THE UNIVERSITY of TENNESSEE KNOXVILLE

Tariff Rate Uncertainty and the Structure of Supply Chains

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November 19, 2024

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Motivation

Incomplete contracts, information asymmetries, quality control, and contract enforcement are common issues in global value chains

Limited theory/empirics on procurement strategy

Potential reasons: Theory is tedious and contracts are not observable

This paper: Theory and data to examine optimal procurement with quality control in the context of bilateral/global uncertainty

Why: Cool predictions, transaction level data, and procurement systems determine trade policy consequences on welfare

Bottom line: Quality control affects the organization of supply chains and interacts with global uncertainty to affect trade patterns, welfare

For this Talk

Objective: optimally procure input q, seller can cheat on quality

Taylor and Wiggins (1997):

- American approach: Costly inspections and contracts
- Japanese approach: Incentive premiums and relationships

Uncertainty: shocks that break up relationships

My favorite US import predictions:

- American: Large shipments, low frequency, low unit values
- Japanese: Small shipments, high frequency, high unit values
- System: Increased uncertainty pushes to American system

Data: US Census transaction-level imports and tariff uncertainty

Quantify in trade model

Contributions

Trade policy uncertainty: Procurement systems (quality control) relevant to understand the consequences of uncertainty and welfare effects

Global value chains: Determinants of organization of buyer-seller relationships

Literature on shipping frequency: Procurement and quality control versus administrative barriers

Procurement: Cajal-Grossi et al (2023) use/build-on our measurement strategy

Quantitative model: Global uncertainty affects relative trade patterns and welfare

Producer Set Up

Cost of producing and delivering an order of x: $f + \frac{x\theta}{\Upsilon}$

Υ: productivity

f: per-shipment cost

In any procurement system $s \in \{A, J\}$, producer participates iff:

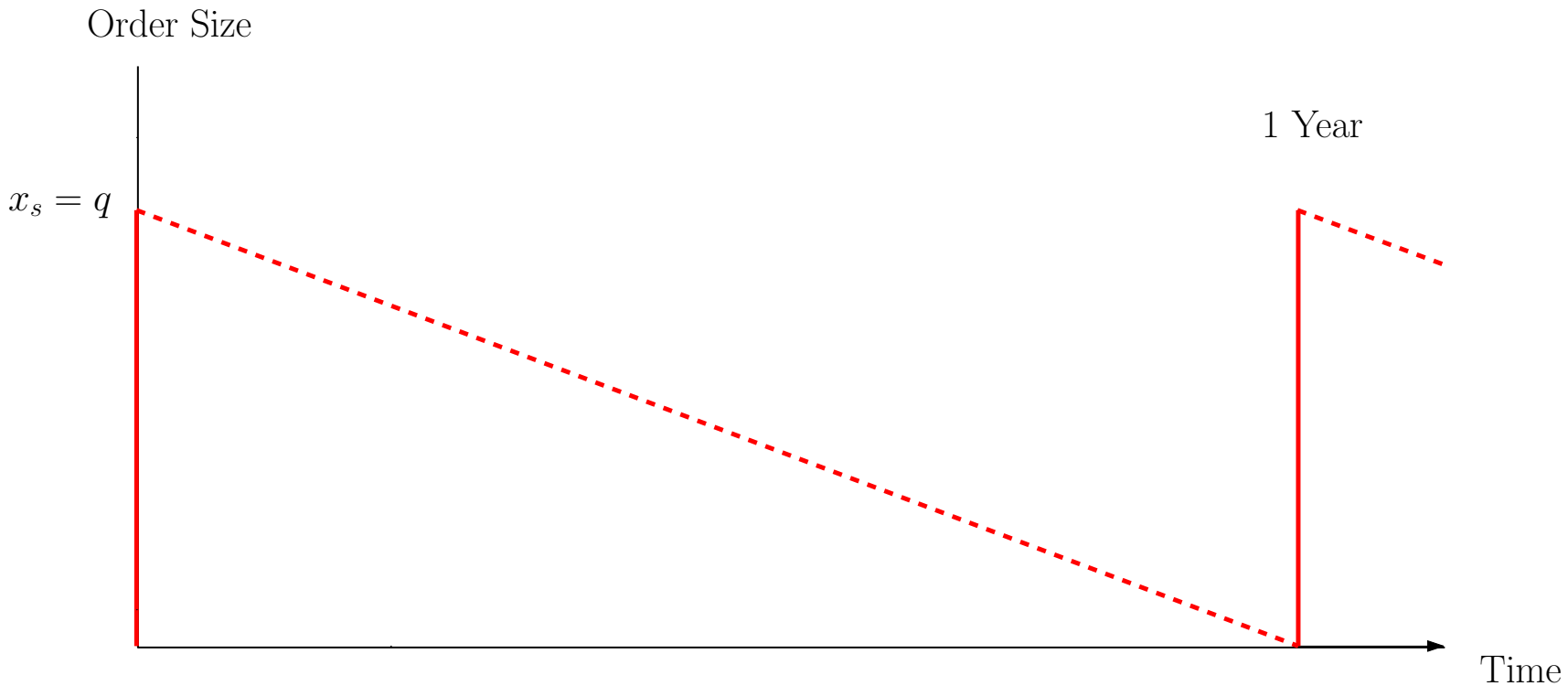
$$\underbrace{v_s(x_s, \theta)}_{\text{payment}} \geq \underbrace{f + \frac{x_s\theta}{\Upsilon}}_{\text{cost}}$$

Quality control problem: $\theta \in \{\overline{\theta}, \underline{\theta}\}$

Sellers have no bargaining power

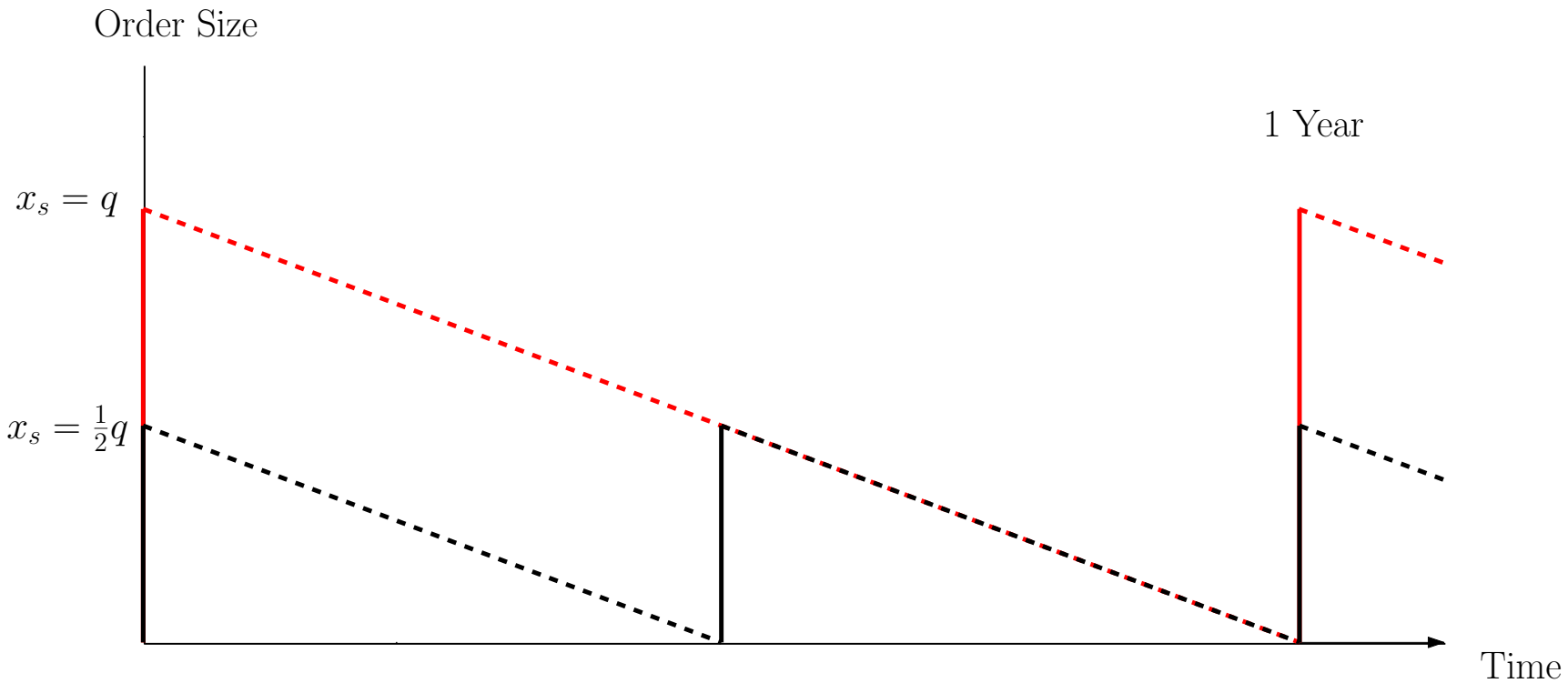
Buyer's problem: Choose x_s^* and system $s \in \{A, J\}$ to minimize total expected procurement costs

Buyer's Problem: import q with quality $\overline{\theta}$



Order Costs: $c_s(x_s, \theta)$ $c_s(x_s, \theta)$

Buyer's Problem: import q with quality $\overline{\theta}$



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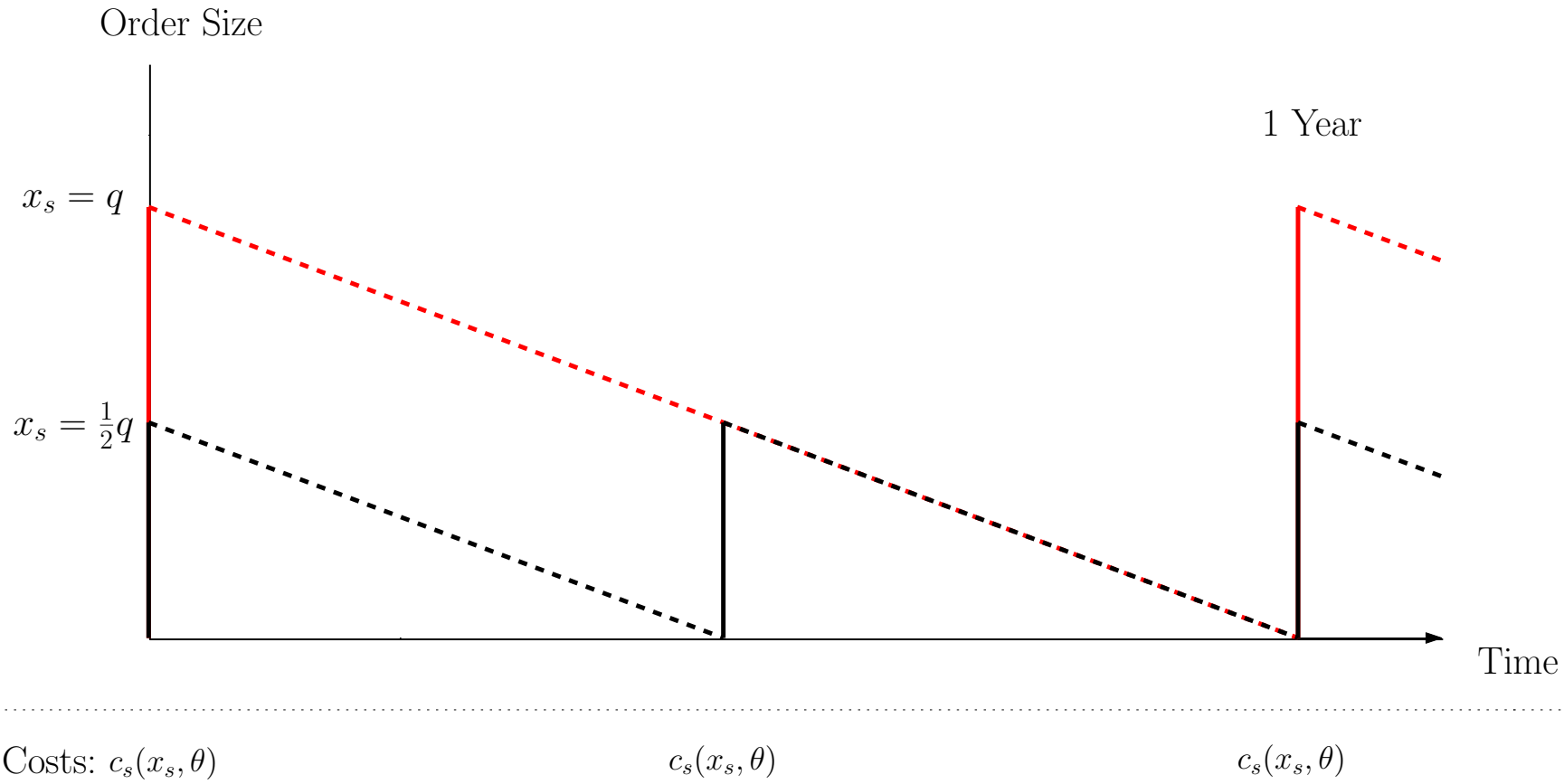


More orders $\Rightarrow$ Lower variable costs today $\Rightarrow$ Higher fixed costs

Objective: Choose shipment size x_s^* and quality control system $s \in \{A, J\}$ to minimize total discounted procurement costs

Quality Control

American:

Each shipment open for bids, inspect at cost m to reveal quality

Buyers with bargaining power pay $v_A(x_A) = f + \frac{x_A\overline{\theta}}{\gamma}$

Japanese:

Buyers form relationship with sellers and do not inspect

Relationships break with probability ρ

Buyers pay $v_J(x_J)$ s.t. long term benefits $\geq$ to cheating

$$\frac{v_J(x_J) - f - \frac{x_J\overline{\theta}}{\gamma}}{1 - e^{-(r+\rho)x_J/q}} \geq v_J(x_J) - f - \frac{x_J\underline{\theta}}{\gamma}$$

$$\Rightarrow v_J(x_J) = f + \frac{x_J\overline{\theta}}{\gamma} + \left[e^{(r+\rho)x_J/q} - 1\right](\overline{\theta} - \underline{\theta})\frac{x_J}{\gamma}$$

Optimal Procurement System

Buyer's per-shipment costs by system:

A: $c_A(x_A) = v_A(x_A) + m = \frac{x_A\bar{\theta}}{Y} + f + m$

J: $c_J(x_J) = v_J(x_J) = f + \frac{x_J\bar{\theta}}{Y} + \left[e^{(r+\rho)x_J/q} - 1\right](\bar{\theta} - \underline{\theta})\frac{x_J}{Y}$

Optimum:

Minimize future discounted expected cost to find x_s^*

Substitute x_s^* into system cost to determine optimal system

Proposition 1: For a given ρ, there exists a unique m^* where buyers are indifferent; if $m < m^*$, then American, else Japanese

Predictions/Propositions

Across systems: Shipment sizes are smaller in the Japanese system, unit values and shipping frequencies are higher

An increase in ρ affects the incentive premium in the Japanese system and may lead firms to switch systems

An increase in the inspection costs affects shipment size in the American system and may lead firms to switch systems

Empirical challenge: We don't observe the system choice or ρ, but we leverage our data and recent trade policy shocks to examine the predictions

Data

Universe of U.S. import transactions from 1992 to 2016

- Focus on arm's length data
- Harmonize 10 digit codes over time
- Clean importer and exporter codes

Observe

- Importer and exporter identifier
- Date of export
- Mode of transport
- HS products at 10 digits

Facts:

- Average trade value between partners about 229K
- On average, importer-exporter relationships last for 32 weeks
- Shipments arrive about every 6 weeks
- Mode of transport
- HS products at 10 digits

Japanese v. American Links

Main challenge: Don't see contracts in the data

Solution: American uses many sellers per shipment, Japanese uses few sellers per shipment (Taylor and Wiggins, 1997)

Empirical Analog: within importer-product-country-mode

$$SPS_{mhcz} = \frac{\text{Sellers}_{mhcz}}{\text{Shipments}_{mhcz}} \tag{1}$$

Empirical Model:

$$\begin{aligned} lnY_{mhcz} = \beta_0 + \beta_1 ln(SPS_{mhcz}) + \beta_2 lnQ_{mhcz} \\ + \beta_3 BW_{mhcz} + \beta_4 EW_{mhcz} + \lambda_{hcz} + \epsilon_{mhcz} \end{aligned}$$

Results

Dependent Variable	Quantity per Shipment	Weeks between Shipments	Unit Value
$lnSPS$	0.418^{***}	0.452^{***}	-0.123^{***}
	(0.017)	(0.017)	(0.021)
$lnQuantity$	0.701^{***}	-0.308^{***}	-0.287^{***}
	(0.014)	(0.014)	(0.020)
Observations		2,966,000	
R-Squared	0.947	0.674	0.845

Notes: Superscripts *, **, and *** indicate statistical significance at the 10, 5, and 1 percent levels, respectively. Number of observations has been rounded to the nearest 1000 as per U.S. Census Bureau Disclosure Guidelines.

Highlights of Robustness Checks

Theory is at the relationship level

$\Rightarrow$Including the exporter dimension does not affect the results

SPS may not be an appropriate measure of system choice

$\Rightarrow$ Product differentiation (Rauch 1999)

Air shipments may follow a different theory

$\Rightarrow$ Drop air shipments from the sample

The relationship between SPS and shipping patterns is non-linear

$\Rightarrow$ Use quartiles of SPS to examine predictions

Many SPS imply short relationships according to the theory

$\Rightarrow$ Examine the effect of SPS on relationship length

WHICH COUNTRIES USE JAPANESE PROCUREMENT?

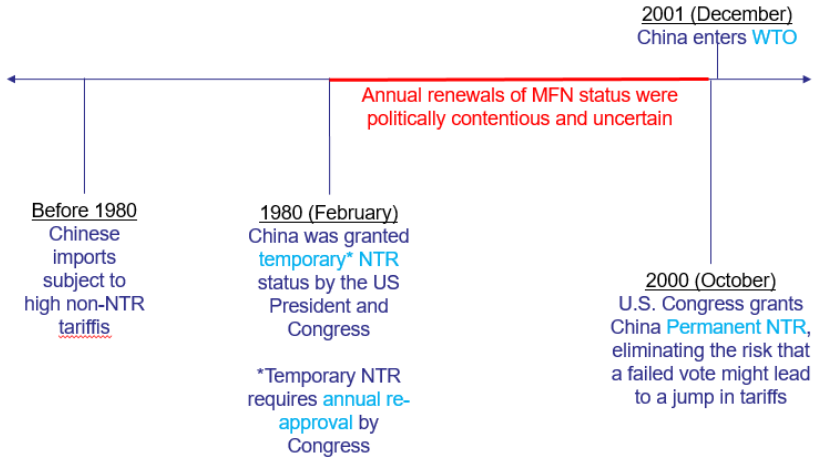
	Mean SPS		$J^{hz}_{mhcz} = 1$ Share of Import Value	
	(1)	(2)	(3)	(4)
Country	1995-2000	2002-2007	1995-2000	2002-2007
Mexico	0.095	0.068	0.750	0.869
Japan	0.107	0.123	0.756	0.725
Taiwan	0.132	0.114	0.711	0.743
Canada	0.141	0.120	0.602	0.667
United Kingdom	0.146	0.225	0.717	0.519
South Korea	0.156	0.135	0.656	0.724
France	0.177	0.158	0.627	0.667
Rest of the World	*0.180*	*0.156*	*0.625*	*0.678*
Germany	0.184	0.163	0.582	0.606
China	0.185	0.147	0.582	0.693
Brazil	0.190	0.151	0.576	0.706

Which Importers Use Japanese Procurement?

	(1)	(2)	(3)	(4)
Dep. var.	$\ln(sales_m)$	$\ln(pay_m)$	$\ln(wage_m)$	$(inv/sales)_m$
$\ln(SPS_m)$	-0.291^{***}	-0.350^{***}	-0.056^{***}	0.015^{***}
	0.005	0.006	0.002	0.001
Observations	184,000	184,000	184,000	48,500
R-squared	0.015	0.018	0.003	0.006

Robust standard errors are reported below coefficient estimates. ***, **, and * represent statistical significance at the 1, 5 and 10 percent levels.

China-U.S. Trade Policy



Policy shock affects longevity of relationships

NTR Tariffs generally low, Non-NTR generally high

NTR Gap$_h$=Non-NTR Tariff$_h$-NTR Tariff$_h$

Idea: If NTR Gap$_h$ $\uparrow$, then PNTR reduces ρ_{htc}

Variation: Policy before/after (first difference), China/others (second difference), NTR Gap across products (third difference)

Results: Effect of Uncertainty on Shipments

Table: Baseline Within *mxhcz* Quintuple PNTR DID Regression

	(1)	(2)	(3)
Dep. var.	$\ln(QPS_{mxhczt})$	$\ln(WBS_{mxhczt})$	$\ln(UV_{mxhczt})$
$Post_t * China_c * NTR\,Gap_h$	-0.197***	-0.168***	0.092***
	0.009	0.009	0.023
$ln(QPW_{mxhczt})$	0.368***	-0.632***	-0.124***
	0.009	0.008	0.013
Observations	439,000	439,000	439,000
R-squared	0.982	0.894	0.985
Fixed effects	$mxhcz, t$	$mxhcz, t$	$mxhcz, t$
Controls	Yes	Yes	Yes

Clustering by country (c) and product (h).

Results: Uncertainty and Procurement

	(1)	(2)	(3)	(4)
Dep. var.	$\ln(SPS_{mhczt})$	$1\{J^{hcz}_{mhczt} = 1\}$	$\ln(SPS_{hczt})$	$1\{J^{hcz}_{hczt} = 1\}$
$Post_t * China_c * Gap_h$	-0.006	0.041*	-0.021**	0.034*
	0.031	0.022	0.009	0.019
$ln(QPW_{mhczt})$	-0.171***	0.124***	-0.062***	0.032***
	0.006	0.005	0.002	0.003
Observations	738,000	291,000	368,000	28,500
R-squared	0.772	0.675	0.695	0.547
Fixed effects	$mhcz, t$	$mhcz, t$	hcz, t	hcz, t
Controls	Yes	Yes	Yes	Yes

Standard errors, adjusted for clustering by country and product.

Computational Trade Model: Endogenize Q

		(1)	(2)	(3)
		Baseline Equilibrium	**Equilibrium Without Japanese Sourcing**	**Removal of PNTR**
(1)	Value imported from China (%)	7.2%	7.5%	7.1%
(2)	- of which, "Japanese"	8.6%	.	6.1%
(3)	Value imported from ROW (%)	24.9%	17.9%	25.0%
(4)	- of which, "Japanese"	51.6%	.	51.6%
(5)	Value imported from U.S. (%)	67.9%	74.6%	67.9%
(6)	Avg. inspection costs	0.4%	1.3%	0.4%
(7)	Avg. fixed costs (imports)	4.1%	3.2%	4.1%
(8)	Manufacturing price index	1.000	1.025	1.000
(9)	Utility	1.000	0.984	0.9998

Summary

Extend existing procurement (quality control) framework for policy uncertainty

Develop a measure to distinguish systems and provide evidence that procurement systems explain transaction level import patterns

Derive predictions for consequences of uncertainty and provide empirical evidence that uncertainty explains procurement strategies

Provide computational/model evidence that an increase in global uncertainty affects trade patterns and welfare