ECON G6905

Topics in Trade

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Today

- Topic: Increasing returns and the home-market effect
- Classic: Krugman (1980) [print this; we'll go through it in detail]
- Main paper: Market Size and Trade in Medical Services

Today: Does size matter?

- In neoclassical trade models, the pattern of specialization is size-invariant:
  - Ricardian: DFS (1977) $A(z)$ schedule independent of L/L^*
  - Heckscher-Ohlin: Factor intensity and abundance do not depend on size
  - Relative size determines the cutoff good z^* or the area of the FPE set, not the pattern of comparative advantage
- In new trade theory, size can influence the pattern of specialization because there are economies of scale
  - Intuition: Size is advantageous when there are economies of scale
  - Implications: strategic trade policy, multiple equilibria
  - Formalizing the idea proved challenging
- A "home-market effect", in which an economy with greater domestic demand is a (net) exporter of that good, distinguishes new trade theories from neoclassical models
- Empirical challenge is inferring "greater demand" from observed equilibrium

A short history of size in theory

- Linder (1961) posits that home demand is a source of comparative advantage such that rich countries will produce high-quality products
- '60s & '70s: Theorists struggle to link market size and specialization
- Krugman (1980) formalizes two-sector, two-country predictions for (1) exogenous demand differences and (2) country size differences
- Widely used case is freely traded CRS good and costly-to-trade IRS varieties
- Early 2000s: Empirical work correlates market size with sectoral composition
- 2010s: Income-driven demand composition in theory and empirics

Linder hypothesis

Linder (1961) posits that home demand governs supply capability (p.87–90)

[The] range of exportable products is determined by internal demand. It is a necessary, but not a sufficient condition, that a product be consumed (or invested) in the home country for this product to be a potential export product. . . In a world of imperfect knowledge, entrepreneurs will react to profit opportunities of which they are aware. These would tend to arise from domestic needs. . . An invention is, in itself, most likely to have been the outcome of an effort to solve some problem which has been acute in one's own environment. . . the production functions of goods demanded at home are the relatively most advantageous ones.

Linder hypothesis for trade flows (p.91–94)

Internal demand determines which products may be imported. . . The range of potential exports is identical to, or included in, the range of potential imports. . . The more similar the demand structure of two countries, the more intensive, potentially, is the trade between these two countries. . . Similarity of average income levels could be used as an index of similarity of demand structures.

Krugman (JIE 1979)

$$U = \sum_{i=1}^{n} v(c_i) \quad v' > 0, v'' < 0 \tag{1}$$

$$\epsilon_i = \frac{-v'}{v'' c_i} \tag{2}$$

$$l_i = \alpha + \beta x_i \tag{3}$$

$$x_i = L c_i \tag{4}$$

$$L = \sum_i l_i = \sum_{i=1}^{n} \alpha + \beta x_i \tag{5}$$

$$p = p_i, x = x_i \ \forall i \tag{6}$$

$$v'(c_i) = \lambda p_i \ \forall i \tag{7}$$

$$p_i = \lambda^{-1} v' \left(x_i / L \right) \tag{8}$$

$$\pi_i = p_i x_i - (\alpha + \beta x_i) w \tag{9}$$

$$p_i = \frac{\epsilon}{\epsilon - 1} \beta w \tag{10}$$

$$0 = px - (\alpha + \beta x) w \tag{11}$$

$$p/w = \beta + \alpha/(Lc) \tag{12}$$

$$n = \frac{L}{\alpha + \beta x} \tag{13}$$

Population growth and free-trade are comparative statics in L

Krugman (AER 1980)

$$U = \sum_i c_i^\theta \tag{1}$$

$$l_i = \alpha + \beta x_i \tag{2}$$

$$x_i = Lc_i \tag{3}$$

$$L = \sum_i (\alpha + \beta x_i) \tag{4}$$

$$\theta c_i^{\theta-1} = \lambda p_i \tag{5}$$

$$p_i = \theta \lambda^{-1} (x_i / L)^{\theta-1} \tag{6}$$

$$\pi_i = p x_i - (\alpha + \beta x_i) w \tag{8}$$

$$p_i = \theta^{-1} \beta w \tag{7}$$

$$x_i = \alpha\theta / \beta(1 - \theta) \tag{9}$$

$$n = L(1 - \theta)/\alpha \tag{10}$$

$$n^* = L^*(1 - \theta)/\alpha \tag{11}$$

Krugman (1980), section II

Transport costs (g), relative demand (call it r), relative wage ($\omega \equiv w/w^*$), and market clearing

$$
\begin{aligned}
r &= \left(\frac{p}{p^*}\right)^{1/(1-\theta)} g^{\theta/(1-\theta)} \\
r^* &= \left(\frac{p}{p^*}\right)^{-1/(1-\theta)} g^{\theta/(1-\theta)} && (12) \\
B &= \frac{r^* n \omega}{r^* n + n^*} L^* - \frac{r n^*}{n + r n^*} \omega L \\
&= \omega L L^* \left[\frac{r^*}{r^* L + L^*} - \frac{r}{L + r L^*}\right] && (14)
\end{aligned}
$$

$$
\omega = 1 \implies r = r^* < 1 \implies B = r L L^* \left[\frac{1}{rL + L^*} - \frac{1}{L + rL^*}\right] \qquad (14')
$$

$L > L^* \iff \omega > 1$. Contrast with DFS '77.

Krugman (1980), section III

- Two types of consumers consuming two classes of SDS varieties

$$U = \sum_{\omega} q(\omega)^{\frac{\sigma-1}{\sigma}}; \quad \tilde{U} = \sum_{\tilde{\omega}} \tilde{q}(\tilde{\omega})^{\frac{\sigma-1}{\sigma}}$$

- Home and foreign have same total population; different shares of types

$$L + \tilde{L} = L^* + \tilde{L}^* = \bar{L}; \quad L = \gamma \bar{L}; \quad L^* = (1-\gamma)\bar{L}$$

- Identical production functions and iceberg trade costs τ

$$l(\omega) = f + cx(\omega); \quad l(\tilde{\omega}) = f + cx(\tilde{\omega})$$

$$\Rightarrow p = \frac{\sigma}{\sigma - 1} cw; \quad \pi = 0 \Rightarrow x = \frac{f}{c}(\sigma - 1)$$

- Symmetry implies $w = \tilde{w} = w^* = \tilde{w}^*$ and thus $p = p^*$
- Only need to solve for $n, \tilde{n}, n^*, \tilde{n}^*$

Krugman (1980), section III

- Relative expenditure on foreign varieties when $p = p^*$ is $\tau^{1-\sigma}$
- Expenditure on domestic varieties as share of total is $\frac{n}{n+n^*\tau^{1-\sigma}}$
- Market clearing: industry income equals domestic plus foreign expenditure

$$npx = \frac{n}{n + n^*\tau^{1-\sigma}} wL + \frac{n\tau^{1-\sigma}}{n\tau^{1-\sigma} + n^*} w^*L^*$$

$$n^*p^*x^* = \frac{n^*\tau^{1-\sigma}}{n + n^*\tau^{1-\sigma}} wL + \frac{n^*}{n^* + n\tau^{1-\sigma}} w^*L^*$$

- With $p = p^*$, $w = w^*$, $x = x^*$, solve for $\frac{n}{n^*}$

$$n > 0, n^* > 0 \Rightarrow \frac{n}{n^*} = \frac{L/L^* - \tau^{1-\sigma}}{1 - \tau^{1-\sigma} L/L^*}, \quad \frac{L}{L^*} \in [\tau^{1-\sigma}, \tau^{\sigma-1}]$$

$$\frac{L}{L^*} < \tau^{1-\sigma} \Rightarrow n = 0; \quad \frac{L}{L^*} > \tau^{\sigma-1} \Rightarrow n^* = 0$$

- $\frac{n}{n^*}$ is increasing in $\frac{L}{L^*}$: greater relative demand calls forth domestic supply

Krugman (1980), section III

- In autarky, entry is proportionate to demand:

$$npx = wL; \quad \tilde{n}\tilde{p}\tilde{x} = \tilde{w}\tilde{L}$$

$$w = \tilde{w}, p = \tilde{p}, x = \tilde{x} \Rightarrow n/\tilde{n} = L/\tilde{L}$$

- With trade, entry more than proportionate to demand (see Figure 2)

$$\frac{n}{n^*} = \frac{L/L^* - \tau^{1-\sigma}}{1 - \tau^{1-\sigma} L/L^*}$$

$$\frac{\partial n/n^*}{\partial L/L^*} = \frac{1 - \left(\tau^{1-\sigma}\right)^2}{\left(1 - \tau^{1-\sigma} \frac{L}{L^*}\right)^2} \geq 1 \text{ if } \frac{L}{L^*} \geq \tau^{1-\sigma}$$

- Krugman's home-market effect: The market with relatively greater demand for a product type is a net exporter of that type.
- Home net exports of first type are

$$\frac{n\tau^{1-\sigma}}{n\tau^{1-\sigma} + n^*} w^* L^* - \frac{n^*\tau^{1-\sigma}}{n + n^*\tau^{1-\sigma}} wL = \frac{\tau^{1-\sigma} wL^*}{\tau^{1-\sigma} n + n^*} \left[n - n^*\right]$$

The gist of it

Krugman (1980)

Another, perhaps more interesting, generalization would be to abandon the assumed symmetry between the industries. Again, we would like to be able to make sense of some arguments made by practical men. For example, is it true that large countries will have an advantage in the production and export of goods whose production is characterized by sizeable economies of scale? This is an explanation which is sometimes given for the United States' position as an exporter of aircraft.

A general analysis of the effects of asymmetry between industries would run to too great a length. We can learn something, however, by considering another special case. Suppose that the *alpha* production is the same as in our last analysis, but that the production of *beta* goods is characterized by *constant* returns to scale and perfect competition. For simplicity, also assume that *beta* goods can be transported costlessly.

It is immediately apparent that in this case the possibility of trade in *beta* products will ensure that wage rates are equal. But this in turn means that we can apply the analysis of Part B, above, to the *alpha* industry. Whichever country has the larger market for the products of that industry will be a net exporter of *alpha* products and a net importer of *beta* products. In particular: if two countries have the same composition of demand, the larger country will be a net exporter of the products whose production involves economies of scale.

The analysis in this section has obviously been suggestive rather than conclusive. It relies heavily on very special assumptions and on the analysis of special cases. Nonetheless, the analysis does seem to confirm the idea that, in the presence of increasing returns, countries will tend to export the goods for which they have large domestic markets. And the implications for the pattern of trade are similar to those suggested by Steffan Linder, Grubel (1970), and others.

The home-market effect, weak and strong

Helpful typology from Costinot, Donaldson, Kyle, and Williams (2019):

- Weak home-market effect: Demand generates exports.
  Linder (1961): "The range of exportable products is determined by internal demand."
- Strong home-market effect: Greater demand generates *net* exports.
  Krugman (1980): "If two countries have the same composition of demand, the larger country will be a net exporter of the products whose production involves economies of scale."
- A weak home-market effect requires economies of scale; the strong HME requires sufficiently strong economies of scale
- Krugman's choice of functional form yielded the strong home-market effect for all parameter values – only CDKW formalize the weak HME

CDKW: The More We Die, The More We Sell?

Costinot, Donaldson, Kyle, Williams (2019):

- Theory: Define "home-market effect" outside Krugman-like settings
- Empirics: Use demographic differences as source of exogenous variation in demand for pharmaceutical drugs

This is the must-read paper on home-market effects

See my blog post on "Market-size effects, across places and over time"

CDKW: Theoretical environment

- Demand: Consumption in j of varieties from i targeting disease n is

$$d_{ij}^n = d(p_{ij}^n / P_j^n)\theta_j^n D(P_j^n / P_j) D_j$$

- Supply: Perfect competition and iceberg trade costs yields supply curve

$$s_i^n = \eta_i^n s(p_i^n)$$

- Equilibrium:

$$s_i^n = \sum_j \tau_{ij}^n d_{ij}^n$$

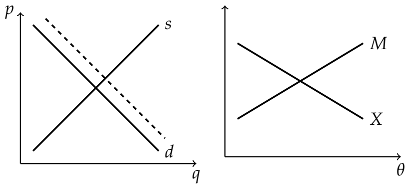
CDKW: Estimating equation

- Reduced-form regression for exports from i to j:

$$\ln X_{ij}^n = \beta_X \theta_i^n + \beta_M \theta_j^n + \delta_{ij} + \delta^n + \epsilon_{ij}^n$$

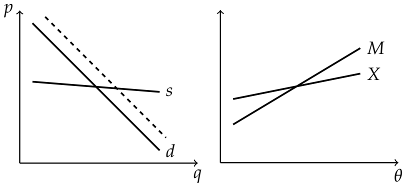
- First-order approximation (log-linearization) around a symmetric equilibrium
- Can be derived in perfect competition (with external economies), monopolistic competition (a la Krugman), Bertrand oligopoly, and monopoly settings
- Empirical strategy is to proxy for θ_i^n using i's age×gender-predicted disease burden
- $\beta_X > 0$ demonstrates a "weak home-market effect"
- $\beta_X > \beta_M > 0$ demonstrates a "strong home-market effect"

CDKW in pictures



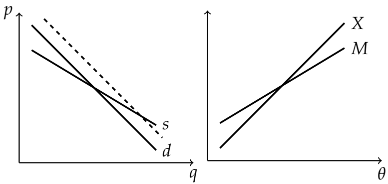
(a) Price and quantity. **(b)** Exports and imports.

Figure 1: Neoclassical Benchmark.



(a) Price and quantity. **(b)** Exports and imports.

Figure 2: Weak home-market effect.



(a) Price and quantity. **(b)** Exports and imports.

Figure 3: Strong home-market effect.

CDKW: Data

- Drug-level pharmaceutical sales for 56 countries; aggregated to countries based on drug's producer's headquarters
- Predicted disease burden from combining WHO's age-gender disease burden in disability-adjusted life years with countries' population demographics
- Theory vs data: Iceberg trade costs vs pricing to market?
- Theory vs data: Multinational production?

CDKW: Is the world symmetric?

$$\ln X_{ij}^n = \beta_X \theta_i^n + \beta_M \theta_j^n + \delta_{ij} + \delta^n + \epsilon_{ij}^n$$

- A symmetric equilibrium with $\theta_i = 1 \ \forall i$ and $\tau_{ij} = \tau > 1 \ \forall i, j : i \neq j$
- Symmetry allows omission of multilateral resistance terms
- How do we define HME away from the symmetric equilibrium?

Table 1: Top 10 countries in terms of sales

Country	Share of world sales (%) (1)	Share of world expenditures (%) (2)	Number of firms headquartered (3)
USA	36.67	42.10	361
Switzerland	13.14	0.61	35
Japan	11.62	12.67	53
United Kingdom	10.69	2.67	79
Germany	6.75	4.67	89
France	6.52	4.34	59
India	2.28	1.61	292
China (Mainland)	2.18	3.74	524
Canada	1.40	2.57	48
Italy	1.35	3.36	63

CDKW: Main result

Table 3: Test of the Home-Market Effect (baseline)

	log(bilateral sales)		
	(1)	(2)	(3)
log(PDB, destination)	0.526		0.563
	(0.098)		(0.109)
log(PDB, origin)		0.932	0.918
		(0.174)	(0.122)
p-value for $H_0 : \tilde{\beta}_X \leq 0$		0.000***	0.000***
p-value for $H_0 : \tilde{\beta}_X \leq \tilde{\beta}_M$			0.027**
Origin × disease FE	✓		
Destination × disease FE		✓	
Disease FE			✓
Adjusted R^2	0.629	0.562	0.539
Observations	18,857	19,008	19,255

Notes: OLS estimates of equation (16). Predicted disease burden (PDB_i^n) is constructed from an interaction between the global (leaving out country i) disease burden by demographic group in disease n, and the size of each demographic group in country i. All regressions omit the bilateral sales observation for home sales (i.e. where $i = j$) and control for origin-times-destination fixed-effects. The number of observations differs across columns due to omission of observations that are completely accounted for by the included fixed-effects. Standard errors in parentheses are two-way clustered at origin and destination country levels. p-values are based on F-test of the stated H_0. *** p<0.01, ** p<0.05.

CDKW: Robustness checks

Attempt to relax symmetry assumption, address spatially correlated demand

Table 6: Test of the Home-Market Effect (sensitivity analysis III)

	log(bilateral sales)			
	(1)	(2)	(3)	(4)
log (PDB, destination)	0.563	0.567	0.623	0.559
	(0.109)	(0.114)	(0.089)	(0.108)
log (PDB, origin)	0.918	0.933	0.820	0.917
	(0.122)	(0.145)	(0.167)	(0.126)
p-value for $H_0 : \tilde{\beta}_X \leq 0$	0.000***	0.000***	0.000***	0.000***
p-value for $H_0 : \tilde{\beta}_X \leq \tilde{\beta}_M$	0.027**	0.046**	0.172	0.027**
Sample of only ij obs. with $dist_{ij} \geq$	–	1,000 km	2,000 km	–
Control for $\sum_{k \neq i} \ln PDB_k^n \cdot dist_{ik}^{-1}$				✓
Control for $\sum_{k \neq j} \ln PDB_k^n \cdot dist_{kj}^{-1}$				✓
Adjusted R^2	0.539	0.538	0.549	0.539
Observations	19,255	16,676	13,459	19,255

Notes: OLS estimates of equation (16). All specifications control for origin-destination fixed-effects and disease fixed-effects. See Table 3 for details on construction of variables, sample restrictions, and calculation of standard errors (reported in parentheses) and p-values. *** p<0.01,** p<0.05.

CDKW: PPML and extensive margin

Table 8: Test of the Home-Market Effect (extensive margin)

	log(bilateral sales)		$\mathbb{1}$(bilateral sales>0)	
	(1)	(2)	(3)	(4)
log (PDB, destination)	0.563	0.383	0.008	0.009
	(0.109)	(0.149)	(0.004)	(0.004)
log (PDB, origin)	0.918	1.272	0.055	0.063
	(0.122)	(0.515)	(0.013)	(0.013)
p-value for $H_0 : \tilde{\beta}_X \leq 0$	0.000***	0.007***	0.000***	0.000***
p-value for $H_0 : \tilde{\beta}_X \leq \tilde{\beta}_M$	0.027**	0.065*	0.000***	0.000***
PPML estimator		✓		
Disease FE × origin GDP/capita				✓
Disease FE × destination GDP/capita				✓
Adjusted R^2	0.539	0.407	0.487	0.500
Observations	19,255	178,640	178,640	178,640

Notes: Column (1) reports OLS estimates, column (2) Poisson Psuedo-Maximum Likelihood (PPML) estimates, and columns (3) and (4) linear probability model estimates, based on equation (16). Pseudo-R^2 reported in column (2). All specifications control for origin-destination fixed-effects and disease fixed-effects. See Table 3 for details on construction of variables, sample restrictions, and calculations of standard errors (reported in parentheses) and p-values. *** p<0.01,** p<0.05.

Home-market effect in services trade

Dingel, Gottlieb, Lozinski, and Mourot (2024) investigate market-size effects in trade in medical services between US regions

- Build procedure-level trade matrices from Medicare claims data
- Derive home-market effect in fixed-price model
- CDKW regression shows strong HME for medical services
- Larger market-size effects in less common procedures

Go to DGLM slidedeck.

Home-market effects

- Home-market effects are a hallmark of new trade theory relative to neoclassical theories
- Empirical evidence is still in its infancy
- Home-market effects appear important to understanding:
  - quality specialization within US manufacturing
  - global pharmaceutical sales
  - regional variation in medical services

Next week

Up next: Agglomeration economies