, HS2	FirmxYear, HS4
Observations	1,719,192	1,685,399	1,685,399	1,685,386
R-squared	0.008	0.204	0.215	0.246

Note: Standard errors are clustered at hs6-year level;
 f-firm, p-product(hs6), i-product(hs8), s-sector, t-time(year).

Mechanism: Aggregate Import Probability of HS8-Exp

Table 11. Country-product-year Level Import Participation Decision - All Products
Dependent Variable = D_cpt (binary, 1 if importer, 0 else)

Uncertainty	-0.00881***	-0.00881***	-0.0193***	-0.0218***
	[0.00198]	[0.00198]	[0.00204]	[0.00228]
Uncertainty×Post	0.0215***	0.0215***	0.0287***	0.0291***
	[0.00266]	[0.00266]	[0.00246]	[0.00301]
Tariffs (ln)	-0.0429***	-0.0429***	-0.00446	-0.0139***
	[0.00454]	[0.00454]	[0.00464]	[0.00494]
Tariffs(ln)×Post	-0.0645***	-0.0645***	-0.0859***	-0.0896***
	[0.00756]	[0.00756]	[0.00705]	[0.00793]
Fixed Effects	c+t	ct	ct+s	ct+st
Observations	7,970,424	7,970,424	7,970,424	7,970,424
R-squared	0.442	0.444	0.451	0.451

Note: Standard errors are clustered at hs6-year level;
f-firm, p-product(hs6), s-sector, t-time(year).

Firm Product Imports by Own Export Status

Table 14a. Firm-product-year Level Import Value - All Products

<u>Never-exporting Firms</u>					
Uncertainty	-4.580***	-4.203***	-2.938***	-3.289***	
	[0.196]	[0.192]	[0.175]	[0.182]	
Uncertainty×Post	2.195***	1.869***	0.960***	1.319***	
	[0.248]	[0.247]	[0.204]	[0.216]	
Tariffs (ln)	-3.566***	-3.701***	-0.918**	-2.215***	
	[0.391]	[0.391]	[0.369]	[0.356]	
Tariffs(ln)×Post	-5.731***	-6.144***	-2.978***	-4.442***	
	[0.583]	[0.570]	[0.499]	[0.507]	
Observations	881,227	850,963	850,963	850,963	
R-squared	0.419	0.463	0.489	0.49	
<u>Always-exporting Firms</u>					
Uncertainty	-5.943***	-5.763***	-4.567***	-4.581***	
	[0.229]	[0.226]	[0.209]	[0.223]	
Uncertainty×Post	2.495***	2.466***	1.720***	1.692***	
	[0.257]	[0.257]	[0.231]	[0.252]	
Tariffs (ln)	-2.000***	-2.001***	-0.514	-1.250***	
	[0.542]	[0.535]	[0.438]	[0.465]	
Tariffs(ln)×Post	-6.754***	-6.854***	-4.463***	-5.408***	
	[0.678]	[0.667]	[0.554]	[0.596]	
Observations	2,599,746	2,589,769	2,589,769	2,589,769	
R-squared	0.195	0.237	0.262	0.262	
<u>New-exporting Firms</u>					
Uncertainty	-5.922***	-5.315***	-3.909***	-3.966***	
	[0.255]	[0.236]	[0.211]	[0.222]	
Uncertainty×Post	2.898***	2.407***	1.558***	1.594***	
	[0.298]	[0.283]	[0.243]	[0.261]	
Tariffs (ln)	-4.517***	-4.443***	-1.635***	-2.410***	
	[0.545]	[0.527]	[0.489]	[0.451]	
Tariffs(ln)×Post	-8.488***	-8.752***	-4.695***	-5.683***	
	[0.742]	[0.709]	[0.642]	[0.625]	
	Fixed Effects	Firm, Year	Firm x Year	Firm×Year, Sector	Firm×Year, Sector×Year
Observations	497,887	491,860	491,860	491,860	491,860
R-squared	0.257	0.315	0.344	0.345	0.345

Note: Standard errors are clustered at hs6-year level;
f-firm, p-product (hs6), s-sector, t-time(year).

Firm Product Imports: SOE Sample

Table 15a. Firm-product-year Level Import Value - All Products, SOEs
Dependent Variable = ln Imports

Uncertainty	-6.390***	-6.236***	-5.265***	-5.450***
	[0.238]	[0.236]	[0.213]	[0.241]
Uncertainty×Post	2.554***	2.551***	1.864***	2.046***
	[0.269]	[0.269]	[0.231]	[0.271]
Tariffs (ln)	-1.083*	-1.203**	-0.542	-0.273
	[0.553]	[0.555]	[0.468]	[0.509]
Tariffs(ln)×Post	-5.947***	-6.140***	-4.405***	-5.437***
	[0.689]	[0.682]	[0.579]	[0.631]
	Fixed Effects	Firm, Year	Firm x Year	FirmxYear, Sector
				FirmxYear, SectorxYear
	Observations	1,937,545	1,927,349	1,927,349
	R-squared	0.206	0.246	0.275
				0.275

Note: Standard errors are clustered at hs6-year level;
f-firm, p-product(hs6), s-sector, t-time(year).

Firm Product Imports: non-SOE Sample

Table 15b. Firm-product-year Level Import Value - All Products, non-SOE
Dependent Variable = ln Imports

Uncertainty	-5.351*** [0.229]	-4.992*** [0.220]	-3.631*** [0.200]	-3.760*** [0.207]	
Uncertainty×Post	2.457*** [0.262]	2.237*** [0.256]	1.404*** [0.228]	1.511*** [0.238]	
Tariffs (ln)	-3.537*** [0.508]	-3.504*** [0.494]	-1.561*** [0.403]	-2.514*** [0.404]	
Tariffs(ln)×Post	-7.369*** [0.685]	-7.508*** [0.670]	-4.314*** [0.553]	-5.377*** [0.575]	
	Fixed Effects	Firm, Year	Firm x Year	FirmxYear, Sector	FirmxYear, SectorxYear
	Observations	5,593,852	5,507,793	5,507,793	5,507,793
	R-squared	0.265	0.314	0.342	0.342

Note: Standard errors are clustered at hs6-year level;
f-firm, p-product(hs6), s-sector, t-time(year).