ECO 745: Theory of International Economics

Jack Rossbach

Fall 2015 - Lecture 16

Asymmetric Trade Costs

In most of the models we've looked at, welfare gains from trade relatively small

- Look at cases where importance of trade is amplified

Asymmetric trade costs

- Poor countries have systematically higher trade costs, which reduces their TFP and welfare

Asymmetric Trade Costs

Waugh (2010) investigates whether differences in trade costs can explain differences in cross-country income per capita

- Uses an Eaton-Kortum (2003) framework
- Shows symmetric trade costs does a poor job fitting the data, while leaving little room for trade to matter
- Finds systematically asymmetric trade costs between rich and poor countries: eliminating these asymmetries would reduce cross-country inequality by one third

Framework

- $i = 1, .., N$ countries, with labor L_i and capital K_i
  - Normalize aggregate variables relative to L_i (e.g. income per capita)
- continuum of tradable intermediate goods $x \in [0,1]$ (Eaton-Kortum)
- non-traded final consumption good
  - Consumer preferences only over this final good

Intermediate Goods Sector

- Continuum of tradable intermediate goods $x \in [0,1]$
  - Iceberg trade cost $\tau_{ij} \geq 1$ ($\tau_{ii} = 1$) to export from country j to country i
- Cobb-Douglas production function

$$m_i(x) = z_i(x)^{-\theta} \left[k_i^{\alpha} n_i^{1-\alpha}\right]^{\beta} q_i^{1-\beta}$$

- q_i is CES aggregate of tradable intermediate goods

$$q_i = \left[m(x)^{\frac{\eta-1}{\eta}} dx\right]^{\frac{\eta}{\eta-1}}$$

- $z_i(x)$ is country i's productivity for producing good x ($z_i(x)^{-\theta}$ is efficiency)
  - Drawn from exponential distribution with parameter $\lambda_i \Rightarrow$ Frechet distribution in efficiency
  - λ_i governs average productivity level, θ governs dispersion (opposite of EK – high θ, high disp.)

Final Good Sector

Cobb-Douglas production function for non-traded final good

$$y_i = \left[k_i^{\alpha} n_i^{1-\alpha}\right]^{\gamma} q_i^{1-\gamma}$$

- Factor shares are constant across countries (same for intermediate goods)
  - Each country will allocate fraction γ of capital and labor to final good production
- Perfectly competitive
- Consumers spend all income on final good

Intermediate Price Index

The CES price index for the aggregate traded good in country i is (represent goods by their productivity)

$$p_i = \left[\int_0^\infty p_i(z)^{1-\eta} \pi(z) dz \right]^{\frac{1}{1-\eta}}$$

Where $p_i(z) = \min\{p_{i1}(z), \dots, p_{iN}(z)\} = \min\{\tau_{i1} p_{11}(z), \dots, \tau_{iN} p_{NN}(z)\}$, and $\pi(z)$ is density function of z

$$\pi(z) = \left(\prod_{i=1}^{N} \lambda_i \right) \exp\left(-\sum_{i=1}^{N} \lambda_i z_i \right)$$

Intermediate Price Index and Trade Shares

Price index can be expressed as

$$p_i = \Upsilon \left\{ \sum_{j=1}^{N} \left[r_j^{\alpha\beta} w_j^{(1-\alpha)\beta} p_j^{(1-\beta)} \tau_{ij} \right]^{-\frac{1}{\theta}} \lambda_j \right\}^{-\theta}, \qquad (1)$$

- Υ depends only on model constants

Country i's expenditure share on goods from country j is

$$X_{ij} = \frac{\left[r_j^{\alpha\beta} w_j^{(1-\alpha)\beta} p_j^{1-\beta} \tau_{ij} \right]^{-\frac{1}{\theta}} \lambda_j}{\sum_{l=1}^{N} \left[r_l^{\alpha\beta} w_l^{(1-\alpha)\beta} p_l^{1-\beta} \tau_{il} \right]^{-\frac{1}{\theta}} \lambda_l}, \qquad (2)$$

Balanced Trade and Wages

Wages determined by balanced trade for each country

$$\underbrace{L_i p_i q_i X_{ii}}_{\text{Domestic Expenditures}} + \underbrace{L_i p_i q_i \sum_{\substack{j=1 \\ j \neq i}}^{N} X_{ij}}_{\text{Imports}} = \underbrace{\sum_{\substack{j=1 \\ j \neq i}}^{N} L_j p_j q_j X_{ji}}_{\text{Exports}} + \underbrace{L_i p_i q_i X_{ii}}_{\text{Domestic Expenditures}} , \qquad \forall i$$

Note every country allocates same fraction of labor to traded sector $(1-\gamma)$

Therefore equilibrium wage rate will be given by

$$w_i = \sum_{j=1}^{N} \frac{L_j}{L_i} w_j X_{ji} , \qquad (3)$$

Taking Model to Data

In model have an expressions for wages, trade shares, and price indices for tradable goods.

Countries are characterized by labor supply, L_i, capital supply, K_i, technology parameter, λ_i, and trade costs $\{\tau_{ij}, \tau_{ji}\}_{j=1,\dots,N}$

- Take L_i and K_i directly from data
- Trade costs often modeled using a symmetric gravity equation (distance, shared language, border, etc)
  - Use price data to show enforced symmetry is at odds with data
- λ_i backed out from model

Trade Data and Expenditure Shares

Sample of 76 countries

- Account for 90 percent of world GDP in base year, 1996
- Data on imports, exports, and gross production for 34 BEA manufacturing industries

Compute expenditure shares as

$$X_{ij} = \frac{\text{Imports}_{ij}}{\text{Gross Mfg. Production}_i - \text{Total Exports}_i + \text{Imports}_i}$$

Where Total Exports is for world, and Imports is just for sample. Can compute domestic expenditures as

$$X_{ii} = 1 - \sum_{\substack{j=1 \\ j \neq i}}^{N} X_{ij}$$

Computed Expenditure Shares

TABLE 1—1996 TRADE SHARE DATA, X_{ij}, IN PERCENT FOR SELECTED COUNTRIES

	US	Canada	Japan	Mexico	China	Senegal	Malawi	Zaire
US	83.25	39.73	2.27	31.62	3.63	2.16	1.57	2.93
Canada	3.78	49.21	0.21	0.72	0.32	0.56	0.67	0.51
Japan	3.04	2.01	92.56	1.59	6.99	1.34	2.65	0.82
Mexico	1.88	1.33	0.02	61.09	0.057	0.01	0	0.007
China	1.78	1.41	1.44	0.30	77.61	2.69	2.50	6.81
Senegal	0*	0*	0*	0	0*	52.68	0	0
Malawi	0*	0*	0*	0	0	0	41.52	0
Zaire	0.003	0.005	0.003	0*	0*	0	0	51.53

Notes: Entry in row i, column j, is the fraction of goods country j imports from country i. Zeros with stars indicate the value is less than 10^{-4}. Zeros without stars are zeros in the data.

Waugh (2010)

Computed Expenditure Shares

TABLE 1—1996 TRADE SHARE DATA, X_{ij}, IN PERCENT FOR SELECTED COUNTRIES

	US	Canada	Japan	Mexico	China	Senegal	Malawi	Zaire
US	83.25	39.73	2.27	31.62	3.63	2.16	1.57	2.93
Canada	3.78	49.21	0.21	0.72	0.32	0.56	0.67	0.51
Japan	3.04	2.01	92.56	1.59	6.99	1.34	2.65	0.82
Mexico	1.88	1.33	0.02	61.09	0.057	0.01	0	0.007
China	1.78	1.41	1.44	0.30	77.61	2.69	2.50	6.81
Senegal	0*	0*	0*	0	0*	52.68	0	0
Malawi	0*	0*	0*	0	0	0	41.52	0
Zaire	0.003	0.005	0.003	0*	0*	0	0	51.53

Notes: Entry in row *i*, column *j*, is the fraction of goods country *j* imports from country *i*. Zeros with stars indicate the value is less than 10^{-4}. Zeros without stars are zeros in the data.

Observation 1:"Home bias" for both rich and poor countries

Waugh (2010)

Computed Expenditure Shares

TABLE 1—1996 TRADE SHARE DATA, X_{ij}, IN PERCENT FOR SELECTED COUNTRIES

	US	Canada	Japan	Mexico	China	Senegal	Malawi	Zaire
US	83.25	39.73	2.27	31.62	3.63	2.16	1.57	2.93
Canada	3.78	49.21	0.21	0.72	0.32	0.56	0.67	0.51
Japan	3.04	2.01	92.56	1.59	6.99	1.34	2.65	0.82
Mexico	1.88	1.33	0.02	61.09	0.057	0.01	0	0.007
China	1.78	1.41	1.44	0.30	77.61	2.69	2.50	6.81
Senegal	0*	0*	0*	0	0*	52.68	0	0
Malawi	0*	0*	0*	0	0	0	41.52	0
Zaire	0.003	0.005	0.003	0*	0*	0	0	51.53

Notes: Entry in row *i*, column *j*, is the fraction of goods country *j* imports from country *i*. Zeros with stars indicate the value is less than 10^{-4}. Zeros without stars are zeros in the data.

Observation 2: Poor country expenditure shares high for goods from rich countries
(Rich) (low) (poor)

Waugh (2010)

Computed Expenditure Shares

TABLE 1—1996 TRADE SHARE DATA, X_{ij}, IN PERCENT FOR SELECTED COUNTRIES

	US	Canada	Japan	Mexico	China	Senegal	Malawi	Zaire
US	83.25	39.73	2.27	31.62	3.63	2.16	1.57	2.93
Canada	3.78	49.21	0.21	0.72	0.32	0.56	0.67	0.51
Japan	3.04	2.01	92.56	1.59	6.99	1.34	2.65	0.82
Mexico	1.88	1.33	0.02	61.09	0.057	0.01	0	0.007
China	1.78	1.41	1.44	0.30	77.61	2.69	2.50	6.81
Senegal	0*	0*	0*	0	0*	52.68	0	0
Malawi	0*	0*	0*	0	0	0	41.52	0
Zaire	0.003	0.005	0.003	0*	0*	0	0	51.53

Notes: Entry in row i, column j, is the fraction of goods country j imports from country i. Zeros with stars indicate the value is less than 10^{-4}. Zeros without stars are zeros in the data.

Observation 2A: Disparity in trade shares larger, the higher disparity is in relative income

- Run regression $\log X_{ji}/X_{ij} = \text{constant} + \beta_y \log y_j/y_i$. Constant is zero, $\beta_y = 2.40$

Waugh (2010)

Price Data

In model p_i are aggregate price indices for tradable goods

- Non-traded goods, plus not all tradable goods actually traded in equilibrium

Data from United Nations International Comparison Program (ICP)

- Collect prices on standardized basket of goods and services across countries
- Construct tradable price indices in 1996 using Penn World Table

Tradable Price Indices

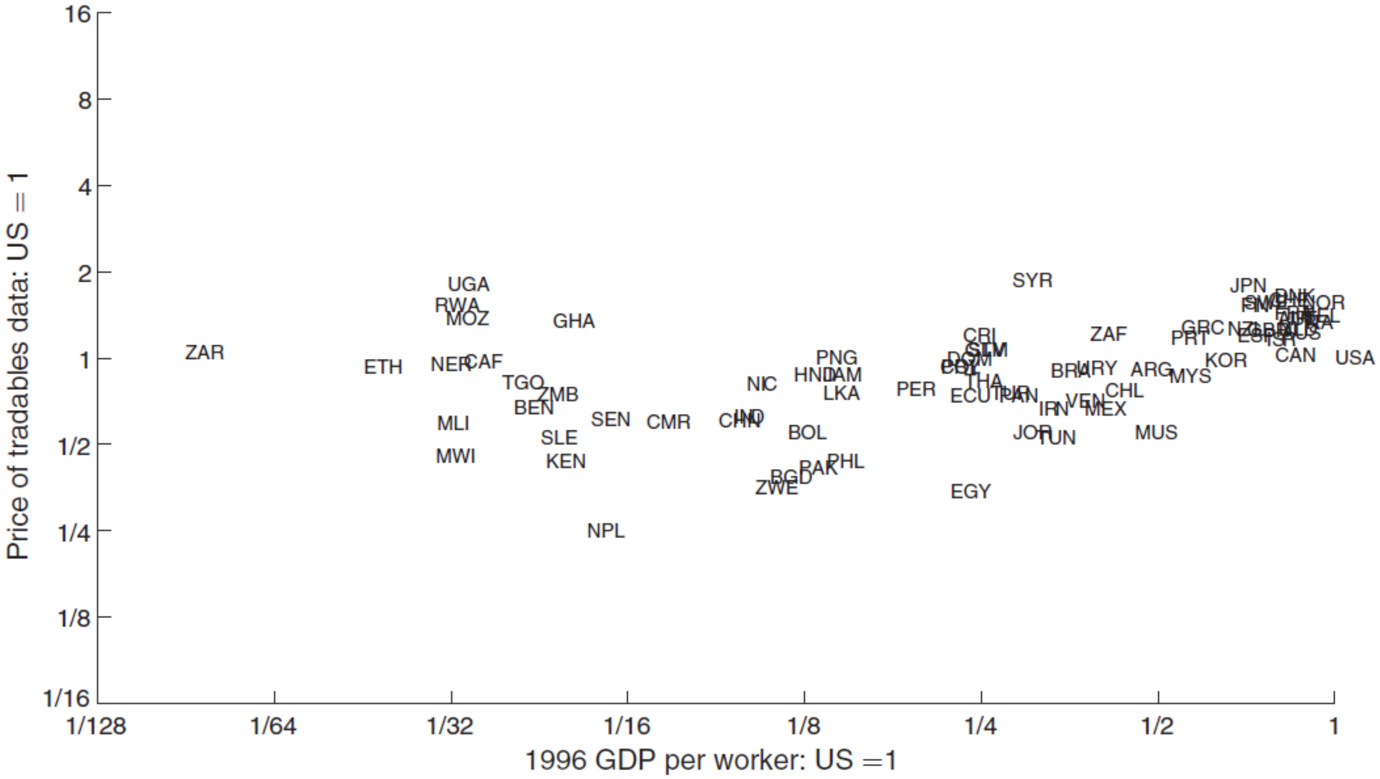


Figure 1. Price of Tradable Goods: Similar Between Rich and Poor Countries

Waugh (2010)

Tradable Price Indices

Observation 3: Tradable price indices similar between rich and poor countries

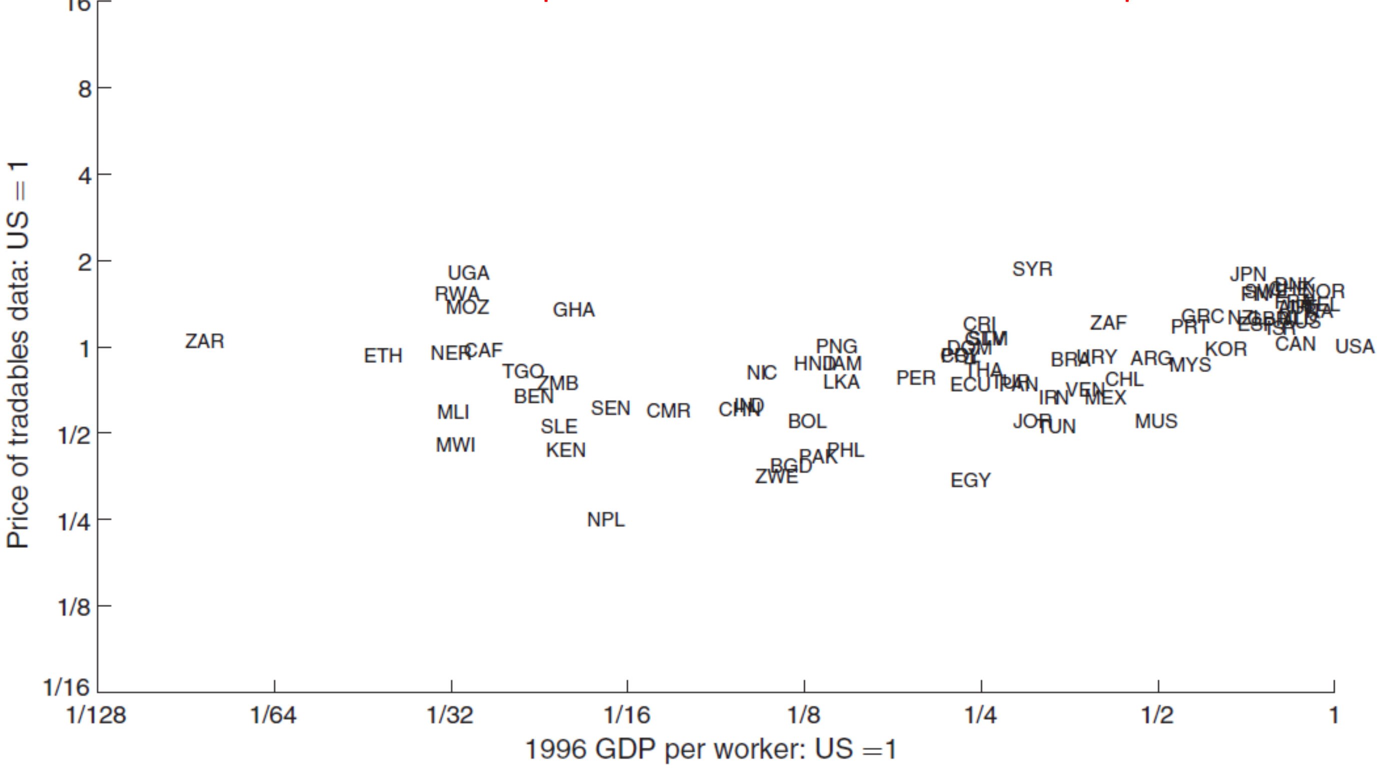


FIGURE 1. PRICE OF TRADABLE GOODS: SIMILAR BETWEEN RICH AND POOR COUNTRIES

Waugh (2010)

Implications and Arbitrage Condition

From equations for price indices and trade shares in model have

$$\frac{X_{ij}}{X_{jj}} = \tau_{ij}^{-\frac{1}{\theta}} \left(\frac{p_j}{p_i}\right)^{-\frac{1}{\theta}}$$

Which says that if $p_i > p_j$ then country i should purchase relatively more goods from country j

- Conversely, if trade costs high, should purchase relatively less goods from country j

Implications and Arbitrage Condition

Using previous equation twice

$$\left(\frac{X_{ij}}{X_{ji}}\frac{X_{ii}}{X_{jj}}\right)\left(\frac{p_j}{p_i}\right)^{\frac{2}{\theta}} = \left(\frac{\tau_{ij}}{\tau_{ji}}\right)^{-\frac{1}{\theta}}$$

- In symmetric world $(X_{ij}/X_{ji})(X_{ii}/X_{jj}) = 1$
- Deviations from symmetric trade shares occur because of asymmetries in prices or in trade costs
  - Didn’t see evidence of systematic asymmetries in price indices of tradable goods
  - Indicates likely systematic asymmetries in trade costs

Modeling Asymmetric Trade Costs: Simple Example

Suppose three countries. Country 1 is rich, country 2 is middle income, and country 3 is poor.

- Observe following bilateral (normalized) trade share matrix for X_{ij}/X_{ii}

$$\begin{pmatrix} 1 & \frac{X_{21}}{X_{22}} & \frac{X_{31}}{X_{33}} \\ \frac{X_{12}}{X_{11}} & 1 & 0 \\ \frac{X_{13}}{X_{11}} & 0 & 1 \end{pmatrix} \quad \text{where} \quad \frac{X_{21}}{X_{22}} = \frac{X_{31}}{X_{33}} \quad \text{and} \quad \frac{X_{12}}{X_{11}} > \frac{X_{13}}{X_{11}}$$

Modeling Asymmetric Trade Costs: Simple Example

Suppose labor only factor of production and labor endowment constant across countries.

- Normalize w_1 and λ_1 to 1.
- Can write observed normalized trade shares in terms of $\{\lambda_2, \lambda_3, \tau_{12}, \tau_{21}, \tau_{13}, \tau_{31}\}$

$$\begin{pmatrix} 1 & \frac{1}{(w_2\tau_{21})^{\frac{-1}{\theta}}\lambda_2} & \frac{1}{(w_3\tau_{31})^{\frac{-1}{\theta}}\lambda_3} \\ \frac{(w_2\tau_{12})^{\frac{-1}{\theta}}\lambda_2}{1} & 1 & 0 \\ \frac{(w_3\tau_{13})^{\frac{-1}{\theta}}\lambda_3}{1} & 0 & 1 \end{pmatrix} \quad \text{where} \quad \frac{1}{(w_2\tau_{21})^{\frac{-1}{\theta}}\lambda_2} = \frac{1}{(w_3\tau_{31})^{\frac{-1}{\theta}}\lambda_3}$$

$$\text{and} \quad \frac{(w_2\tau_{12})^{\frac{-1}{\theta}}\lambda_2}{1} > \frac{(w_3\tau_{13})^{\frac{-1}{\theta}}\lambda_3}{1}$$

Difficulty: Six unknowns, but only four informative moments. Need additional restrictions.

Modeling Asymmetric Trade Costs: General Problem

In model with N countries, have N^2 parameters to estimate, but only $N^2 - N$ informative moments

Parameters:

- Trade costs: τ_{ij}. Impose $\tau_{ii} = 1 \Rightarrow N^2 - N$ parameters
- Productivities: λ_i. N parameters

Informative Moments:

- Bilateral normalized trade share matrix: X_{ij}/X_{ii}. Identity $X_{ii}/X_{ii} = 1 \Rightarrow N^2 - N$ moments

Modeling Asymmetric Trade Costs, Option 1: Export Effects

Go back to simple example. Suppose trade costs determined by exporter effects

- $\{\tau_{21}, \tau_{31}\} = \bar{\tau}$, so cost for countries 2 and 3 to import from country 1 is same

Implication 1: Since normalized trade shares equal $(X_{21}/X_{22} = X_{31}/X_{33})$, therefore $w_2^{-\frac{1}{\theta}}\lambda_2 = w_3^{-\frac{1}{\theta}}\lambda_3$

- Cost of producing a good is the same on average across middle income and poor country

Modeling Asymmetric Trade Costs, Option 1: Export Effects

Suppose trade costs determined by exporter effects

- $\{\tau_{21}, \tau_{31}\} = \bar{\tau}$, so cost for countries 2 and 3 to import from country 1 is same

Implication 1: Since normalized trade shares equal $(X_{21}/X_{22} = X_{31}/X_{33})$, therefore $w_2^{-\frac{1}{\theta}} \lambda_2 = w_3^{-\frac{1}{\theta}} \lambda_3$

- Cost of producing a good is the same on average across middle income and poor country

Implication 2: Since U.S. imports more from country 2 than country 3 $(X_{12} > X_{13})$, therefore $\tau_{12} < \tau_{13}$

- Higher trade costs for poor country (relative to middle income country) to export to rich country

Modeling Asymmetric Trade Costs, Option 1: Export Effects

Suppose trade costs determined by exporter effects

- $\{\tau_{21}, \tau_{31}\} = \bar{\tau}$, so cost for countries 2 and 3 to import from country 1 is same

Implication 3: Suppose unit costs (depend on wages and productivity) equal across countries 2 and 3.

- Balanced Trade implies

$$\frac{X_{12}}{X_{21}} = w_2 > \frac{X_{13}}{X_{31}} = w_3$$

- Therefore country 2 is more productive than country 3 $(\lambda_2 > \lambda_3)$, and also richer than country 3.

Modeling Asymmetric Trade Costs, Option 2: Importer Effects

Suppose trade costs determined by importer effects

- $\{\tau_{13}, \tau_{13}\} = \bar{\tau}$, so cost for countries 2 and 3 to export to country 1 is same

Implication 1: Since U.S. imports more from country 2 than country 3 $(X_{12} > X_{13})$, $\Rightarrow w_2^{-\frac{1}{\theta}}\lambda_2 > w_3^{-\frac{1}{\theta}}\lambda_3$

- Cost of producing a good is less on average in middle income country compared to poor country

Implication 2: Since normalized trade shares equal $(X_{21}/X_{22} = X_{31}/X_{33})$, therefore $\tau_{21} < \tau_{31}$

- Higher trade costs for poor country (relative to middle income country) to import from rich country

Modeling Asymmetric Trade Costs, Option 1: Import Effects

Suppose trade costs determined by importer effects

- $\{\tau_{13}, \tau_{13}\} = \bar{\tau}$, so cost for countries 2 and 3 to export to country 1 is same

Implication 3: Unit cost no longer equal across countries.

- Still have country 2 is more productive than country 3 $(\lambda_2 > \lambda_3)$

- To fit observed trade shares, need difference in productivities to be even larger

$$\underbrace{\lambda_2/\lambda_3}_{\text{import effects}} > \underbrace{\lambda_2/\lambda_3}_{\text{export effects}} > 1$$

Estimating Technology and Trade Costs: Benchmark

Benchmark is structural gravity equation as in Eaton-Kortum (2003)

$$\log\left(\frac{X_{ij}}{X_{ii}}\right) = S_j - S_i - \frac{1}{\theta}\log\tau_{ij}$$

Where S_i is a country fixed effect

$$S_i \equiv \log\left[r_i^{\alpha\beta/-\theta} w_i^{(1-\alpha)\beta/-\theta} p_i^{(1-\beta)/-\theta} \lambda_i\right]$$

And trade costs are modeled as

$$\log\tau_{ij} = d_k + b_{ij} + ex_j + \epsilon_{ij}$$

Where d_k is one of six distance intervals, b_{ij} is shared border dummy, ϵ_{ij} is trade costs from other factors

- ex_j is exporter fixed effect. In simple example $\{\tau_{21}, \tau_{31}\} = \bar{\tau} = \exp[ex_1]$

Estimating Technology and Trade Costs: Alternative

Alternative is to model trade costs as

$$\log \tau_{ij} = d_k + b_{ij} + m_i + \epsilon_{ij}$$

Where d_k is one of six distance intervals, b_{ij} is shared border dummy, ϵ_{ij} is trade costs from other factors

- m_i is a importer fixed effect. In simple example $\{\tau_{12}, \tau_{13}\} = \bar{\tau} = \exp[m_1]$

Exporter vs Importer Fixed Effects

Consider simple 3 country example. Bilateral trade cost matrix for exporter fixed effects are:

$$\begin{pmatrix} 1 & \exp(ex_1) & \exp(ex_1) \\ \exp(ex_2) & 1 & \exp(ex_2) \\ \exp(ex_3) & \exp(ex_3) & 1 \end{pmatrix}$$

Bilateral trade cost matrix for importer fixed effects are

$$\begin{pmatrix} 1 & \exp(m_2) & \exp(m_3) \\ \exp(m_1) & 1 & \exp(m_3) \\ \exp(m_1) & \exp(m_2) & 1 \end{pmatrix}.$$

Recovering Technology

After estimating gravity equation to get estimated $\hat{S}_i$ and $\hat{\tau}_{ij}$, estimated traded aggregate price index is

$$\hat{p}_i = \Upsilon \left\{ \sum_{j=1}^{N} e^{\hat{S}_j} \hat{\tau}_{ij}^{-\frac{1}{\theta}} \right\}^{-\theta}$$

Combine with equilibrium condition we derived earlier

$$p_i = \Upsilon \left\{ \sum_{j=1}^{N} \left[r_j^{\alpha\beta} w_j^{(1-\alpha)\beta} p_j^{(1-\beta)} \tau_{ij} \right]^{-\frac{1}{\theta}} \lambda_j \right\}^{-\theta}$$

Therefore can estimate $\left[r_j^{\alpha\beta} w_j^{(1-\alpha)\beta} p_j^{(1-\beta)} \tau_{ij} \right]^{-\frac{1}{\theta}} \lambda_j$

- Get wages from bilateral trade shares $w_i = \sum_{j=1}^{N} \frac{L_j}{L_i} w_j X_{ji}$
- Get rental rates from capital-labor ratio. Then can back out technology parameters: λ_i

Estimating $\boldsymbol{\theta}$

Benchmark approach is to follow Eaton and Kortum (2002)

- Note that $\tau_{ij} \geq p_i(x)/p_j(x)\ \forall x$, otherwise arbitrage opportunity, therefore can estimate trade costs as

$$\log \hat{\tau}_{ij} = \underset{x}{\text{2ndmax}} \left\{ \log\left(p_i(x)\right) - \log\left(p_j(x)\right) \right\}$$

- Get the prices from the Penn World Table database

- Combine with normalized trade shares to back out θ

$$\frac{X_{ij}}{X_{jj}} = \tau_{ij}^{-\theta} \left(\frac{p_j}{p_i}\right)^{-\frac{1}{\theta}}$$

Estimating $\boldsymbol{\theta}$: Alternative

May be case that θ differs across rich and poor countries

- Divide sample into OECD and non-OECD countries
- Follow procedure and estimate separate θ for each sample

Results:

- Benchmark estimates $1/\theta$ of 5.5
- Asymmetric θ estimates $1/\theta_{\text{rich}}$ of 5.5 and $1/\theta_{\text{poor}}$ of 7.9
  - Asymmetric θ can't explain observations noted at beginning (asymmetric trade shares)

Income per Worker

Income per worker is measured using wages and capital income relative to final price index

$$y_i = \frac{w_i + r_i k_i}{p_i^y}$$

- Where wages, rental rates, capital/labor ratio, and final good price form penn-world tables

- Factor shares are set as $\alpha = \frac{1}{3}$, $\beta = \frac{1}{3}, \gamma = \frac{3}{4}$, recall

$$m_i(x) = z_i(x)^{-\theta}\left[k_i^{\alpha} n_i^{1-\alpha}\right]^{\beta} q_i^{1-\beta}$$

$$y_i = \left[k_i^{\alpha} n_i^{1-\alpha}\right]^{\gamma} q_i^{1-\gamma}$$

Exporter Effects Results

Estimate gravity equation with exporter effects

Summary statistics			
Observations	TSS	SSR	σ_ϵ^2
4,242	4,924	851	2.08

Geographic barriers

Barrier	Parameter estimate	Standard error	% effect on cost
[0, 375)	−4.66	0.21	133.3
[375, 750)	−5.60	0.14	177.1
[750, 1,500)	−6.16	0.09	206.3
[1,500, 3,000)	−7.22	0.06	271.3
[3,000, 6,000)	−8.44	0.04	363.9
[6,000, maximum]	−9.37	0.05	449.7
Shared border	0.77	0.16	−13.0

Note: All parameters were estimated by OLS. For an estimated parameter $\hat{b}$, the implied percentage effect on cost is $100 \times (e^{-\theta \hat{b}} - 1)$ with $\theta = 0.1818$.

Exporter Effects Results

Estimate gravity equation with exporter effects

TABLE 3—COUNTRY-SPECIFIC ESTIMATES (*benchmark model*)

Country	ex_i	Standard error	Percent cost	$\hat{S}_i$	Standard error	$\left(\frac{\lambda_{us}}{\lambda_i}\right)^{\theta}$
United States	5.40	0.24	−62.5	0.54	0.17	1.00
Argentina	1.62	0.26	−25.5	0.69	0.19	1.60
Australia	2.50	0.25	−36.4	0.11	0.18	1.42
Austria	1.35	0.24	−21.8	0.77	0.17	0.93
Belgium	5.13	0.24	−60.7	−1.55	0.17	1.21
Benin	−3.71	0.41	96.3	−0.25	0.23	10.40
Bangladesh	−0.43	0.27	8.03	0.54	0.21	2.92
Bolivia	−2.61	0.31	60.7	−0.09	0.21	3.83
Brazil	2.21	0.25	−33.0	1.27	0.18	1.30
Central African Republic	−4.04	0.52	109	0.33	0.24	3.46
Canada	3.32	0.24	−45.2	0.11	0.17	0.99
Switzerland	2.19	0.24	−32.8	0.75	0.17	0.75
Chile	2.40	0.26	−35.2	−0.39	0.18	1.89

Exporter Fixed Effects Higher for Poorer Countries

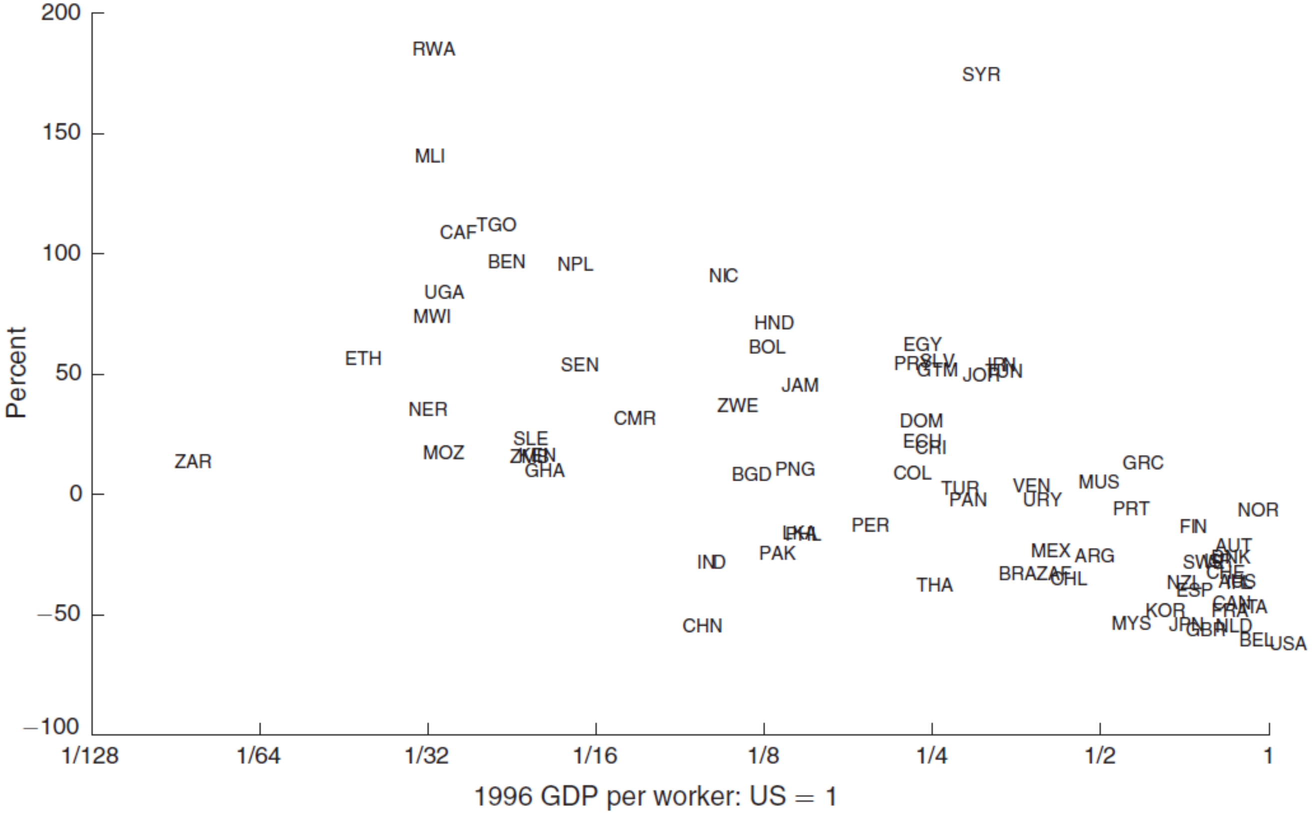
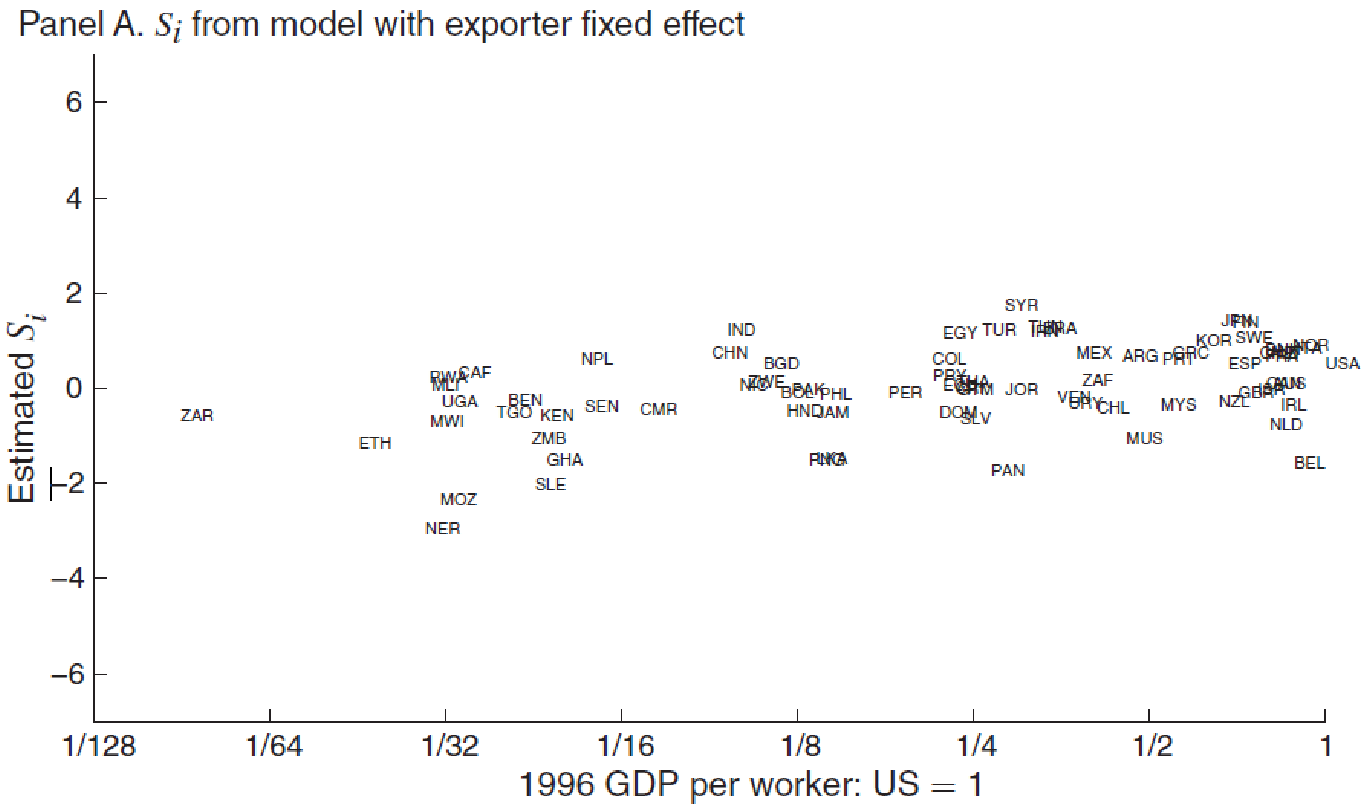


Figure 2. Exporter Fixed Effect: Easy for Rich Countries to Export, Difficult for Poor Countries

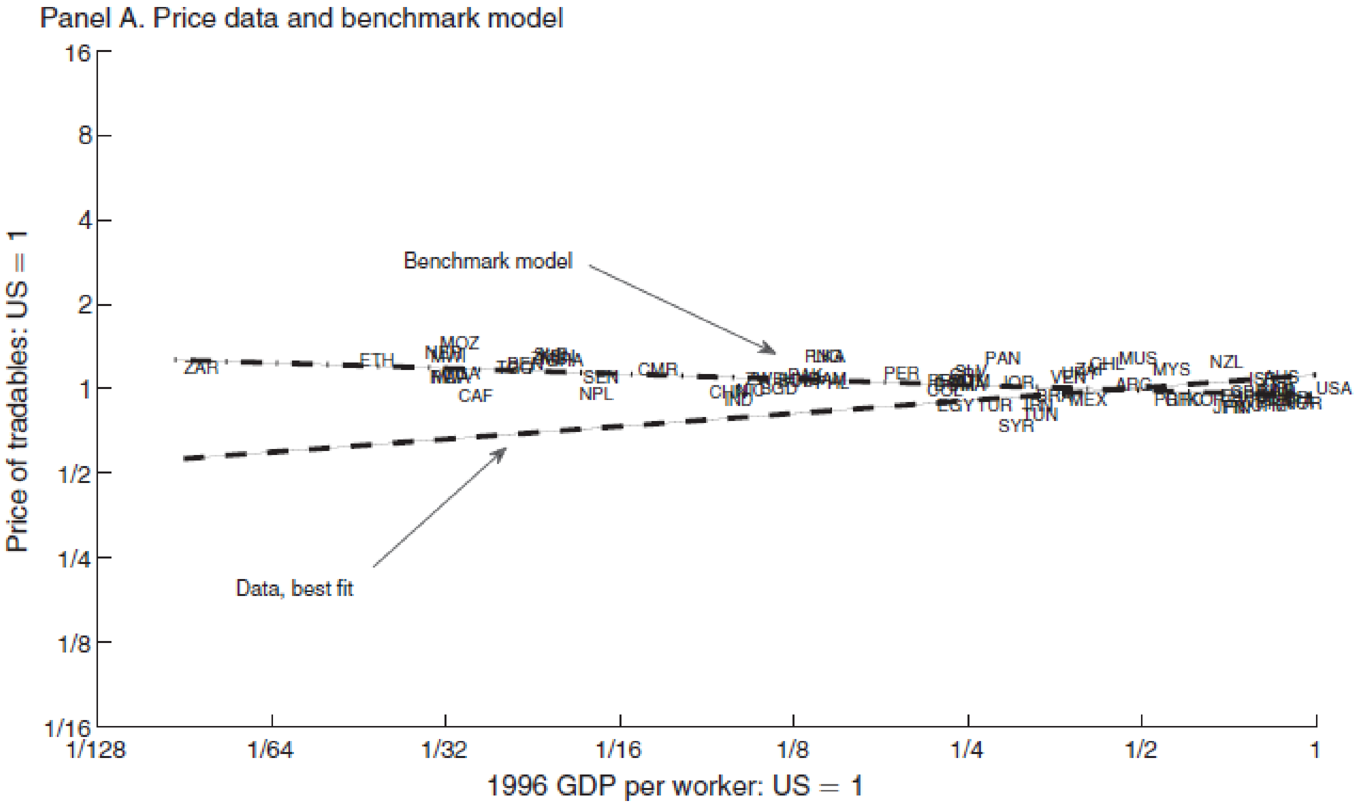
Waugh (2010)

Implied Prices for Exporter Fixed Effects



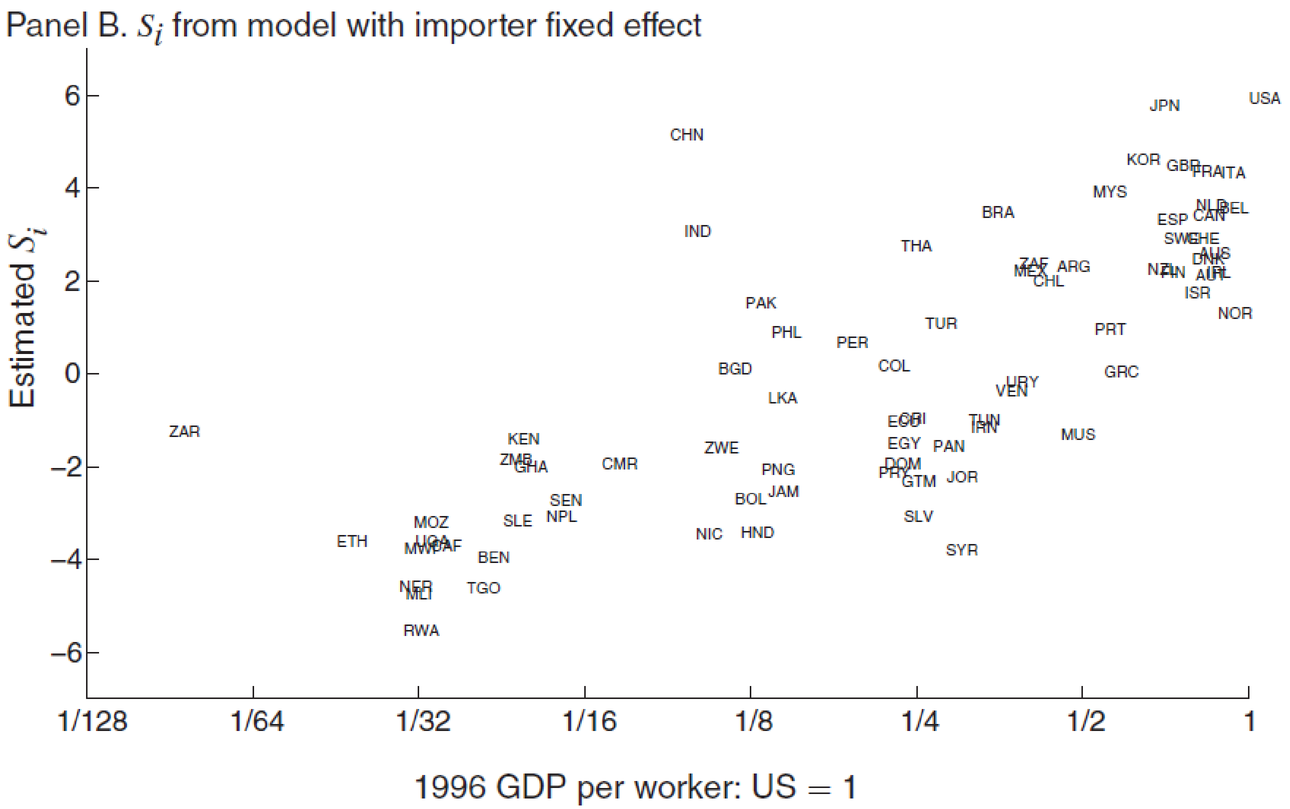
Waugh (2010)

Implied Prices for Exporter Fixed Effects



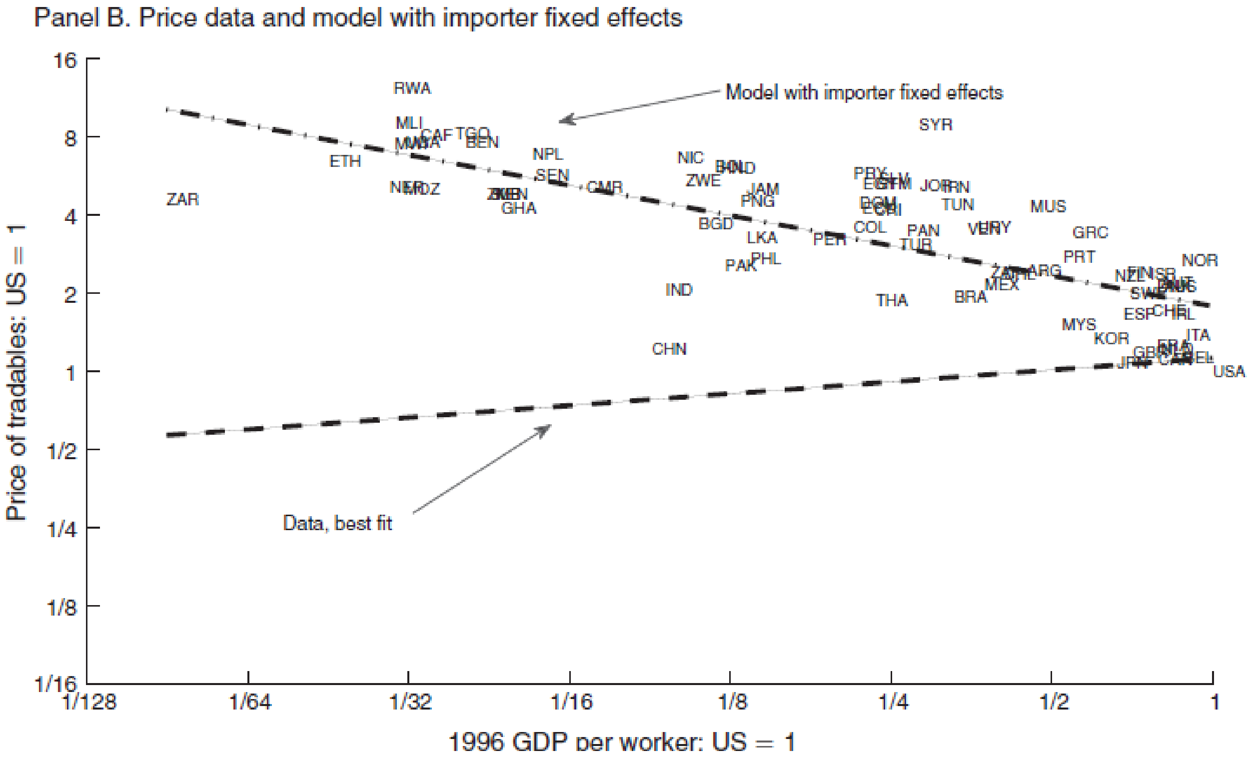
Waugh (2010)

Implied Prices for Importer Fixed Effects



Waugh (2010)

Implied Prices for Importer Fixed Effects



Waugh (2010)

Income in Model vs Data

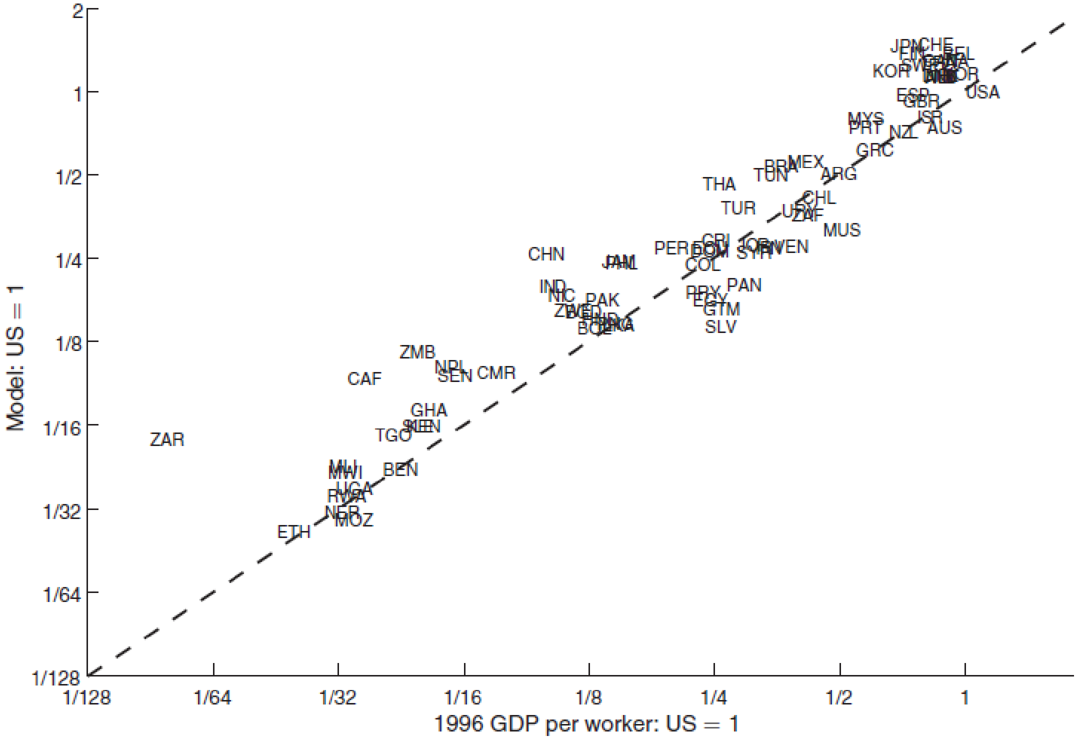


FIGURE 5. INCOME PER WORKER: DATA AND BENCHMARK MODEL

Waugh (2010)

Welfare Gains From Trade

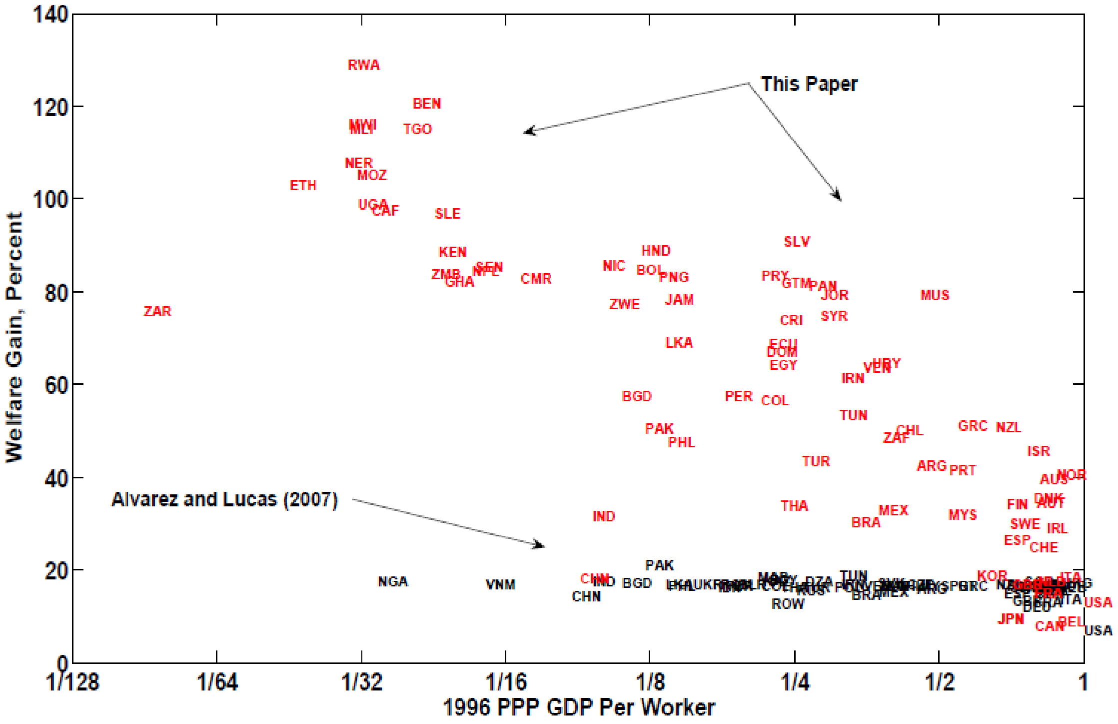


Figure 8: Welfare Gains: Calibrated Model to Frictionless Trade

Waugh (2010)