Quality, Variable Markups, and Welfare: A Quantitative General Equilibrium Analysis of Export Prices

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Introduction

Rapid growth in quantitative general equilibrium trade models

- Parsimonious models a la Eaton and Kortum (2002), Melitz (2003), Chaney (2008)
  - Require few parameters
  - Key parameter is the "trade elasticity", the effect on import value of a change in ad-valorem trade costs
  - Limited use of price data (e.g. Jung, Simonovska, and Weinberger 2019)

Introduction

Fact: The same firm charges prices that can vary dramatically across countries.

Price variation reflects the interaction of

1. Heterogeneous trade costs
2. Pricing to market
3. Quality heterogeneity across firms

What does the literature miss by modeling only two of the three?

What We Do

We analyze a simple quantitative GE model with heterogeneous firms and endogenous price and quality choice that allows for

- **Rich Treatment of Trade costs**: our setting allows for trade costs that are both *ad-valorem* and *specific*
- **Variable Markups**: Non-homothetic preferences and firm heterogeneity generate price heterogeneity across firms.
- **Washington Apples Effects**: Demand for quality, *specific-trade* costs, and higher costs to producing quality generate quality provision differences across countries

What We Do (cont.)

- We calibrate the model to moments from Chinese firm-level data and aggregate trade data
  - show need for all three mechanisms to match data
  - highlight the relationship between the nature of trade costs and quality and variable markups
- We also consider the comparative static to show the differential effect of the shocks of reducing specific and iceberg trade costs on the pattern of prices across countries.

Connection to Literature

1. **Quality Literature**: e.g., Schott (2003), Hummels and Skiba (2004), Feenstra and Romalis (2015), Johnson (2012), Manova and Zhang (2012), Kugler and Verhoogen (2009, 2012); Hottman, Redding, and Weinstein (2016); Fan, Li and Yeaple (2015, 2018)
2. **Variable Markups and Pricing-to-Market Literature**: e.g., Simonovska (2015), Jung, Simonovska, and Weinberger (2019, JSW), Atkeson and Berstein (2008), Berman, Martin, and Mayer (2012, BMM)

Road Map

- **Stylized Facts**
- Model
- Data and Quantification
- Comparative Static
- Conclusion

Stylized Facts

- **Selection**: more productive firms are more likely to export and export to a larger number of markets than less productive firms (e.g. Bernard and co-authors)
- **Selection**: More firms export to rich countries than to poor countries (e.g. Eaton, Kortum, and Kramarz, 2011)
- **Quality vs Markups**: More productive firms charge higher prices and earn greater revenues than less productive firms in any given market (e.g. Manova and Zhang 2012)
- **Quality vs Markups**: Within firms, prices charged in rich countries are higher than in poor countries (e.g. Fan Li and Yeaple, 2015)
- **Washington Apples Effect**: Higher priced goods tend to be shipped longer distances than lower priced goods (e.g. Hummels and Skiba, 2004).

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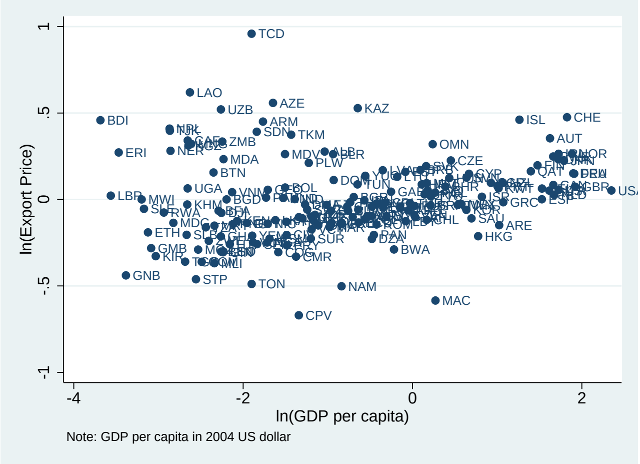
Stylized Fact 1: Export prices are higher in developed countries.

Table: Export Prices across Destination

	Dependent Variable: ln(*price*)			
	ln(p_{fhc})		ln(p_{hc})	
	(1)	(2)	(3)	(4)
GDP per capita (current in US dollar)	0.024***	0.026***	0.042***	0.045***
	(0.005)	(0.005)	(0.010)	(0.009)
Population		0.008***		0.011***
		(0.001)		(0.002)
Distance		0.020***		0.018***
		(0.003)		(0.004)
Firm-Product Fixed Effect	yes	yes	no	no
Product Fixed Effect	no	no	yes	yes
Observations	1,441,468	1,441,468	173,055	173,055
R-squared	0.946	0.946	0.831	0.831

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Robust standard errors corrected for clustering at the destination country level in parentheses. Robust standard errors corrected for clustering at the destination country level in parentheses. The dependent variable in specifications (1)-(2) is the (log) price at the firm-HS6-country level, and in specifications (3)-(4) is the (log) price at the HS6-country level. All regressions include a constant term.

Figure: Export prices increase with destination income



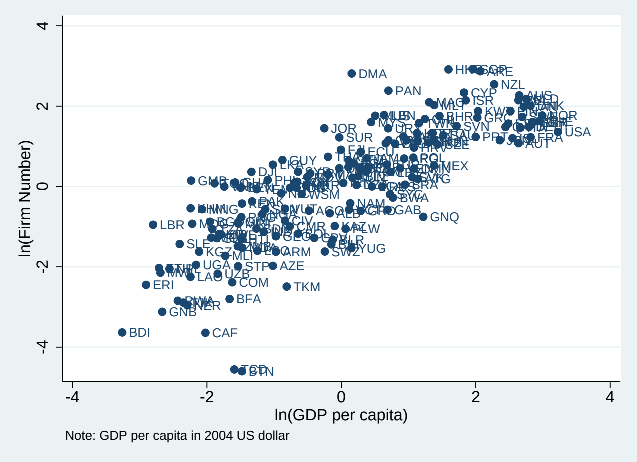
Stylized Fact 2: A larger number of firms export to developed countries.

Table: Firm Mass across Destination

	Dependent Variable: ln(*FirmNumber*)			
	$\ln(N_{hc})$		$\ln(N_c)$	
	(1)	(2)	(3)	(4)
GDP per capita (current in US dollar)	0.236***	0.296***	0.687***	0.767***
	(0.042)	(0.020)	(0.070)	(0.042)
Population		0.283***		0.762***
		(0.022)		(0.039)
Distance		-0.453***		-0.178
		(0.085)		(0.154)
Country-level other Control	no	yes	no	yes
Product Fixed Effect	yes	yes	no	no
Observations	173,422	173,422	173	173
R-squared	0.322	0.528	0.292	0.808

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Robust standard errors corrected for clustering at the destination country level in parentheses. The dependent variable in specifications (1)-(2) is the (log) firm number at the HS6-country level, and in specifications (3)-(4) is the (log) firm number at the destination country level. Country-level other controls include population and distance. All regressions include a constant term.

Figure: Firm Mass increases with destination income



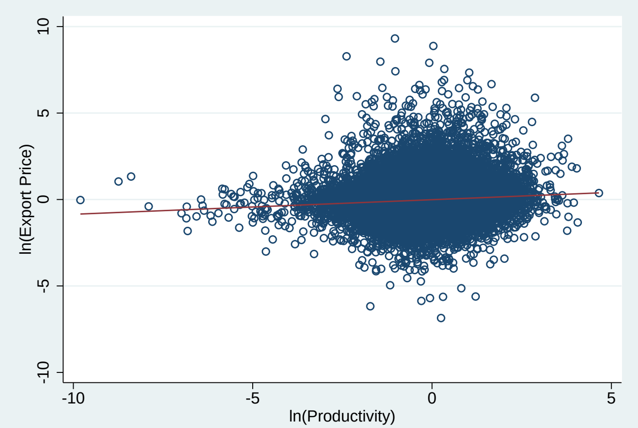
Stylized Fact 3: More productive firms charge higher export prices.

Table: Export Prices across Firm

	Dependent Variable: ln(*price*)			
	ln(p_{fhc})		ln(p_{fh})	
	(1)	(2)	(3)	(4)
ln(TFP)	0.095***	0.050***	0.094***	0.050***
	(0.009)	(0.009)	(0.009)	(0.011)
Firm-level Other Control	no	yes	no	yes
Product-country Fixed Effect	yes	yes	no	no
Product Fixed Effect	no	no	yes	yes
Observations	504,813	504,627	185,689	185,607
R-squared	0.775	0.779	0.638	0.644

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Robust standard errors corrected for clustering at the firm level in parentheses. The dependent variable in specifications (1)-(2) is the (log) price at the firm-HS6-country level, and in specifications (3)-(4) is the (log) price at the firm-HS6 level. Firm-level other controls include employment, capital-labor ratio, and wage. All regressions include a constant term.

Figure: Export prices increase with firm productivity



Road Map

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Countries and Endowments

- I countries indexed by i and j
- Country i is endowed with measure L_i of consumers
- Each consumer is endowed with one unit of labor that is mobile within a country but is not mobile across countries.

Preferences

Consumers have generalized CES preferences::

$$U_j = \left[\sum_i \int_{\omega \in \Omega_{ij}} \left(q_{ij}(\omega) x_{ij}^c(\omega) + \bar{x}\right)^{\frac{\sigma-1}{\sigma}} - \bar{x}^{\frac{\sigma-1}{\sigma}} d\omega\right]^{\frac{\sigma}{\sigma-1}},$$

where

- j: destination country; i: source country;
- $q_{ij}(\omega)$: quality of variety ω produced in country i and sold in j
- $x_{ij}^c(\omega)$: quantity consumed of variety ω by a consumer in j and produced in i;
- σ governs the elasticity of substitution across ω and $\bar{x} > 0$ is a constant that creates a "choke price"

Demand

Utility maximization implies that the demand for variety ω in country j is

$$x_{ij}(\omega) \equiv x_{ij}^{c}(\omega)L_j = \frac{L_j}{q_{ij}(\omega)}\left[\frac{y_j + \bar{x}P_j}{P_{j\sigma}^{1-\sigma}}\left(\frac{p_{ij}(\omega)}{q_{ij}(\omega)}\right)^{-\sigma} - \bar{x}\right] \quad (1)$$

- $P_j = \sum_i \int_{\omega\in\Omega_{ij}} \frac{p_{ij}(\omega)}{q_{ij}(\omega)} d\omega$ and $P_{j\sigma} = \left\{\sum_i \int_{\omega\in\Omega_{ij}} \left(\frac{p_{ij}(\omega)}{q_{ij}(\omega)}\right)^{1-\sigma} d\omega\right\}^{\frac{1}{1-\sigma}}$ are aggregate price index
- Define the **quality-adjusted** price $\tilde{p}_{ij}(\omega) \equiv \frac{p_{ij}(\omega)}{q_{ij}(\omega)}$; $\tilde{p}_j^{*} \equiv \left(\frac{y_j+\bar{x}P_j}{\bar{x}P_{j\sigma}^{1-\sigma}}\right)^{\frac{1}{\sigma}}$
- Demand could be simplified as:

$$x_{ij}(\omega) = \frac{\bar{x}L_j}{q_{ij}(\omega)}\left[\left(\frac{\tilde{p}_{ij}(\omega)}{\tilde{p}_j^{*}}\right)^{-\sigma} - 1\right] \quad (2)$$

Optimal Pricing Decision

- Firm's pricing decision solves:

$$\max_{p_{ij}(\omega)} \left[p_{ij}(\omega) - c_{ij}(\omega)\right] x_{ij}(\omega)$$

$$\Leftrightarrow \max_{\tilde{p}_{ij}(\omega)} \bar{x} L_j \left[\tilde{p}_{ij}(\omega) - \tilde{c}_{ij}(\omega)\right] \left[\left(\frac{\tilde{p}_{ij}(\omega)}{\tilde{p}_j^*}\right)^{-\sigma} - 1\right]$$

- Optimal pricing decision is the solution to:

$$\sigma \frac{\tilde{c}_{ij}(\omega)}{\tilde{p}_j^*} = \left(\frac{\tilde{p}_{ij}(\omega)}{\tilde{p}_j^*}\right)^{\sigma+1} + (\sigma - 1)\left(\frac{\tilde{p}_{ij}(\omega)}{\tilde{p}_j^*}\right) \tag{3}$$

- $\tilde{p}_{ij}(\omega)$ is a function of $\tilde{c}_{ij}(\omega)$. According to envelope theorem, maximizing firm's profit is equivalent to minimizing $\tilde{c}_{ij}(\omega) = \frac{c_{ij}(\omega)}{q_{ij}(\omega)}$

Quality and Production

- Productivity φ is heterogeneous and follows Pareto distribution

$$G_i(\varphi) = 1 - b_i \varphi^{-\theta}$$

- Production of quality follows Feenstra and Romalis (2014)

$$q_{ij} = (\varphi l_{ij})^{\frac{1}{\eta}}$$

- Firm's quality-adjusted marginal cost is

$$\tilde{c}_{ij} \equiv \frac{c_{ij}(\varphi, \varepsilon)}{q_{ij}} = \frac{\left(T_{ij} w_i + \frac{w_i \tau_{ij}}{\varphi} q_{ij}^{\eta}\right) \varepsilon}{q_{ij}}$$

where τ_{ij} is ad valorem trade cost and T_{ij} is a specific transportation cost from country i to country j. Following Eaton, Kortum and Kramarz (2011), we assume that each firm draws a cost shock ε, with $\log \varepsilon \sim N(0, \sigma_{\varepsilon})$ that is heterogeneous across firms and across destinations.

Optimal Quality Decision

- Firm chooses quality to minimize quality-adjusted marginal cost $\tilde{c}_{ij}$

$$\min_{q_{ij}} \tilde{c}_{ij}$$

- Positive relationship b/w productivity and quality

$$q_{ij}(\varphi, \varepsilon) = \left(\frac{T_{ij}\varphi}{(\eta - 1)\tau_{ij}} \right)^{\frac{1}{\eta}}, \tag{4}$$

- Negative relationship b/w productivity and quality-adjusted marginal cost

$$\tilde{c}_{ij}(\varphi, \varepsilon) = \gamma \frac{w_i \delta_{ij} \varepsilon}{\varphi^{\frac{1}{\eta}}}$$

where γ is a constant and $\delta_{ij} = (T_{ij})^{1-\frac{1}{\eta}} (\tau_{ij})^{\frac{1}{\eta}}$ is average trade cost.

Equilibrium Productivity Cutoff

- To sell in market j, $\tilde{p}_{ij}(\varphi, \varepsilon) \leq \tilde{p}_j^*$. Otherwise, the demand by consumers is zero.
- At the cut-off, we have:

$$\tilde{p}_{ij}(\varphi, \varepsilon) = \tilde{c}_{ij}(\varphi, \varepsilon) = \tilde{p}_j^*$$

- Equilibrium productivity cutoff φ_{ij}^*:

$$\varphi_{ij}^* = \gamma^{\eta} \underbrace{\left[(T_{ij})^{\eta-1} \tau_{ij}\right]}_{\text{trade cost}} \left(\frac{w_i}{\tilde{p}_j^*}\right)^{\eta} \varepsilon^{\eta} \tag{5}$$

Closing the Model

- **Free entry**: pay f in local labor get variety draw with productivity φ
  - The exporting firm mass from i to j endogenously determined
- Labor market is perfectly competitive
- Countries are on their budget constraint (trade balances):

$$\sum_j X_{ij} = \sum_j X_{ji}$$

Quantitative Implications

- More productive firms
  - charge higher prices and higher quality adjusted markups
  - earn larger sales revenue
- Consumers in richer countries
  - Pay higher import prices
  - Enjoy greater access to variety

Road Map

- Stylized Facts
- Model
- **Data and Quantification**
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Data

- Customs' transaction-level trade data
  - Price and sales data on Firm$\times$HS6$\times$Destination
- Firm level production data from National Bureau of Statistics of China
  - Firm level productivity estimation
- CEPII data
  - Country level macro variables
  - Gravity variables
- Global Trade Analysis Project (GTAP)
  - Industry level output
  - Bilateral trade flows

Three Steps

(1) Estimate two sets of the parameters of the model:
- Θ_1: η, the inverse of quality scope, θ, productivity shape, σ and σ_ε;
- All endogeneous macro variables:

$$\Theta_2 = \left\{ \left\{ w_j, P_{j\sigma}, P_j, fJ_i, T_{ij}^{\eta-1}\tau_{ij}, b_i, N_j \right\}_{i=1}^{I} \right\}_{j=1}^{I}$$

(2) Simulate the model using the estimated parameter set Θ_1 and Θ_2.

(3) Generate pseudo-Chinese exporters that is comparable with the custom data and analyze the model fit by comparing the real data and model generated one.

Parameterization: Identification of Θ_1

$$\log\left(\frac{\lambda_{ij}}{\lambda_{jj}}\right) = \underbrace{log\left[J_i b_i w_i^{-\theta\eta}\right]}_{S_i} - \underbrace{log\left[J_i b_i \left(T_{jj}^{\eta-1}\tau_{jj} w_j^{-\eta} w_i^{-\theta\eta}\right)^{\theta}\right]}_{S_j} - \theta\left(\eta-1\right) log T_{ij} - \theta log \tau_{ij}$$

- Estimation of θ.
  - Following Caliendo and Parro(2015) and Arkolakis et al.(2017b);
  - estimate θ from the coefficient on tariffs in a gravity equation.
- Use a set of gravity variables to proxy for T_{ij} and for τ_{ij}.
  - Following Waugh (2010) and Jung, Simonovska and Weinberger (2019);
  - Assume that specific and ad valorem trade costs are related to observables.
  - Note that with an estimate θ, it's possible to back out the aggregate trade cost $T_{ij}^{\eta-1}\tau_{ij}$

Parameterization: Identification of Θ_1 (cont.)

- Bilateral trade share λ_{ij} is constructed based on the method in Ossa (2014)
- Gravity variables $dist_{ij}$ and other variables (eg. common language, common currency) are taken from CEPII dataset;
- Tariff data is from WITS
  - The average tariff rate for all HS6 sectors of each destination is used to represent tar_{ij}
  - Let $tar_{ij} = 1$ if both i and j belongs to EU, NAFTA, ASEAN members countries.

Summary Statistis of Gravity Variables

Variable	Mean	Std. Dev.	Min.	Max.	N
$\log(\lambda_{ij}/\lambda_{jj})$	-5.221	1.842	-10.491	0	1296
$\log(tar_{ij})$	0.066	0.067	0	0.264	1296
$\log(dist_{ij})$	8.432	1.059	2.258	9.811	1296

Parameterization: Identification of Θ_1 (cont.)

Table: Estimation of Gravity Equation

Dependent variable: $\log(\lambda_{ij}/\lambda_{jj})$	
$\log(tar_{ij})$	-6.097***
	(0.795)
$\log(dist_{ij})$	-0.765***
	(0.031)
Common language	0.349***
	(0.071)
Common currency	0.165*
	(0.086)
Same country Dummy	2.658***
	(0.139)
Importer Fixed Effects	YES
Exporter Fixed Effects	YES
Observations	1,296
R-squared	0.988

Notes: Standard errors in parentheses.

Parameterization: Identification of Θ_1 (cont)

Estimating the remaining coefficients: σ_ε, σ, η using Chinese firm-level trade data

- Simulated method of moments to identify σ_ε, σ, η
  - Standard deviation of observed (not quality adjusted) log price (demeaned by industry and country)
  - Standard deviation of log sales
  - Correlation between log prices and log sales.
- Define $\xi = (\varphi/\varphi^*_{ij})^{\frac{1}{\eta}}$, we could obtain:

$$\log p_{ij}(\xi, \varepsilon) = \log\left(\frac{\tilde{p}_{ij}(\xi))}{\tilde{p}^\star_j}\right) + \log(\varepsilon) + \log(\xi) + \log\left(\frac{\eta}{\eta - 1} T_{ij} w_i\right)$$

$$\log r_{ij}(\xi) = \log\left(\frac{\tilde{p}_{ij}(\xi))}{\tilde{p}^\star_j}\right) + \log\left(\left(\frac{\tilde{p}_{ij}(\xi))}{\tilde{p}^\star_j}\right)^{-\sigma} - 1\right) + \log(\bar{x} L_j)$$

Parameterization: Identification of Θ_1 (cont)

In summary, estimation strategy could be summarized as follows:

- First, calibrate σ to target the standard deviation of the log of export sales.
- Second, choose σ_ε to target the standard deviation of the log of export price.
- Third, the correlation between log-sale and log-price helos to identify $\eta\theta$.
  - Note that the distribution of ξ is governed by the value of $\eta\theta$.
  - And a higher ξ implies a higher price and also a higher sales.

Parameterization: Identification of Θ_1 (cont)

Table: Calibration of Θ_1

Parameter	symbol	value (Exact ID)	value (Over ID)
elasticity of substitution	σ	4.8179	5.4819
std. dev. of cost shock	σ_ε	0.6004	0.7599
inverse of quality scope	η	1.7111	1.2193
trade elasticity w.r.t. tariff	θ	6.0973	6.0973

Identification: Solving for Θ_2

- Solve wage w_i for each country, using labor market clearing condition:

$$w_i L_i = \sum_j X_{ij} = \sum_j \lambda_{ij} w_j L_j$$

- Recover b_j, using the importer fixed effect from the gravity estimation:

$$S_j = log \left[(fJ_j)\, b_j w_j^{-\eta\theta} \right]$$

- Solve total firm mass N_j:

$$N_j = \frac{(\eta - 1)^{\frac{\eta-1}{\eta}}}{\eta \bar{x} \left[\beta_\sigma - \beta\right]} \left(T_{ij}^{\eta-1} \tau_{ij} \right)^{-\frac{1}{\eta}} \frac{w_j}{wi} \left(\frac{\kappa J_i b_i}{N_{ij}} \right)^{\frac{1}{\eta\theta}}$$

Model Simulation

Following Eaton, Kortum, Karmaz (2011) and Jung, Simonovska and Weinberger (2019):

- First, define $u = b_c \varphi^{-\theta}$ where b_c corresponds for China's productivity;
- Then write the conditional productivity entry cutoff in terms of u.
- Define

$$\tilde{u} \equiv \frac{u}{u_{cj}^{*}(\varepsilon)} \sim U[0,1]$$

Now, we can simulate the model in the next four steps:

Step1 Draw 1×10^6 $\tilde{u}$ and 1×10^6 $\tilde{\varepsilon}$.

- make the transfomation $\varepsilon = exp(\sigma_\varepsilon \tilde{\varepsilon})$ to obtain the simulated specific trade cost shocks.
- for each draw of $\tilde{u}$, construct then entry hurdles u_{cj}^{*max} for each country.

Step2 For each ũ, compute $u_c^{*max} = max_{j \neq China} \left\{ u_{cj}^{*}(\varepsilon) \right\}$. And then construct $u = u_c^{*max} \tilde{u}$ using the draw of $\tilde{u}$ in step 1.

Step3 For each u, the export status δ_{cj} can be given by

$$\delta_{cj}(u) = \begin{cases} 1, & if \quad u \leqq u^*_{cj}(\tilde{\varepsilon}) \\ 0, & otherwise \end{cases}$$

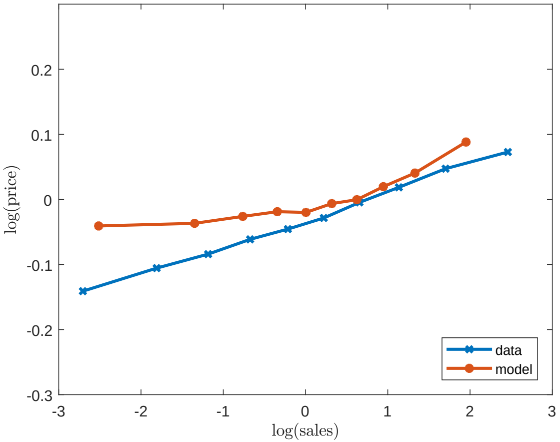
Step4 Recover firm level variables.

- Firm-level productivity.
- Exporter-destination quality.
- Firm-level prices that are not adjusted for quality:

$$p_{ij}(u,\varepsilon) = \frac{\tilde{p}_{ij}(u,\varepsilon)}{\tilde{p}^\star_j}\tilde{p}^\star_j q_{ij}(u,\varepsilon)$$

- Firm sales.

Model Fit: Price-Sales Relationship



Model Fit: Non-Targeted Moments

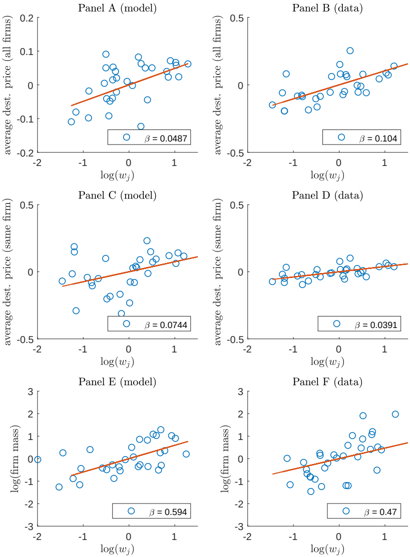
Table: Data Targets and Simulation Results

moment	data	model (Exact ID)	model (Over ID)
Panel A: targeted moments			
std(log(sale))	1.3916	1.3916	1.4935
std(log(price))	0.6017	0.6017	0.7613
corr(log(sale), log(price))	0.0543	0.0543	0.0541
trade elasticity w.r.t. tariff	6.0973	6.0973	6.0973
log(sales) 90-10	4.1551	-	1.9511
log(price) 90-10	2.0297	-	3.6124
log(sales) 90-50	2.0369	-	0.9752
log(price) 90-50	1.0451	-	1.6070
log(sales) 99-90	1.3814	-	0.7954
log(price) 99-90	1.3242	-	1.4837
Panel B: non-targeted moments			
exporter domestic sales advantage	1.7152	2.0831	3.3971
firm frac. with exp. intensity (0.00, 0.10]	38.2064	27.2619	64.4882
firm frac. with exp. intensity (0.10, 0.50]	35.5425	72.5898	35.5118
firm frac. with exp. intensity (0.50, 1.00]	26.2511	0.1483	0.0000

Notes: The targeted moments are constructed from customs data, which covers the universe of all exporters and importers. The non-targeted moments are constructed from the merged sample based on customs data and Chinese Manufacturing Survey data provided by NBSC (National Bureau of Statistics of China), because we need both exporters and non-exporters in the non-targeted moments to check exporter domestic sales advantage, and we also need total sales information from the NBSC data to compute export intensity.

- Model has trouble fitting the thick tails
- Fitting dispersion in prices across markets limits dispersion in sales across firms

Model Fit: Price-Wage and Entrant-Wage Relationship



Welfare Discussion

- Change in welfare associated with small trade shock

$$d \ln W_j = -\left(1 - \frac{\rho}{1 + \eta\theta}\right) \frac{d \ln \lambda_{jj}}{\eta\theta},$$

  where ρ is the average markup elasticity that depends on $\eta\theta$
- Sufficient-statistic type formula reminiscent of Arkolakis et al. (2019), with $\eta\theta$ being the trade elasticity

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Comparative Static: Prices and Trade Shocks

- Consider a 5% *increase* in trade costs between country i and j as measured by $T_{ij}^{\eta-1}\tau_{ij}$.
- By construction, whether these shocks are specific or ad-valorem has no impact on the size of the gains from trade
- They do, however, have big implications for the observed change in local import prices.

Comparative Static: Prices and Trade Shocks

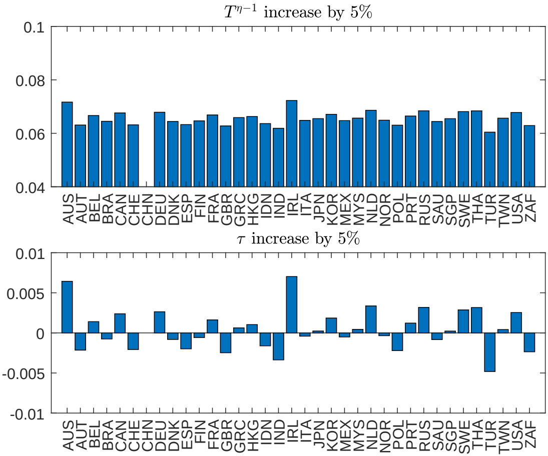
- We use the same firm productivity draw (φ) and cost shock draw (ε) in the benchmark simulation.

$$\widehat{\tilde{p}_j}^{\star} = \frac{\hat{w}_j}{\sum_i \lambda_{ij} \left(\widehat{\varphi_{ij}^{\star}} \right)}^{-\theta}$$

$$\widehat{\varphi_{ij}^{\star}} = \widehat{T}_{ij}^{\eta - 1} \hat{\tau}_{ij} \left(\hat{w}_i \right)^{\eta} \left(\widehat{\tilde{p}_j}^{\star} \right)^{-\eta}$$

$$\left(p_{CHN,j} \left(\varphi, \varepsilon \right) \right)' = \left(\frac{\tilde{p}_{CHN,j(\varphi,\varepsilon)}}{\tilde{p}_j^{\star}} \right)' \left(\tilde{p}_j^{\star} \right)' \left(q_{CHN,j} \left(\varphi, \varepsilon \right) \right)'$$

Prices and Trade Shocks



- Specific trade costs, quality $\Uparrow$; ad-valorem trade costs, quality $\Downarrow$.
- Price changes amplified for T but dampened for τ.

Prices and Trade Shocks (cont.)

Table: Effects of T and τ on prices, markups, and sales distribution (% change)

	CAN	DEU	FRA	GBR	JPN	USA
Panel A: T shock						
mean(log(prices))	5.86	5.77	5.75	5.80	5.67	5.70
Panel B: τ shock						
mean(log(prices))	-1.00	-1.09	-1.11	-1.06	-1.19	-1.16
panel C: common responses to T and τ shocks						
std(log(prices))	0.02	0.01	0.01	0.02	0.02	0.02
log(prices) 99-50	-0.02	0.01	-0.04	0.03	0.02	0.03
mean(log(markups))	-1.00	-1.09	-1.11	-1.06	-1.19	-1.16
std(log(markups))	2.59	2.85	2.91	2.76	3.12	3.03
log(markups) 99-50	2.81	3.11	3.18	3.00	3.40	3.30
mean(log(sales))	-78.04	-80.06	-80.36	-78.92	-87.62	-85.28
std(log(sales))	70.57	72.18	71.12	71.04	78.74	75.33
log(sales) 99-50	20.61	21.63	21.60	21.00	23.67	22.99
corr(log(prices), log(sales))	-10.50	-21.35	-29.09	-15.61	-11.84	-18.10
corr(log(prices), log(markups))	2.04	3.73	4.86	2.67	3.03	2.89
corr(log(markups), log(sales))	-16.32	-16.21	-15.31	-15.85	-18.02	-16.59

Conclusion

- "Washington Apples" mechanism first order important to fit the facts.
- Document three stylized facts using disaggregated Chinese customs data regarding export prices across firms and destinations.
- Build a model containing three mechanisms that contribute to price dispersion across firms and countries.
- Calibrate the model and simulate to show the quantitative prediction of the model.
- Comparative statics show the importance of specific trade costs on prices changes.

Thank you!

Backup Slide

Model Fit: A Check on the Solution of the Model