The Gains from Input Trade With Heterogeneous Importers

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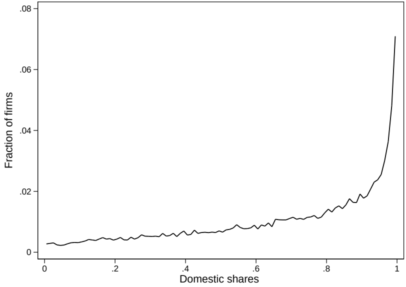
INTRODUCTION

- Large fraction of world trade is accounted for by firms sourcing intermediate inputs from abroad
- Trade in **inputs** benefits domestic **consumers**:
  - Better quality / new inputs reduce firms' production costs
  - This lowers price of domestically produced goods
- Question: by how much?

INTRODUCTION (CTD)

- Recent quantitative trade models: aggregate statistics are sufficient
- Rely on assumption that firms' import intensities are equalized
- This is at odds with the data:



- Accounting for this heterogeneity: resort to firm-based models
- We show that doing so matters

OUR APPROACH (I): MICRO SUFFICIENCY

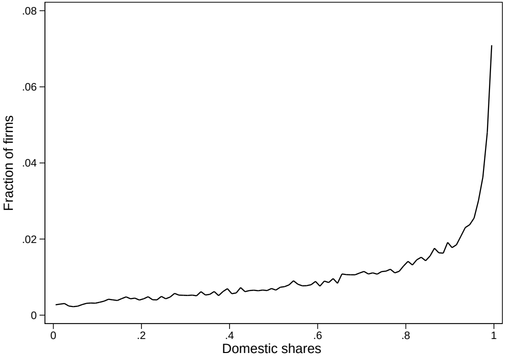


FIGURE: Heterogeneity in Import Intensity

- Domestic expenditure share = unit costs relative to autarky

OUR APPROACH (II): MACRO SUFFICIENCY

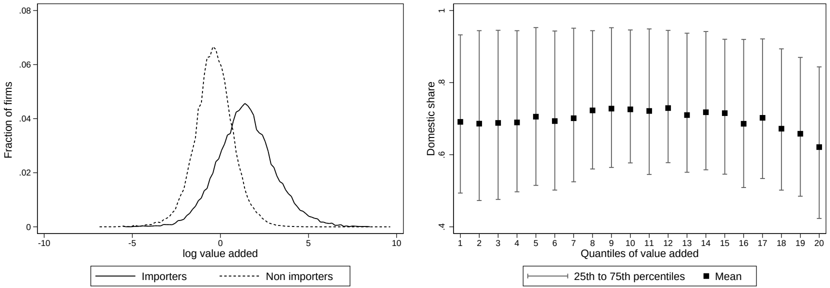


FIGURE: Import Intensity and Firm Size in France

- Data on value added and domestic shares is sufficient for change in consumer prices
- Holds in class of models where demand is CES
- Arbitrary extensive margin of trade

Related Literature

- Trade and Consumer Prices:
  - Feenstra (1994), Broda and Weinstein (2006), Arkolakis, Costinot and Rodriguez-Clare (2012)
- Aggregate models with input trade:
  - Eaton, Kortum and Kramarz (2011), Caliendo and Parro (2014), Costinot and Rodriguez-Clare (2014)
- Models of importing with firm heterogeneity:
  - Halpern, Koren and Szeidl (2015), Gopinath and Neiman (2014), Ramanarayanan (2015)
  - Antras, Fort and Tintelnot (2014), Lu, Asier and Mejia (2015)
- Reduced-form analysis of trade reforms:
  - Amiti and Konings (2007), Goldberg, Khandelwal, Pavcnik and Topalova (2010), Amiti, Dai, Feenstra and Romalis (2016),

A Model of Importing

Production structure:

$$
\begin{aligned}
y &= \varphi_i l^{1-\gamma} x^{\gamma} && (1) \\
x &= \left(\beta_i \left(q_D z_D \right)^{\frac{\varepsilon-1}{\varepsilon}} + (1-\beta_i)\, x_I^{\frac{\varepsilon-1}{\varepsilon}} \right)^{\frac{\varepsilon}{\varepsilon-1}} && (2) \\
x_I &= h_i \left(\left[q_{ci} z_c \right]_{c \in \Sigma_i} \right) && (3)
\end{aligned}
$$

where

- φ_i is firm efficiency
- q_{ci} is country quality and z_c is quantity sourced
- h_i any CRS production function
- Σ_i is the firm's **sourcing strategy**

Extensive margin: no restrictions

MP

Market Structure

- Input markets: firm faces prices $p_D, [p_{ci}]$ parametric
- Output markets: no restrictions
- This structure nests existing work:
  - Koren, Halpern, Szeidl (2015),
  - Gopinath Neiman (2014),
  - Antràs, Fort, Tintelnot (2015),
  - Amiti, Itskhoki, Konings (2014)
  - Aggregate trade models

IMPORT DEMAND

Unit cost is given by

$$u_i = \frac{1}{\varphi_i} w^{1-\gamma} Q_i(\Sigma_i)^{\gamma}$$

where

$$Q_i(\Sigma_i) = \left(\beta_i^{\varepsilon}(p_D/q_D)^{1-\varepsilon} + (1-\beta_i)^{\varepsilon} A_i(\Sigma_i)^{1-\varepsilon}\right)^{\frac{1}{1-\varepsilon}}$$

and $A_i(\Sigma_i)$ is the price index of the foreign bundle

IMPORTING AND UNIT COST

- $Q_i(\Sigma_i)$ depends on *unobserved* parameters, e.g. $[q_{ci}], [p_{ci}], h_i, \beta_i$
- However, $Q_i(\Sigma_i)$ is proportional to *observed* domestic share:

$$Q_i(\Sigma_i) \propto \frac{p_D}{q_D} s_{Di}^{\frac{1}{\varepsilon-1}}$$

- Hence:

$$u_i = \underbrace{1/\varphi_i}_{\text{Exogenous}} \times \underbrace{(s_{Di})^{\frac{\gamma}{\varepsilon-1}}}_{\text{Input trade}} \times \underbrace{(p_D/q_D)^{\gamma} w^{1-\gamma}}_{\text{GE}}$$

Producer Gains from Input Trade

1. Any model in CES class: effect of a trade shock

$$ln\left(\frac{u_i'}{u_i}\right)\Bigg|_{p_D,w} = \frac{\gamma}{1-\varepsilon} ln\left(\frac{s_{Di}}{s_{Di}'}\right)$$

   - Conditional on $s_{Di}/s_{Di}^{'}$, import environment does not matter

2. Special case: input autarky

$$G_i \equiv ln\left(\frac{u_i^{aut}}{u_i}\right)\Bigg|_{p_D,w} = \frac{\gamma}{1-\varepsilon} ln\left(s_{Di}\right)$$

   - Effect of input trade is observable, given γ and ε
   - Identifies distributional effects of input trade

MP CES General

From Micro to Macro

- So far: distribution of unit cost changes across firms
- Now: quantify effect of input trade on **consumer prices**
- Need to take a stand on:
  1. Consumer demand and output market structure
  2. Linkages across producers

The Macro Model

- Multi-sector CES monopolistic competition structure
- Consumers:

$$U = \prod_{s=1}^{S} C_s^{\alpha_s} \tag{4}$$

$$C_s = \left(\int_0^{N_s} c_{is}^{\frac{\sigma_s - 1}{\sigma_s}} di \right)^{\frac{\sigma_s}{\sigma_s - 1}} \tag{5}$$

- Firm i in sector s:

$$y_i = \varphi_i l^{1-\gamma_s} x^{\gamma_s}$$

$$x = \left(\beta_i \left(q_{Ds} z_{Ds} \right)^{\frac{\varepsilon_s - 1}{\varepsilon_s}} + (1 - \beta_i) x_I^{\frac{\varepsilon_s - 1}{\varepsilon_s}} \right)^{\frac{\varepsilon_s}{\varepsilon_s - 1}}$$

- Domestic bundle:

$$z_{Ds} = \prod_{j=1}^{S} Y_j^{\zeta_j^s}$$

where Y_j is akin to (5)

Input Trade and Consumer Prices

Proposition

Let P be the consumer price index. For any trade shock,

$$ln\left(P^{'}/P\right) = \alpha'\left(\Gamma\left(I-\Xi\times\Gamma\right)^{-1}\Xi+I\right)\times\Lambda$$

where $\Xi \equiv \zeta_j^s$, $\Gamma = diag\left(\gamma\right)$, *and*

$$\Lambda_s = \frac{1}{1-\sigma_s} ln\left(\int_0^{N_s} \frac{va_i}{\int va_i di}\left(\frac{s_{Di}}{s'_{Di}}\right)^{\frac{\gamma_s}{\varepsilon_s - 1}(\sigma_s - 1)} di\right).$$

- Change in consumer prices fully determined from $\left[va_i, \frac{s_{Di}}{s'_{Di}}\right]_i$
- Special case of autarky:

$$\Lambda_s^{Aut} = \frac{1}{1-\sigma_s} ln\left(\int_0^{N_s} \frac{va_i}{\int va_i di} s_{Di}^{\frac{\gamma_s}{\varepsilon_s - 1}(\sigma_s - 1)} di\right).$$

Single Sector Proof Markups

METHODOLOGY

- Structural approach to evaluate trade shocks (e.g. Halpern, Koren and Szeidl (2015)):
  - Specify extensive margin, e.g. fixed costs FC Model
  - Specify import environment $[p_{ci}, q_{ci}, f_{ci}, h_i, \beta_i]$
  - Estimate model: deal with computational complexity
  - Evaluate $Q_i(\Sigma_i)$
- We measure unit cost changes by relying on domestic shares:
  - Robustness: do not need to specify the import environment.
  - Flexibility: easily incorporate **multiple sectors with rich I/O structure, general equilibrium** and **strategic pricing**.
  - Limitation: requires domestic shares (past policies).

Models of Importing: Aggregate Models

Aggregate models: $s_{Di} = s_D$

- Gains from Input Trade: above result with

$$\Lambda^{Aut}_{Agg,s} = \frac{\gamma_s}{1-\varepsilon_s} ln\left(s_D\right) = \frac{\gamma_s}{1-\varepsilon_s} ln\left(s^{Agg}_{Ds}\right)$$

- Bias

$$Bias_s \equiv \Lambda^{Aut}_{Agg,s} - \Lambda^{Aut}_{s} = \frac{\gamma_s}{\varepsilon_s - 1} \times ln\left[\frac{\left(\int_0^{N_s} \frac{va_i}{\int va_i di} s_{Di}^{\chi_s} di\right)^{1/\chi_s}}{\int_0^{N_s} \frac{va_i}{\int va_i di} s_{Di} di}\right]$$

where $\chi_s = \frac{\gamma_s(\sigma_s - 1)}{\varepsilon_s - 1}$

- Result

$$Bias_s > 0 \iff \chi_s > 1$$

- Also: ε estimated from firm-level data can differ from aggregate trade elasticity

Intuition | Back to Consumer Gains

Models of Importing: Firm-based Models

Firm-based models: $s_{Di} \neq s_D$

1. Fixed costs and single source of heterogeneity (φ)

$$corr\left(s_{Di}, va_i\right) = -1$$

   - tends to *amplify* gains
   - e.g. Gopinath and Neiman (2014), Ramanarayanan (2015)

2. Fixed costs and multiple sources of heterogeneity $(\varphi, f, ...)$

$$corr\left(s_{Di}, va_i\right) = ?$$

   - depends on calibration
   - e.g. Halpern, Koren, Szeidl (2015)

Quantifying the Gains

- Gains from Input Trade: Consumer prices relative to autarky
- Application to French micro data
  - Population of manufacturing firms
  - Customs data matched to fiscal data at firm-level
- Need to estimate parameters:
  - Estimate (Ξ, α) from aggregate data
    - Can be read off Input-Output matrix
  - Estimate $(\varepsilon, \gamma, \sigma)$ from micro data
    - σ: from profit margins, $\sigma_s \in [1.8, 6]$
    - (ε, γ): see below

Standard Parameters

ESTIMATING THE ELASTICITY ε

$$y_{is} = \varphi_i l_i^{\phi_{ls}} k_i^{\phi_{ks}} x_i^{\gamma_s} = \tilde{\varphi}_i s_{Di}^{-\frac{\gamma_s}{\varepsilon_s - 1}} l_i^{\phi_{ls}} k_i^{\phi_{ks}} m_i^{\gamma_s}$$

- Input trade akin to firm-specific productivity shifter
- In terms of revenue:

$$ln(Rev_{is}) = \delta + \tilde{\phi}_{ks} ln(k_i) + \tilde{\phi}_{ls} ln(l_i) + \tilde{\gamma}_s ln(m_i) + ln(\vartheta_i) \tag{6}$$

$$ln(\vartheta_i) = -\frac{1}{\varepsilon_s - 1} \tilde{\gamma}_s ln(s_{Di}) + \frac{\sigma_s - 1}{\sigma_s} ln(\tilde{\varphi}_i) \tag{7}$$

  - Get productivity residuals from (6), then get ε from (7)
  - Or estimate (6)-(7) in one step; PF estimation with additional input
- Endogeneity: Instrument s_D with firm-specific index of shocks to world supply

$$z_{it} = \Delta ln\left(\sum_{ck} WES_{ckt} \times s_{cki}^{pre}\right)$$

More on Instrument Approaches

Estimating ε : Results

$$\Delta ln\left(\hat{\vartheta}_{ist}\right) = \delta_s + \delta_t + \frac{1}{1-\varepsilon} \times \Delta\tilde{\gamma}_s ln\left(s^D_{ist}\right) + u_{ist}$$

			Reduced form estimates:			
		First stage	Δ ln productivity	Δ ln VA	ε	N
Full sample	All weights	-0.019***	0.014***	0.050***	2.378***	526,687
		(0.003)	(0.004)	(0.005)	(0.523)	
	Pre-sample weights	-0.017***	0.024***	0.068***	1.711***	443,954
		(0.004)	(0.004)	(0.006)	(0.166)	
Importers	All weights	-0.010***	0.005	0.030***	2.322**	65,799
		(0.004)	(0.004)	(0.006)	(1.014)	
	Pre-sample weights	-0.010**	0.009**	0.033***	1.892***	54,604
		(0.005)	(0.004)	(0.006)	(0.541)	

Estimates of $\varepsilon \in (1.71, 2.38)$

First Stage GMM Results GMM Graph

The Producer Gains

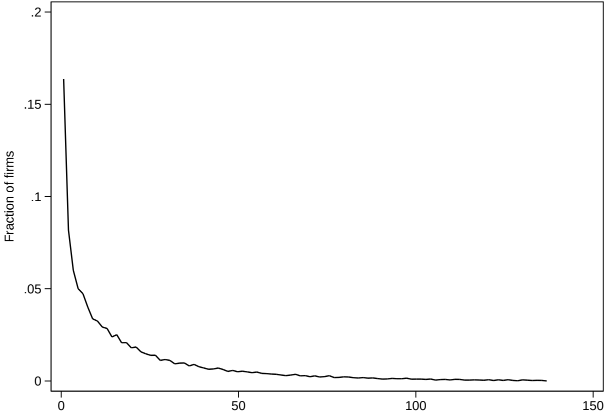


FIGURE: Distribution of Producer Gains from Input Trade,

- Empirical distribution of $(s_{Di}^{\gamma_s/(1-\varepsilon)} - 1) \times 100$
- Vast heterogeneity: 90-10 quantile is $[0.64\%, 86\%]$

Sum Stats Correlates of Gains

The Consumer Gains

	Manufacturing Sector		Entire Economy	
Consumer Price Gains	27.52	*[21.2,35.9]*	9.04	*[7.1,11.6]*
Aggregate Data	30.86	*[21.5,45.3]*	9.92	*[7.1,14]*
Bias	3.34	*[0.2,10]*	0.88	*[0,2.6]*

TABLE: Consumer Price Gains From Input Trade in France

- French consumer prices would be 27.5% higher under input autarky.
- When non-manufacturing sector is included, gains amount to 9%.
- Relying on aggregate data leads to over-estimating gains.
  - But elasticity estimated from aggregate data is also different. Bias Eps

Bootstrap Bias Formula Results with Var Markups

CONSUMER GAINS: BY TYPE AND SECTOR

Industry	ISIC	Sectoral Price Gains (1)		Direct Price Reductions (2)		Domestic Inputs (3)		Aggregate Data (4)		χ_s (5)
Mining	10-14	7.8	*[5.2,10.3]*	3.0	*[1.8,4.2]*	14.9	*[11.1,19.2]*	2.5	*[1.6,3.6]*	0.38
Food, tobacco, beverages	15-16	17.8	*[12.4,23.4]*	11.1	*[7.5,14.6]*	8.4	*[6.2,10.6]*	12.6	*[7.8,18.2]*	1.50
Textiles and leather	17-19	55.6	*[42.4,74]*	31.1	*[24.2,39.9]*	31.4	*[24.3,40.3]*	31.9	*[22.4,46.9]*	1.07
Wood and wood products	20	14.4	*[11.1,18.2]*	8.2	*[6.4,10.5]*	9.6	*[7.4,12.1]*	9.6	*[6.7,13.7]*	1.59
Paper, printing, publishing	21-22	20.1	*[14.7,26.5]*	12.2	*[9,16]*	14.5	*[10.9,18.7]*	11.0	*[7.7,15.4]*	0.64
Chemicals	24	45.1	*[32.7,60.7]*	27.2	*[20.1,36.4]*	21.6	*[16.1,28.2]*	28.1	*[18.7,41.8]*	1.11
Rubber and plastics products	25	38.4	*[27.5,50.9]*	20.1	*[14.3,26.5]*	27.3	*[20.2,36]*	21.5	*[13.9,31]*	1.30
Non-metallic mineral products	26	20.8	*[15.3,27.4]*	13.4	*[9.6,17.9]*	12.7	*[9.7,16.3]*	13.3	*[9,19]*	0.95
Basic metals	27	38.9	*[28.2,50.2]*	21.8	*[16.3,27.7]*	21.5	*[16.4,27.3]*	28.8	*[19,41.6]*	2.42
Metal products (ex machinery and equipment)	28	18.3	*[13.8,23.5]*	8.2	*[6.2,10.5]*	20.5	*[15.5,26.2]*	7.7	*[5.5,10.8]*	0.79
Machinery and equipment	29	31.7	*[23,41.6]*	17.6	*[12.8,23.2]*	20.0	*[15,25.7]*	18.2	*[12.2,26.2]*	1.13
Office and computing machinery	30	44.6	*[31.9,57]*	20.4	*[15.4,25.5]*	25.2	*[18.3,32.1]*	37.0	*[22.4,60.3]*	3.76
Electrical machinery	31	36.1	*[26.4,46.6]*	19.8	*[14.6,25.6]*	23.9	*[17.7,30.6]*	21.6	*[14.8,30.7]*	1.51
Radio and communication	32	38.5	*[23.5,54.8]*	21.5	*[13.1,31.1]*	23.3	*[16.6,30.5]*	22.1	*[12.5,36.1]*	1.11
Medical and optical instruments	33	29.2	*[21.1,38.3]*	17.9	*[12.8,23.4]*	20.4	*[15.1,26.2]*	15.9	*[10.7,22.5]*	0.70
Motor vehicles, trailers	34	23.3	*[17.4,39]*	6.2	*[3.2,16.4]*	21.7	*[17,29.3]*	11.2	*[6.1,24.3]*	3.22
Transport equipment	35	22.9	*[16,33.2]*	15.3	*[10.5,22]*	19.9	*[14.5,27.2]*	11.8	*[7.9,18.2]*	0.22
Manufacturing, recycling	36-37	26.0	*[19.2,33.4]*	12.9	*[9.7,16.3]*	19.0	*[14.5,24]*	14.1	*[9.5,20.4]*	1.35
Non-manufacturing		3.0	*[2.3,3.8]*	0.0	*[0,0]*	7.5	*[5.7,9.4]*	0.0	*[0,0]*	

CONSUMER GAINS: BY TYPE AND SECTOR

Industry	ISIC	Sectoral Price Gains (1)		Direct Price Reductions (2)		Domestic Inputs (3)		Aggregate Data (4)		χ_s (5)
Mining	10-14	7.8	*[5.2,10.3]*	3.0	*[1.8,4.2]*	14.9	*[11.1,19.2]*	2.5	*[1.6,3.6]*	0.38
Food, tobacco, beverages	15-16	17.8	*[12.4,23.4]*	11.1	*[7.5,14.6]*	8.4	*[6.2,10.6]*	12.6	*[7.8,18.2]*	1.50
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Wood and wood products	20	14.4	*[11.1,18.2]*	8.2	*[6.4,10.5]*	9.6	*[7.4,12.1]*	9.6	*[6.7,13.7]*	1.59
Paper, printing, publishing	21-22	20.1	*[14.7,26.5]*	12.2	*[9,16]*	14.5	*[10.9,18.7]*	11.0	*[7.7,15.4]*	0.64
Chemicals	24	45.1	*[32.7,60.7]*	27.2	*[20.1,36.4]*	21.6	*[16.1,28.2]*	28.1	*[18.7,41.8]*	1.11
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Radio and communication	32	38.5	*[23.5,54.8]*	21.5	*[13.1,31.1]*	23.3	*[16.6,30.5]*	22.1	*[12.5,36.1]*	1.11
Medical and optical instruments	33	29.2	*[21.1,38.3]*	17.9	*[12.8,23.4]*	20.4	*[15.1,26.2]*	15.9	*[10.7,22.5]*	0.70
Motor vehicles, trailers	34	23.3	*[17.4,39]*	6.2	*[3.2,16.4]*	21.7	*[17,29.3]*	11.2	*[6.1,24.3]*	3.22
Transport equipment	35	22.9	*[16,33.2]*	15.3	*[10.5,22]*	19.9	*[14.5,27.2]*	11.8	*[7.9,18.2]*	0.22
Manufacturing, recycling	36-37	26.0	*[19.2,33.4]*	12.9	*[9.7,16.3]*	19.0	*[14.5,24]*	14.1	*[9.5,20.4]*	1.35
Non-manufacturing		3.0	*[2.3,3.8]*	0.0	*[0,0]*	7.5	*[5.7,9.4]*	0.0	*[0,0]*	

Beyond Autarky and Consumer Prices

- So far, change in consumer prices relative to autarky
  - using observed distribution of (s_D, va)
- Now:
  - Currency devaluation: (finite) increase in the price of foreign varieties
  - Welfare: take into account resources lost through extensive margin

$$\frac{W}{W^{aut}} = \frac{P^{aut}}{P} \times \left(\frac{L - \int_i^N l_{\Sigma_i} di}{L} \right)$$

- Need a theory of domestic shares:
  - Take a stand on extensive margin: fixed costs Details
  - Impose functional form assumptions on $[p_c, q_c, f_c]$, form for h_i
  - Balanced trade Closing
  - One-sector model
- Calibrate the model

Additional Structure

1. **Extensive margin tractability: $f_c = f$ for all c**
   - **Σ reduces to price-adjusted quality cut-off $\overline{q}$**
2. Country quality is Pareto distributed:

$$G(q) = \Pr(q_c \leq q) = 1 - (q_{min}/q)^{\theta}$$

3. Imported inputs are combined according to:

$$x_I = \left(\int_{c \in \Sigma} (q_c z_c)^{\frac{\kappa - 1}{\kappa}} dc \right)^{\frac{\kappa}{\kappa - 1}}$$

- Implication: Firm-specific price index

$$A(\Sigma) = \left(\int_{c \in \Sigma} (p_c / q_c)^{1-\kappa} dc \right)^{\frac{1}{1-\kappa}} = z n^{-\eta} \equiv A(n)$$

  - η and z depend on structural parameters $(\kappa, \theta, q_{min})$ Details
  - can directly be estimated from micro-data Estimate η

Firm Problem

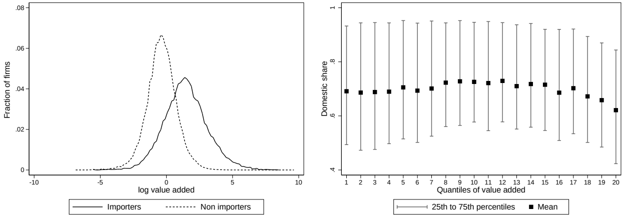
$$\pi = \max_n \left\{ u(n)^{1-\sigma} \times B - w\left(nf + f_I \mathbb{I}(n > 0)\right) \right\},$$

where

$$\begin{aligned} u(n) &\equiv \frac{1}{\tilde{\varphi}} w^{1-\gamma} \left(\frac{p_D}{q_D}\right)^{\gamma} s_D(n)^{\frac{\gamma}{\varepsilon-1}} \\ s_D(n) &= \left(1 + \left(\frac{1-\beta}{\beta}\right)^{\varepsilon} \left(\left(\frac{p_D}{q_D}\right) \frac{1}{z} n^{\eta}\right)^{\varepsilon-1}\right)^{-1}. \end{aligned}$$

- This gives a theory of domestic shares:
  - s_D can be small either because n is large or β is low

TARGET: FIRM SIZE AND IMPORT INTENSITY



- Need two dimensions of firm heterogeneity:
  - Efficiency $(\tilde{\varphi}_i)$ and either (i) fixed costs (f_i) or (ii) home bias (β_i)
  - Parametrize efficiency as log-normal.
  - Fixed costs (or home bias) as log-normal conditional on efficiency.

    Parametrization

- Take ε, γ, and σ from above estimation View

Calibration Results

		Firm-Based Models				Agg. Model
		Heterogeneous		Homogeneous		
		Fixed Costs	Home Bias	Fixed Costs	Home Bias	
Panel A: Structural Parameters						
Dispersion in efficiency	σ_φ	0.528	0.528	0.513	0.496	0.556
Fixed cost of importing	f_I	0.047	0.058	0.047	0.561	-
Avg. home bias	$\mu_{\tilde{\beta}}$	$1^\dagger$	2.595	$1^\dagger$	1.193	1.284
Dispersion in home bias	$\sigma_{\tilde{\beta}}$	-	1.028	-	0	-
Corr. home bias-efficiency	$\rho_{\tilde{\beta}\varphi}$	-	0.124	-	0	-
Avg. fixed cost	μ_f	5.059	-	5.475	-	-
Dispersion in fixed cost	σ_f	2.373	-	0	-	-
Corr. fixed cost-efficiency	$\rho_{f\varphi}$	0.739	-	0	-	-
Panel B: Moments						
	Data					
Agg. domestic share	0.720	**0.720**	**0.720**	**0.720**	**0.720**	**0.720**
Dispersion in ln va	1.520	**1.520**	**1.520**	**1.520**	**1.520**	**1.520**
Share of importers	0.199	**0.199**	**0.199**	**0.200**	**0.199**	1.000
Dispersion in $\ln s_D$	0.360	**0.360**	**0.360**	0.137	0.179	0.000
Corr. ln va- $\ln s_D$	-0.310	**-0.310**	**-0.310**	-0.720	-0.768	0.000

COUNTERFACTUALS

		Firm-Based Models				Agg. Model
		Heterogeneous		Homogeneous		
		Fixed Costs	Home Bias	Fixed Costs	Home Bias	
		Panel A: Reversal to Autarky				
Δ Consumer Prices	$\frac{P^{Aut}-P}{P}$	37.87%	38.01%	43.09%	43.89%	44.73%
	Bias		*0.36%*	*13.78%*	*15.90%*	*18.10%*
Δ Welfare	$\frac{W-W^{Aut}}{W}$	17.43%	36.42%	21.59%	27.81%	44.73%
		Panel B: Devaluations				
Δ Agg. Import Share						
5%	$\frac{P'-P}{P}$	1.85%	1.87%	2.08%	2.15%	2.19%
	Bias		*0.79%*	*12.47%*	*16.05%*	*18.21%*
10%	$\frac{P'-P}{P}$	3.71%	3.73%	4.17%	4.30%	4.39%
	Bias		*0.67%*	*12.58%*	*16.08%*	*18.31%*
20%	$\frac{P'-P}{P}$	7.42%	7.47%	8.37%	8.63%	8.80%
	Bias		*0.67%*	*12.86%*	*16.31%*	*18.55%*

COUNTERFACTUALS: RESULT #1

		Firm-Based Models				Agg. Model
		Heterogeneous		Homogeneous		
		Fixed Costs	Home Bias	Fixed Costs	Home Bias	
Panel A: Reversal to Autarky						
Δ Consumer Prices	$\frac{P^{Aut}-P}{P}$	37.87%	38.01%	43.09%	43.89%	44.73%
	Bias		*0.36%*	*13.78%*	*15.90%*	*18.10%*
Δ Welfare	$\frac{W-W^{Aut}}{W}$	17.43%	36.42%	21.59%	27.81%	44.73%
Panel B: Devaluations						
Δ Agg. Import Share						
5%	$\frac{P'-P}{P}$	1.85%	1.87%	2.08%	2.15%	2.19%
	Bias		*0.79%*	*12.47%*	*16.05%*	*18.21%*
10%	$\frac{P'-P}{P}$	3.71%	3.73%	4.17%	4.30%	4.39%
	Bias		*0.67%*	*12.58%*	*16.08%*	*18.31%*
20%	$\frac{P'-P}{P}$	7.42%	7.47%	8.37%	8.63%	8.80%
	Bias		*0.67%*	*12.86%*	*16.31%*	*18.55%*

Counterfactuals: Result #2

		Firm-Based Models				Agg. Model
		Heterogeneous		Homogeneous		
		Fixed Costs	Home Bias	Fixed Costs	Home Bias	
Panel A: Reversal to Autarky						
Δ Consumer Prices	$\frac{P^{Aut}-P}{P}$	37.87%	38.01%	43.09%	43.89%	44.73%
	Bias		*0.36%*	*13.78%*	*15.90%*	*18.10%*
Δ Welfare	$\frac{W-W^{Aut}}{W}$	17.43%	36.42%	21.59%	27.81%	44.73%
Panel B: Devaluations						
Δ Agg. Import Share						
5%	$\frac{P'-P}{P}$	1.85%	1.87%	2.08%	2.15%	2.19%
	Bias		*0.79%*	*12.47%*	*16.05%*	*18.21%*
10%	$\frac{P'-P}{P}$	3.71%	3.73%	4.17%	4.30%	4.39%
	Bias		*0.67%*	*12.58%*	*16.08%*	*18.31%*
20%	$\frac{P'-P}{P}$	7.42%	7.47%	8.37%	8.63%	8.80%
	Bias		*0.67%*	*12.86%*	*16.31%*	*18.55%*

Counterfactuals: Result #3

		Firm-Based Models				Agg. Model
		Heterogeneous		Homogeneous		
		Fixed Costs	Home Bias	Fixed Costs	Home Bias	
		Panel A: Reversal to Autarky				
Δ Consumer Prices	$\frac{P^{Aut}-P}{P}$	37.87%	38.01%	43.09%	43.89%	44.73%
	Bias		*0.36%*	*13.78%*	*15.90%*	*18.10%*
Δ Welfare	$\frac{W-W^{Aut}}{W}$	17.43%	36.42%	21.59%	27.81%	44.73%
		Panel B: Devaluations				
Δ Agg. Import Share						
5%	$\frac{P'-P}{P}$	1.85%	1.87%	2.08%	2.15%	2.19%
	Bias		*0.79%*	*12.47%*	*16.05%*	*18.21%*
10%	$\frac{P'-P}{P}$	3.71%	3.73%	4.17%	4.30%	4.39%
	Bias		*0.67%*	*12.58%*	*16.08%*	*18.31%*
20%	$\frac{P'-P}{P}$	7.42%	7.47%	8.37%	8.63%	8.80%
	Bias		*0.67%*	*12.86%*	*16.31%*	*18.55%*

Counterfactuals: Summary

1. Models that match data on size and dom shares predict very similar changes in consumer prices.

2. Models that do *not* match data on size and dom shares yield quantitatively meaningful biases.
   - Changes in consumer prices are 14-18% too high.

3. Welfare implications vary substantially across models, *even conditional on matching micro data*.

CONCLUSIONS

- Input trade is wide-spread but normative implications can be difficult to characterize.

- Spending patterns at the firm level are crucial for our understanding of input trade:
  - Capture unit cost changes
  - Agnostic about details of import environment

- If micro data on value added is also available, can measure consumer price gains:
  - For reversal to autarky, data is sufficient
  - For other counterfactuals, data is informative
  - Aggregate data gives biased answers

Supplementary Material

Multiple Products

Back

- If product aggregator is nested in country aggregator,

$$q_{ci} z_c \equiv \psi_{ci}\left(\left[q_{kci} z_{kc}\right]_{k \in K_{ci}}\right), \tag{8}$$

then our analysis goes through unchanged.

- Otherwise, if:

$$x = \left(\sum_{k=1}^{K} \left(\eta_k x_k\right)^{\frac{\iota-1}{\iota}}\right)^{\frac{\iota}{\iota-1}} \tag{9}$$

$$x_k = \left(\beta_{ki}\left(q_{kD} z_{kD}\right)^{\frac{\varepsilon_k-1}{\varepsilon_k}} + \left(1-\beta_{ki}\right) x_{kI}^{\frac{\varepsilon_k-1}{\varepsilon_k}}\right)^{\frac{\varepsilon_k}{\varepsilon_k-1}} \tag{10}$$

$$x_{kI} = h_{ki}\left(\left[q_{kci} z_{kc}\right]_{c \in \Sigma_{ki}}\right), \tag{11}$$

the analysis can be extended but requires domestic shares by product.

MULTIPLE PRODUCTS (CTD)

Back

Firm-level gains:

$$ln\left(\frac{u^{Aut}}{u}\right)\Bigg|_{p_D,w} = \frac{\gamma}{\iota-1}\times ln\left(\sum_{k=1}^{K}\chi_{ki}\left(s_{kDi}\right)^{\frac{\iota-1}{1-\varepsilon_k}}\right), \tag{12}$$

where

$$\chi_{ki} \equiv \frac{\left(\beta_{ki}^{-\frac{\varepsilon_k}{\varepsilon_k-1}}p_{kD}/q_{kD}\right)^{1-\iota}}{\sum_{k=1}^{K}\left(\beta_{ki}^{-\frac{\varepsilon_k}{\varepsilon_k-1}}p_{kD}/q_{kD}\right)^{1-\iota}}.$$

When product aggregator is CD (i.e. $\iota = 1$):

$$ln\left(\frac{u^{Aut}}{u}\right)\Bigg|_{p_D,w} = \sum_{k=1}^{K}\eta_k\frac{\gamma}{1-\varepsilon_k}ln\left(s_{Di}^{k}\right).$$

CES Upper Tier

Back

Suppose that:

$$y = \varphi\left((1-\gamma)\, l^{\frac{\zeta-1}{\zeta}} + \gamma x^{\frac{\zeta-1}{\zeta}}\right)^{\frac{\zeta}{\zeta-1}}.$$

Then:

$$u = \frac{1}{\varphi} s_M^{\frac{1}{\zeta-1}} \left(\frac{1}{\gamma}\right)^{\frac{\zeta}{\zeta-1}} s_D^{\frac{1}{\varepsilon-1}} \left(\frac{1}{\beta}\right)^{\frac{\varepsilon}{\varepsilon-1}} \left(\frac{p_D}{q_D}\right) \propto s_M^{\frac{1}{\zeta-1}} s_D^{\frac{1}{\varepsilon-1}}, \tag{13}$$

Because s_M^{Aut} is not observed, we can compute as:

$$s_M^{Aut} = \frac{\left(\frac{\gamma}{1-\gamma}\right)^{\zeta} \beta^{-\frac{\varepsilon}{\varepsilon-1}(1-\zeta)} \left(\frac{p_D/q_D}{w}\right)^{1-\zeta}}{1+\left(\frac{\gamma}{1-\gamma}\right)^{\zeta} \beta^{-\frac{\varepsilon}{\varepsilon-1}(1-\zeta)} \left(\frac{p_D/q_D}{w}\right)^{1-\zeta}}. \tag{14}$$

so that

$$ln\left(\frac{u^{Aut}}{u}\right)\Bigg|_{p_D,w} = ln\left(\frac{1+\left(\frac{\gamma}{1-\gamma}\right)^{\zeta} \beta^{-\frac{\varepsilon}{\varepsilon-1}(1-\zeta)} \left(\frac{p_D/q_D}{w}\right)^{1-\zeta} s_D^{\frac{1-\zeta}{\varepsilon-1}}}{1+\left(\frac{\gamma}{1-\gamma}\right)^{\zeta} \beta^{-\frac{\varepsilon}{\varepsilon-1}(1-\zeta)} \left(\frac{p_D/q_D}{w}\right)^{1-\zeta}}\right)^{\frac{1}{\zeta-1}} \tag{15}$$

General Production Function For Materials

Back

Suppose that:

$$x = g\left(q_D z_D, x_I\right). \tag{16}$$

Then:

$$dln\left(u\right)\big|_{p_D,w} \quad = \quad -\frac{\gamma}{1-\varepsilon_L} dln\left(s_D\right). \tag{17}$$

where

$$-\frac{1}{\varepsilon_L} \equiv \frac{\partial ln\left(\frac{\partial g(q_D z_D, x_I)/\partial x_D}{\partial g(q_D z_D, x_I)/\partial x_I}\right)}{\partial ln\left(\frac{q_D z_D}{x_I}\right)}$$

is the local elasticity of substitution.

Consumer Price Gains: Special Cases

- Single sector economy:

$$G = \frac{\Lambda}{1-\gamma}$$

- No cross-industry input-output linkages, i.e. $\zeta_j^s = 0$ for $j \neq s$ and $\zeta_j^j = 1$

$$G = \sum_{s=1}^{S} \alpha_s \frac{\Lambda_s}{1-\gamma_s}$$

back

Sketch of Proof

Back

1. Prices are given by

$$P_s = \frac{\sigma_s}{\sigma_s - 1}\left(\frac{p_{Ds}}{q_{Ds}}\right)^{\gamma_s} \times \left(\int_0^{N_s}\left(\frac{1}{\tilde{\varphi}_i} s_{Di}^{\gamma_s/(\varepsilon_s - 1)}\right)^{1-\sigma_s} di\right)^{\frac{1}{1-\sigma_s}}$$

2. Efficiency $\tilde{\varphi}_i$ is unknown but:

$$va_i = \kappa_s \tilde{\varphi}_i^{\sigma_s - 1} s_{Di}^{\frac{\gamma_s}{1-\varepsilon_s}(\sigma_s - 1)}$$

3. Hence

$$ln\left(\frac{P_s^{Aut}}{P_s}\right) = \gamma_s ln\left(\frac{p_{Ds}^{Aut}}{p_{Ds}}\right) + \underbrace{\frac{1}{1-\sigma_s} ln\left(\int_0^{N_s} \frac{va_i}{\int va_i di} s_{Di}^{\frac{\gamma_s}{\varepsilon_s - 1}(\sigma_s - 1)} di\right)}_{=\Lambda_s^{Aut}}$$

Variable Markups

Back

- Allow distribution of markups to respond to changes in trading environment.
- As in Edmond, Midrigan and Xu (2012), use setting of Atkeson-Burstein (2008).
- Demand structure:

$$C_s = \left(\int_0^{N_s} c_{js}^{\frac{\sigma_s - 1}{\sigma_s}} dj \right)^{\frac{\sigma_s}{\sigma_s - 1}},$$

$$c_{js} = \left(\sum_{i=1}^{N_{js}} c_{ijs}^{\frac{\theta_s - 1}{\theta_s}} \right)^{\frac{\theta_s}{\theta_s - 1}},$$

  where $\theta_s \geq \sigma_s$.
- Firms compete with other firms in their variety j, but take decisions in other sectors as given. Assume Cournot competition.

Input Trade & Consumer Prices: Variable Markups

Back

Proposition applies with:

$$\Lambda_s = \frac{1}{1-\sigma_s} ln \int_0^{N_s} \left(\sum_{i=1}^{N_{js}} \omega_i \left(\frac{s_{Di}}{s'_{Di}} \right)^{\frac{\gamma_s}{1-\varepsilon_s}(1-\theta_s)} \left(\frac{\mu'_i\left([\omega_i, s_{Di}/s'_{Di}]\right)}{\mu_i\left(\omega_i\right)} \right)^{1-\theta_s} \right)^{\frac{1-\sigma_s}{1-\theta_s}} \omega_{js} dj$$

where μ_i, μ'_i are given by

$$\mu_i^{-1} = 1 - \frac{1}{\theta} - \left(\frac{1}{\sigma} - \frac{1}{\theta} \right) \omega_i,$$

$$\frac{1}{\frac{1}{\sigma_s} - \frac{1}{\theta_s}} \left(\left(\frac{\theta_s - 1}{\theta_s} \right) - \frac{1}{\mu'_i} \right) = \frac{\left(\mu'_i\right)^{1-\theta_s} a_i}{\sum_v \left(\mu'_v\right)^{1-\theta_s} a_v},$$

$$a_i \equiv \mu_i^{-(1-\theta_s)} \omega_i \left(s_{Di}/s'_{Di} \right)^{\frac{\gamma_s}{1-\varepsilon_s}(1-\theta_s)}$$

Bias of Aggregate Data: Intuition

$$P_s = \frac{\sigma_s}{\sigma_s - 1} \left(\frac{p_{Ds}}{q_{Ds}} \right)^{\gamma_s} \times \left(\int_0^{N_s} \left(\frac{1}{\tilde{\varphi}_i} s_{Di}^{\gamma_s/(\varepsilon_s - 1)} \right)^{1-\sigma_s} di \right)^{\frac{1}{1-\sigma_s}}$$

- Consumer price index in trade equilibrium depends on observed value added data
- Quantifying the gains = predicting prices in autarky $\tilde{\varphi}_i^{\sigma-1}$
- Infer from data on value added and domestic shares:

$$\tilde{\varphi}_i^{\sigma_s - 1} \propto va_i s_{Di}^{\frac{\gamma_s}{\varepsilon_s - 1}(\sigma_s - 1)}$$

- If $\frac{\gamma_s}{\varepsilon_s - 1}(\sigma_s - 1) > 1$ then
  - Dispersion in s_{Di} is valued
  - Equalizing domestic shares $\rightarrow$ worse autarky equilibrium, higher gains

back

Demand and Interlinkages Parameters

back

Industry	ISIC	α	σ	γ	VA share	s_D^{Agg}
Mining	10-14	0.02%	2.58	0.33	1.28%	0.90
Food, tobacco, beverages	15-16	9.90%	3.85	0.73	15.24%	0.80
Textiles and leather	17-19	3.20%	3.35	0.63	3.96%	0.54
Wood and wood products	20	0.13%	4.65	0.60	1.67%	0.81
Paper, printing, publishing	21-22	1.37%	2.77	0.50	7.96%	0.75
Chemicals	24	2.04%	3.29	0.67	12.91%	0.60
Rubber and plastics products	25	0.44%	4.05	0.59	5.88%	0.63
Non-metallic mineral products	26	0.24%	3.48	0.53	4.54%	0.72
Basic metals	27	0.01%	5.95	0.67	2.07%	0.60
Metal products (ex machinery and equipment)	28	0.26%	3.27	0.48	9.27%	0.81
Machinery and equipment	29	0.66%	3.52	0.62	7.00%	0.69
Office and computing machinery	30	0.43%	7.39	0.81	0.35%	0.59
Electrical machinery	31	0.47%	4.49	0.60	3.99%	0.64
Radio and communication	32	0.63%	3.46	0.62	1.92%	0.64
Medical and optical instruments	33	0.35%	2.95	0.49	3.83%	0.66
Motor vehicles, trailers	34	4.31%	6.86	0.76	9.99%	0.82
Transport equipment	35	0.37%	1.87	0.35	4.72%	0.64
Manufacturing, recycling	36-37	1.79%	3.94	0.63	3.42%	0.75
Non-manufacturing		73.39%	na	0.41		1

Instrument for Domestic Share

back

- Cannot apply OLS as s_D is not orthogonal to φ
  - More efficient firms tend to feature lower domestic shares
- Instrument $\Delta\tilde{\gamma} ln\left(s_D\right)$ with

$$z_{it} = \Delta ln \left(\sum_{ck} WES_{ckt} \times s_{cki}^{pre} \right)$$

  where WES_{ckt} = total exports for product k of county c in year t to the entire world excluding France, s_{cki}^{pre} = import share on product k of county c *prior* to our sample
- z_{it} is a firm-specific index of shocks to the supply of the firm's input bundle.
- Define products at the 6-digit level
- Taking first year as importer to calculate the pre-sample shares s_{cki}^{pre}

Estimation Approaches

back

- Approach #1: Factor shares

$$\tilde{\gamma}_s = \frac{m_i}{p_i y_i}$$

  - measure $\tilde{\gamma}_s$ as average share of material spending across firms
  - measure $\tilde{\phi}_{ks}$ and $\tilde{\phi}_{ls}$ similarly

- Approach #2: Production function estimation, follow DeLoecker (2011)
  - estimate (6)-(7) in one step
  - treat s_D as an additional input
  - estimate all parameters via GMM
  - $\left(\tilde{\gamma}, \tilde{\phi}_k, \tilde{\phi}_l\right)$ identified using lagged values of capital, labor and materials to proxy for φ, and two-year lagged intermediate inputs as instrument for current intermediate inputs.

First Step, Factor Shares

back

Industry	ISIC	ϕ_k		ϕ_l		γ	
Mining	10-14	0.374***	(0.039)	0.293***	(0.017)	0.333***	(0.043)
Food, tobacco, beverages	15-16	0.098***	(0.004)	0.177***	(0.003)	0.725***	(0.006)
Textiles and leather	17-19	0.081***	(0.003)	0.293***	(0.009)	0.626***	(0.012)
Wood and wood products	20	0.113***	(0.004)	0.285***	(0.006)	0.602***	(0.006)
Paper, printing, publishing	21-22	0.134***	(0.007)	0.362***	(0.011)	0.504***	(0.011)
Chemicals	24	0.124***	(0.008)	0.204***	(0.01)	0.671***	(0.014)
Rubber and plastics products	25	0.124***	(0.005)	0.289***	(0.007)	0.587***	(0.011)
Non-metallic mineral products	26	0.178***	(0.01)	0.294***	(0.012)	0.529***	(0.015)
Basic metals	27	0.124***	(0.01)	0.202***	(0.015)	0.674***	(0.021)
Metal products (ex machinery and equipment)	28	0.108***	(0.002)	0.412***	(0.008)	0.479***	(0.009)
Machinery and equipment	29	0.071***	(0.003)	0.313***	(0.015)	0.616***	(0.018)
Office and computing machinery	30	0.037***	(0.012)	0.150***	(0.032)	0.813***	(0.04)
Electrical machinery	31	0.096***	(0.008)	0.306***	(0.011)	0.598***	(0.014)
Radio and communication	32	0.055***	(0.006)	0.322***	(0.048)	0.624***	(0.052)
Medical and optical instruments	33	0.071***	(0.004)	0.435***	(0.026)	0.494***	(0.029)
Motor vehicles, trailers	34	0.106***	(0.009)	0.135***	(0.016)	0.759***	(0.014)
Transport equipment	35	0.152***	(0.019)	0.499***	(0.03)	0.349***	(0.044)
Manufacturing, recycling	36-37	0.084***	(0.003)	0.283***	(0.009)	0.633***	(0.012)

TABLE: Production Function Coefficient Estimates, by 2-digit Sector: Factor Shares

One-Step GMM

back

Industry	ISIC	Cobb-Douglas $-\frac{\tilde{\gamma}_s}{\varepsilon_s-1}$	$\tilde{\gamma}_s$	ε_s	Translog in (k,l) $-\frac{\tilde{\gamma}_s}{\varepsilon_s-1}$	$\tilde{\gamma}_s$	ε_s	Observations
Mining	10-14	0.309*	0.119	0.616*	0.341*	0.087	0.745***	4,393
		(0.177)	(0.076)	(0.324)	(0.184)	(0.075)	(0.254)	
Food, tobacco, beverages	15-16	-0.358***	0.459***	2.285***	-0.223***	0.398***	2.789***	129,567
		(0.034)	(0.047)	(0.212)	(0.031)	(0.046)	(0.381)	
Textiles and leather	17-19	-0.226***	0.233***	2.031***	-0.241***	0.238***	1.986***	19,002
		(0.071)	(0.069)	(0.546)	(0.071)	(0.069)	(0.500)	
Food and wood products	20	-0.252***	0.352***	2.397***	-0.197***	0.383***	2.943***	16,748
		(0.028)	(0.047)	(0.279)	(0.026)	(0.046)	(0.399)	
Paper, printing, publishing	21-22	-0.163***	0.315***	2.932***	-0.141***	0.314***	3.233***	34,301
		(0.042)	(0.058)	(0.709)	(0.043)	(0.059)	(0.910)	
Chemicals	24	0.111	0.767***	-5.877	0.040	0.697***	-16.38	7,502
		(0.093)	(0.159)	(5.244)	(0.088)	(0.150)	(36.46)	
Rubber and plastics products	25	-0.126***	0.202**	2.611**	-0.170***	0.081	1.478	11,989
		(0.048)	(0.094)	(1.190)	(0.060)	(0.149)	(1.003)	
Non-metallic mineral products	26	-0.383***	0.311***	1.813***	-0.288***	0.307***	2.067***	14,587
		(0.063)	(0.080)	(0.263)	(0.061)	(0.079)	(0.382)	
Basic metals	27	-0.678*	-0.143	0.788	-0.697*	-0.158	0.773	2,435
		(0.397)	(0.519)	(0.655)	(0.394)	(0.513)	(0.623)	

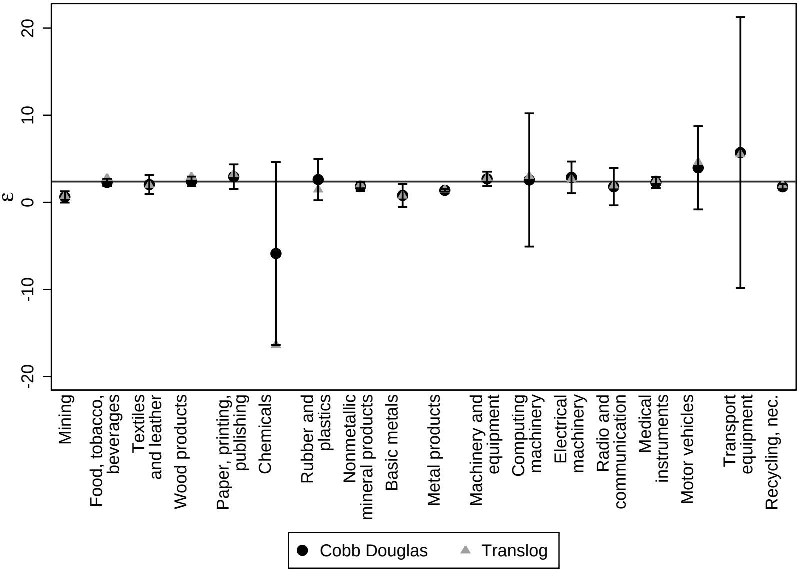
One-Step GMM

back

Industry	ISIC	Cobb-Douglas $-\frac{\tilde{\gamma}_s}{\varepsilon_s-1}$	$\tilde{\gamma}_s$	ε_s	Translog in (k,l) $-\frac{\tilde{\gamma}_s}{\varepsilon_s-1}$	$\tilde{\gamma}_s$	ε_s	Observations
Metal products	28	-0.402***	0.151***	1.374***	-0.347***	0.156***	1.450***	61,017
		(0.023)	(0.026)	(0.0734)	(0.023)	(0.025)	(0.0865)	
Machinery and equipment	29	-0.191***	0.323***	2.688***	-0.178***	0.323***	2.808***	27,450
		(0.028)	(0.048)	(0.415)	(0.028)	(0.048)	(0.459)	
Office and computing machinery	30	-0.078	0.123	2.564	-0.059	0.118	2.996	655
		(0.134)	(0.189)	(3.823)	(0.131)	(0.188)	(5.615)	
Electrical machinery	31	-0.180***	0.334***	2.859***	-0.201***	0.334***	2.659***	8,326
		(0.055)	(0.084)	(0.910)	(0.052)	(0.082)	(0.735)	
Radio and communication	32	-0.301*	0.238	1.790*	-0.276	0.258	1.934	3,146
		(0.170)	(0.208)	(1.071)	(0.177)	(0.209)	(1.279)	
Medical and optical instruments	33	-0.243***	0.306***	2.261***	-0.195***	0.304***	2.558***	22,541
		(0.037)	(0.049)	(0.319)	(0.040)	(0.048)	(0.454)	
Motor vehicles, trailers	34	-0.203***	0.599**	3.958*	-0.169**	0.608**	4.605	4,870
		(0.077)	(0.288)	(2.388)	(0.072)	(0.281)	(2.972)	
Transport equipment	35	-0.098	0.462***	5.705	-0.106	0.477***	5.515	3,949
		(0.150)	(0.129)	(7.770)	(0.141)	(0.123)	(6.577)	
Manufacturing, recycling	36-37	-0.386***	0.303***	1.786***	-0.321***	0.308***	1.958***	34,863
		(0.049)	(0.040)	(0.167)	(0.047)	(0.039)	(0.216)	

ONE-STEP GMM: RESULTS

back



Producer Gains: Summary

Mean	Quantile				
	10	25	50	70	90
24.87	0.64	2.79	11.18	33.74	85.73

Table: Moments of the Distribution of Producer Gains in France

- Table reports empirical distribution of $\left(s_{Di}^{\gamma_s/(1-\varepsilon)} - 1\right) \times 100$
- The data for the domestic expenditure share corresponds to the cross-section of importing firms in 2004.

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PRODUCER GAINS: CORRELATES

	Dependent variable: Producer gains $\frac{\gamma}{1-\varepsilon} ln(s_{Di})$							
ln(Value Added)	0.028***		0.013***	0.005***		-0.008***		-0.029***
	(0.000)		(0.000)	(0.001)		(0.001)		(0.001)
ln(Employment)		0.028***			-0.000			
		(0.000)			(0.001)			
Exporter			0.085***			0.040***		0.024***
			(0.001)			(0.002)		(0.002)
Intl. Group			0.148***			0.138***		0.113***
			(0.003)			(0.003)		(0.003)
ln (Num. Varieties)							0.128***	0.144***
							(0.002)	(0.002)
Sample		Full sample				Importers Only		
Observations	633,240	640,610	633,240	118,799	120,344	118,799	120,344	118,799

TABLE: Cross-Sectional Variation in Producer Gains

Regressions include sector and time FE

Back

Elasticity Bias

Back

	Micro-data	Aggregate Data				
			ε			
	2.378	2.378	3	4	5	6
Entire Economy	9.04	9.9	6.72	4.43	3.31	2.64
Manufacturing Sector	27.52	30.8	20.32	13.12	9.69	7.68

TABLE: The Consumer Price Gains for Different Values of ε

- Aggregate approaches typically find values larger than our benchmark estimate of $\varepsilon = 2.378$, see Simonovska and Waugh (2013, 2014)
- e.g. Costinot and Rodriguez-Clare (2014) use $\varepsilon = 5$
- **This would lead to under-estimating gains by 65%**

Consumer Gains: Bootstrap Distribution

Back

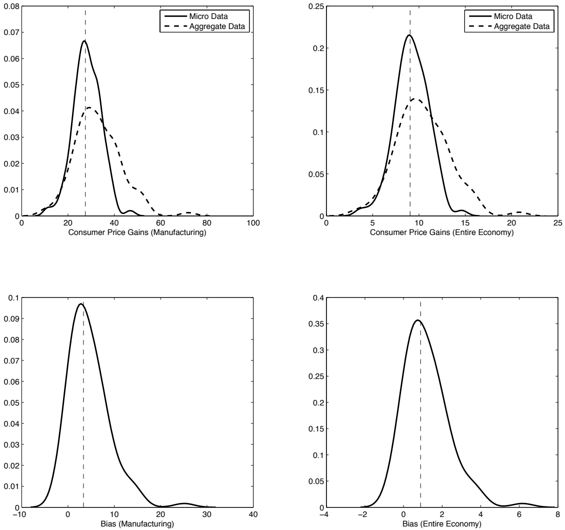

Figure: Bootstrap Distribution of Consumer Price Gains and Bias

Consumer Gains: Variable Markups

Back

Industry	ISIC	Constant Mark-ups		Variable Mark-ups					
				Case 1: $\theta_s = 2 \times \sigma_s$			Case 2: $\theta_s = 1.1 \times \sigma_s$		
		σ_s	Sectoral Price Gains	σ_s	θ_s	Sectoral Price Gains	σ_s	θ_s	Sectoral Price Gains
Mining	10-14	2.58	7.8	1.406	2.812	10.0	2.362	2.599	9.0
Food, tobacco, beverages	15-16	3.85	17.8	1.969	3.937	17.7	3.505	3.856	17.4
Textiles and leather	17-19	3.35	55.6	1.723	3.446	62.5	3.054	3.360	62.3
Wood and wood products	20	4.65	14.4	2.350	4.701	17.1	4.229	4.651	16.6
Paper, printing, publishing	21-22	2.77	20.1	1.400	2.801	21.1	2.518	2.769	20.8
Chemicals	24	3.29	45.1	1.711	3.422	43.2	3.002	3.302	43.0
Rubber and plastics products	25	4.05	38.4	2.141	4.282	39.5	3.705	4.076	39.1
Non-metallic mineral products	26	3.48	20.8	1.854	3.709	19.8	3.189	3.507	19.5
Basic metals	27	5.95	38.9	3.203	6.407	38.6	5.451	5.997	38.1
Metal products	28	3.27	18.3	1.653	3.306	20.5	2.972	3.269	20.2
Machinery and equipment	29	3.52	31.7	1.856	3.712	33.6	3.219	3.541	33.4
Office and computing machinery	30	7.39	44.6	4.108	8.216	68.7	6.790	7.469	73.6
Electrical machinery	31	4.49	36.1	2.443	4.886	38.4	4.120	4.532	38.7
Radio and communication	32	3.46	38.5	2.215	4.430	43.8	3.230	3.553	45.4
Medical and optical instruments	33	2.95	29.2	1.543	3.085	31.5	2.691	2.960	31.8
Motor vehicles, trailers	34	6.86	23.3	4.436	8.873	23.9	6.421	7.063	23.0
Transport equipment	35	1.87	22.9	1.067	2.134	22.5	1.724	1.896	22.5
Manufacturing, recycling	36-37	3.94	26.0	2.020	4.040	28.6	3.588	3.946	28.1

Change in P is 28.9% (28.7%) for θ_H (θ_L)

A Model with Fixed Costs

Back Back2

$$\pi_i \equiv \max_{\Sigma_i, y} \left\{ (p(y) - u_i) y - w \sum_{c \in \Sigma_i} f_{ci} \right\},$$

where

$$u_i = \frac{1}{\varphi_i} w^{1-\gamma} \left[\beta_i^{\varepsilon} (p_D/q_D)^{1-\varepsilon} + (1-\beta_i)^{\varepsilon} A_i (\Sigma_i)^{1-\varepsilon} \right]^{\frac{\gamma}{1-\varepsilon}}.$$

- Trade off unit cost reduction vs payment of fixed costs
- Computing optimal Σ_i can be challenging
  - Input complementarities: interdependece of entry decisions
  - When p_{ci}, q_{ci} and f_{ci} vary in arbitrary way: evaluate π_i at every possible Σ_i
- See Antras, Fort and Tintelnot (2014) for solution algorithm
- Supply of foreign inputs is perfectly elastic at price p_c
- Foreign firms demand output of local firms with same CES demand as domestic consumers and producers
- Balance trade:

Import Price Index

back

Let n the mass of varieties imported. Then, import price index is given by

$$A(\Sigma) = \left(\int_{c \in \Sigma} (p_c / q_c)^{1-\kappa} dc \right)^{\frac{1}{1-\kappa}} = zn^{-\eta} \equiv A(n),$$

where

$$z \equiv q_{min} \left(\frac{\theta}{\theta - (\kappa - 1)} \right)^{\frac{1}{1-\kappa}}$$

$$\eta \equiv \frac{1}{\kappa - 1} - \frac{1}{\theta}.$$

- Two key parameters:
  - "Avg price" z depends on diversity (θ), mean quality (q_{min}), complementarity (κ)
  - "returns to scale" η depends on diversity (θ), complementarity (κ)
- Only need (z, η) for firms' problem and hence the macro-exercise

Estimating the "Returns to Variety" η

back

- Theory implies that

$$s_D(n) = \frac{1}{1 + \left(\frac{p_D}{q_D}\frac{1}{z}n^{\eta}\right)^{\varepsilon-1}}$$

- Estimate η from

$$\frac{1}{\varepsilon - 1} ln\left(\frac{1 - s_D}{s_D}\right) = \text{const} + \eta\, ln(n)$$

results

Estimating Returns to Variety $\eta(ctd)$

back

$$ln\left(\frac{1-s_{Dist}}{s_{Dist}}\right) = \delta_s + \delta_t + \delta_{NK} + \eta\,(\varepsilon - 1)\,ln\,(n_{ist}) + u_{ist}$$

Dep. Variable: $ln(\frac{1-s_D}{s_D})$						
		All Importers			>1 variety	>2 varieties
ln (Number of Varieties)	1.308***	0.707***	0.733***	0.739***	0.526***	0.463***
	(0.009)	(0.010)	(0.010)	(0.010)	(0.011)	(0.019)
ln (Capital / Employment)				-0.070***		
				(0.006)		
Exporter Dummy			-0.395***	-0.388***	-0.254***	-0.198***
			(0.013)	(0.013)	(0.017)	(0.029)
International Group			0.150***	0.174***	0.216***	0.223***
			(0.016)	(0.016)	(0.016)	(0.019)
Control for Num of products	No	Yes	Yes	Yes	Yes	Yes
Implied Eta	0.950***	0.513***	0.532***	0.536***	0.382***	0.336***
	(0.260)	(0.142)	(0.147)	(0.148)	(0.106)	(0.096)
Observations	120,344	120,344	120,344	120,344	73,651	35,751

Parametrization of Firm Heterogeneity

Back

- Parametrize efficiency $(\tilde{\varphi}_i)$ as

$$ln(\tilde{\varphi}) \sim \mathcal{N}\left(-\frac{1}{2}\sigma_{\varphi}^2, \sigma_{\varphi}^2\right).$$

- In fixed costs model, let

$$ln(f)\,|ln(\tilde{\varphi}) \sim \mathcal{N}\left(a_0 + a_{\varphi} ln(\tilde{\varphi}), \sigma_{f|\varphi}^2\right).$$

- In home bias model, let

$$ln\left(\tilde{\beta}\right)|ln(\tilde{\varphi}) \sim \mathcal{N}\left(b_0 + b_{\varphi} ln(\tilde{\varphi}), \sigma_{\tilde{\beta}|\varphi}^2\right),$$

where $\tilde{\beta} \equiv \beta/(1-\beta) \in [0,\infty]$.

Estimated Parameters

Back

Use value-added weighted averages of the above sectoral estimates of σ and γ

Estimated		
Parameter	Value	Identified from
σ	3.83	Revenue/Cost Data
ε	2.38	Prod. Function Estimation
γ	0.61	Prod. Function Estimation
η	0.38	Dom Share and Ext. Margin