The More We Die, The More We Sell? A Simple Test of the Home-Market Effect

Arnaud Costinot, Dave Donaldson, Margaret Kyle, Heidi Williams

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Introduction: The Home-Market Effect Puzzle

The Home-Market Effect (HME) stands as one of the central predictions of New Trade Theory:

- Countries tend to export products for which they have large domestic markets (Linder, 1961; Krugman, 1980)
- This arises from economies of scale: larger home markets enable firms to achieve lower average costs
- The theoretical intuition is compelling, but empirical verification has proven remarkably difficult

The Fundamental Identification Challenge:

Traditional demand measures (expenditure shares) are equilibrium outcomes simultaneously determined by both supply and demand forces. A positive correlation between home demand and exports could reflect:

- True causal effect of demand on exports (the HME)
- Reverse causality: productive advantages lead to both domestic sales and exports
- Omitted variables affecting both supply and demand

Research Question and Contribution

Core Research Question:
Can we find a credible source of exogenous variation in home demand to provide a definitive causal test of the home-market effect?
This Paper's Contribution:

- Develops a novel identification strategy using demographic variation to predict disease burdens
- Provides the first credible test of the causal mechanism behind the HME
- Quantifies the role of economies of scale in driving the effect
- Distinguishes between "weak" and "strong" versions of the HME

The paper focuses on the global pharmaceutical industry, where the link between demographics, disease prevalence, and drug demand is particularly clear.

Theoretical Framework: A General Approach

The authors develop a flexible theoretical model that nests various market structures:

- **Demand**: Nested structure across diseases and countries of origin
- **Supply**: Industry-level supply curve $s_i^n = \eta_i^n s(p_i^n)$ with elasticity ε^s
- **Key Insight**: The HME requires $\varepsilon^s < 0$ (economies of scale)
- **Market Structures**: Model accommodates perfect competition, monopolistic competition, endogenous innovation, and regulated markets

Through log-linearization around a symmetric equilibrium, the model yields a testable equation for bilateral sales:

$$\ln(x_{ij}^n) = \delta_{ij} + \delta^n + \beta_M \ln(\theta_j^n) + \beta_X \ln(\theta_i^n) + \varepsilon_{ij}^n$$

where x_{ij}^n represents sales from country i to country j for drugs treating disease n.

Testable Hypotheses

The theoretical framework generates two precise, testable predictions:

Hypothesis 1: Weak Home-Market Effect

- Prediction: $\beta_X > 0$
- Interpretation: Higher home demand increases a country's exports
- Economic intuition: With economies of scale, larger home markets reduce average costs, making firms more competitive abroad
- Crucial implication: $\beta_X > 0$ *only* occurs when $\varepsilon^s < 0$ (economies of scale present)

Hypothesis 2: Strong Home-Market Effect

- Prediction: $\beta_X > \beta_M$
- Interpretation: The export boost from home demand exceeds the import boost from foreign demand
- Economic intuition: Country becomes a net exporter in the product category
- Requires sufficiently strong economies of scale

Identification Strategy: The Core Innovation

The paper's most important contribution is solving the endogeneity problem through a novel instrument:

Predicted Disease Burden (PDB)

$$(PDB)_i^n = \sum_{\text{age } a,\ \text{gender } g} \left[\text{pop}_{iag} \times \left(\frac{\sum_{k \neq i} \text{burden}_{kag}^n}{\sum_{k \neq i} \text{pop}_{kag}} \right) \right]$$

measures the average disease burden per capita from disease n for gender g and age group a. **Construction Details:**

- Uses country i's demographic composition (age and gender distribution)
- Combines with global disease prevalence patterns for each demographic group
- "Leave-one-out" construction: excludes country i itself when calculating global disease rates
- Creates a plausibly exogenous predictor of disease-specific drug demand

Why This Identification Strategy Works

Exogeneity Justification:

- Demographic composition is predetermined and slow-moving
- Global disease patterns are largely exogenous to any single country's economic conditions
- "Leave-one-out" construction prevents mechanical correlation with country-specific factors
- Instrument relevance: demographics strongly predict disease burdens, which drive drug demand

Sources of Variation for the PDB Instrument

Variation in Demographics Across Countries

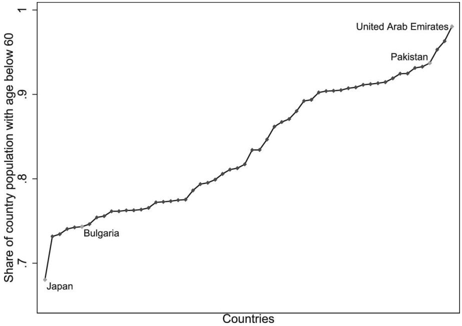

Figure: Share of population under age 60 varies dramatically. Based on Figure IV in Costinot et al. (2019).

Variation in Disease Profile Across Demographics

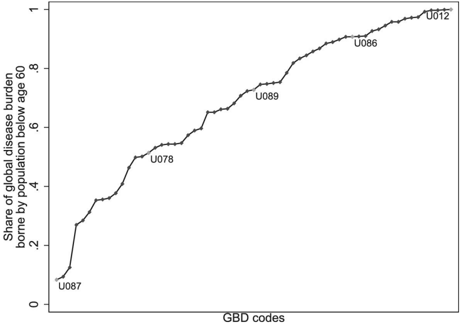

Figure: The labeled global burden of disease (GBD) codes correspond to the following diseases: U087: Alzheimer's disease and other dementia; U078: other neoplasms; U089: multiple sclerosis; U086: alcohol use disorders; and U012: whooping cough.

Data Sources and Measurement

Pharmaceutical Sales Data (IMS MIDAS, 2012)

- Comprehensive global pharmaceutical sales data
- 56 countries, covering over 20,000 molecules
- Bilateral sales flows between country pairs
- Origin country defined as firm headquarters location
- Drugs classified by ATC codes, mapped to specific diseases
- Important limitation: combines both exports and sales by foreign affiliates

Disease Burden and Demographic Data

- WHO Global Burden of Disease: DALYs by disease, age, gender, and country
- U.S. Census Bureau International Database: Population by age and gender for each country
- Hand-coded mapping from ATC drug classifications to WHO disease categories

Baseline Model

Equation (15) & (16)

$$\ln \theta_i^n = \gamma \ln(PDB)_j^n + \gamma_i^n$$

$$\ln x_{ij}^n = \delta_{ij} + \delta^n + \tilde{\beta}_M \ln(PDB)_j^n + \tilde{\beta}_X \ln(PDB)_i^n + \tilde{\epsilon}_{ij}^n$$

- x_{ij}^n: Bilateral sales from origin i to destination j for disease n.
- $(PDB)_i^n$: Predicted Disease Burden in the origin (exporter).
- $(PDB)_j^n$: Predicted Disease Burden in the destination (importer).
- δ_{ij}: Origin-Destination fixed effects (absorbs distance, etc.).
- δ^n: Disease fixed effects (absorbs global disease size).

Baseline Results: Evidence for Home-Market Effect

Variable	Coefficient	(Std. Err.)
$\ln$(PDB, destination) ($\tilde{\beta}_M$)	0.545	(0.107)
$\ln$(PDB, origin) ($\tilde{\beta}_X$)	0.928	(0.123)
Observations	19,150	
Fixed Effects	Origin×Destination, Disease	

Hypothesis Test 1: Weak Home-Market Effect

- Null hypothesis: $\tilde{\beta}_X \leq 0$
- Result: $\tilde{\beta}_X = 0.928$, p-value < 0.001
- Interpretation: Strong evidence that home demand increases exports
- Economic significance: 10% increase in home PDB associated with 9.3% increase in exports

Hypothesis Test 2: Strong Home-Market Effect

- Null hypothesis: $\tilde{\beta}_X \leq \tilde{\beta}_M$
- Result: F-test p-value $= 0.018$
- Interpretation: Evidence that countries become net exporters

Economic Interpretation of Baseline Results

What Do These Coefficients Mean?

The positive and significant $\tilde{\beta}_X$ provides the credible causal evidence for the home-market effect. This means:

- Countries systematically export more of drugs for which they have higher *exogenous* home demand
- This pattern cannot be explained by supply-side advantages alone
- The effect is economically substantial and statistically robust

Why is This Evidence Causal?

- PDB provides exogenous variation in demand uncorrelated with supply conditions
- Extensive fixed effects structure controls for confounding factors
- The identification strategy breaks the fundamental endogeneity problem that plagued previous tests

Policy Implication: Countries may develop export advantages in industries where they have large domestic markets, supporting strategic trade policy arguments.

Robustness Checks: Addressing Alternative Explanations

Supply-Side Confounds

- Controls for GDP per capita interacted with disease characteristics
- Restricts sample to generic drugs (where R&D advantages matter less)
- Focuses on poorer countries

TABLE IV

TEST OF THE HOME-MARKET EFFECT (SENSITIVITY ANALYSIS I)

	Log (bilateral sales)		
	(1)	(2)	(3)
Log (PDB, destination)	0.545	0.533	0.405
	(0.107)	(0.102)	(0.099)
Log (PDB, origin)	0.928	0.740	0.865
	(0.123)	(0.166)	(0.113)
p-value for $H_0 : \tilde{\beta}_X \leqslant 0$	.000***	.000***	.000***
p-value for $H_0 : \tilde{\beta}_X \leqslant \tilde{\beta}_M$	.018**	.122	.003***
Disease FE × origin p.c. GDP		√	
Disease FE × dest. p.c. GDP		√	
Origin FE × disease decile			√
Dest. FE × disease decile			√
Adjusted R^2	0.540	0.555	0.560
Observations	19,150	19,150	19,105

Notes. OLS estimates of equation (16). All specifications control for origin-destination fixed effects and disease fixed effects. "Disease decile" in column (3) represents the decile of the worldwide distribution, based on total disease burden, in which a given disease falls. See Table III for details on construction of variables, sample restrictions, and calculation of standard errors (reported in parentheses) and p-values. *** $p < .01$,** $p < .05$.

TABLE V

TEST OF THE HOME-MARKET EFFECT (SENSITIVITY ANALYSIS II)

	Log (bilateral sales)				
	(1)	(2)	(3)	(4)	(5)
Log (PDB, destination)	0.545	0.361	0.346	0.510	0.671
	(0.107)	(0.187)	(0.183)	(0.217)	(0.234)
Log (PDB, origin)	0.928	1.056	1.018	0.398	0.638
	(0.123)	(0.185)	(0.197)	(0.144)	(0.161)
p-value for $H_0 : \tilde{\beta}_X \leqslant 0$	.000***	.000***	.000***	.004***	.000***
p-value for $H_0 : \tilde{\beta}_X \leqslant \tilde{\beta}_M$	.018**	.033**	.040**	.668	.542
USA only origin		√	√		
Control for NIH subsidies			√		
Generic drugs only				√	
Drop richest 1/3 origins					√
Adjusted R^2	0.540	0.778	0.778	0.472	0.446
Observations	19,150	597	597	8,700	5,461

Notes. OLS estimates of equation (16). Columns (1), (4), and (5) control for origin-destination fixed effects and disease fixed effects. Columns (2) and (3) use only the United States as an origin country, aggregate disease-level variation to the NIH institute level, and control for destination fixed effects. Column (3) additionally controls for the log of the value of NIH subsidies within each NIH institute. See Table III for details on construction of variables, sample restrictions, and calculation of standard errors (reported in parentheses) and p-values. $^{***}\ p < .01$, $^{**}\ p < .05$.

Spatial Correlation Concerns

- Controls for disease burden in neighboring countries
- Restricts to country pairs that are geographically distant
- Result: No evidence that spatial correlation drives the results

TABLE VI

TEST OF THE HOME-MARKET EFFECT (SENSITIVITY ANALYSIS III)

	Log (bilateral sales)			
	(1)	(2)	(3)	(4)
Log (PDB, destination)	0.545	0.537	0.610	0.542
	(0.107)	(0.115)	(0.087)	(0.107)
Log (PDB, origin)	0.928	0.941	0.843	0.928
	(0.123)	(0.147)	(0.166)	(0.127)
p-value for $H_0 : \tilde{\beta}_X \leqslant 0$	.000***	.000***	.000***	.000***
p-value for $H_0 : \tilde{\beta}_X \leqslant \tilde{\beta}_M$	.018**	.033**	.134	.019**
Sample of only ij obs. with $dist_{ij} \geqslant$	–	1,000 km	2,000 km	–
Control for $\sum_{k \neq j} \ln PDB_k^n \cdot dist_{kj}^{-1}$				✓
Control for $\sum_{k \neq i} \ln PDB_k^n \cdot dist_{ik}^{-1}$				✓
Adjusted R^2	0.540	0.540	0.551	0.540
Observations	19,150	16,405	13,141	19,150

Notes. OLS estimates of equation (16). All specifications control for origin-destination fixed effects and disease fixed effects. See Table III for details on construction of variables, sample restrictions, and calculation of standard errors (reported in parentheses) and p-values. *** $p < .01$, ** $p < .05$.

Market Structure and Regulation

- Examines EU markets separately (less price discrimination)
- Controls for US NIH research funding
- Uses PPML to account for zero trade flows
- Result: HME patterns persist across specifications

TABLE VII

TEST OF THE HOME-MARKET EFFECT (SENSITIVITY ANALYSIS IV)

	Log (bilateral sales)				
	(1)	(2)	(3)	(4)	(5)
Log (PDB, destination)	0.545	−0.007	0.573	0.547	0.514
	(0.107)	(0.460)	(0.265)	(0.102)	(0.104)
Log (PDB, origin)	0.928	0.726	0.823	0.785	0.843
	(0.123)	(0.285)	(0.201)	(0.104)	(0.098)
p-value for $H_0 : \tilde{\beta}_X \leqslant 0$	.000***	.010**	.000***	.000***	.000***
p-value for $H_0 : \tilde{\beta}_X \leqslant \tilde{\beta}_M$	.018**	.098*	.198	.061*	.023**
EU destinations only		✓			
Below median FDI share			✓		
PDB with 1996 demographics				✓	
Home sales (X^n_{ii}) obs. incl.					✓
Adjusted R^2	0.540	0.538	0.459	0.539	0.563
Observations	19,150	7,223	5,081	19,150	21,291

Notes. OLS estimates of equation (16). All specifications control for origin-destination fixed effects and disease fixed effects. See Table III for details on construction of variables, sample restrictions, and calculations of standard errors (reported in parentheses) and p-values. *** $p < .01$, ** $p < .05$, * $p < .1$.

Mechanism Analysis: Disentangling Scale Economies

A key question: Is the HME driven by economies of scale (as theory predicts) or could alternative mechanisms explain the results?

Estimating Demand Elasticity

- Method: Uses gravity equation combined with micro-level price data
- Estimates how trade costs affect both quantities and prices
- Result: $\varepsilon^x \approx 6.22$ (demand is highly elastic)
- Implication: Inelastic demand cannot explain the HME findings

Estimating Supply Elasticity

- Method: Uses PDB as instrument for total production scale
- Estimates relationship between scale and producer prices
- Result: $\varepsilon^s \approx -7.83$ (strong economies of scale)
- Implication: Supply curve is downward sloping, confirming scale economies

Conclusion: The HME is indeed driven by substantial industry-level economies of scale, exactly as predicted by theory.

Structural Results: Quantitative Assessment

The estimated supply elasticity of $\varepsilon^s \approx -7.83$ provides several important insights:

Magnitude of Scale Economies

- The negative sign confirms downward-sloping supply (increasing returns)
- The magnitude indicates substantial scale economies in pharmaceuticals
- Comparison: About 25% smaller than Krugman's (1980) benchmark prediction ($\varepsilon^s = -\varepsilon^x$)
- Suggests real-world scale economies are large but not as extreme as in simplest models

Welfare Implications

- Scale economies create potential gains from trade through lower average costs
- Home-market effects can shape comparative advantage and specialization patterns
- Trade policy that expands market access can yield efficiency benefits

Critical Assessment: Strengths of the Paper

Methodological Innovation

- Solves the fundamental endogeneity problem that plagued previous HME tests
- PDB instrument is plausible, and well-justified
- Theoretical framework is general and accommodates multiple market structures

Empirical Rigor

- Comprehensive robustness checks address most plausible alternatives
- Clear distinction between weak and strong HME provides nuanced test

This paper likely represents the definitive empirical test of the home-market effect in the pharmaceutical industry.

Critical Assessment: Limitations and Questions

External Validity Concerns

- Single-industry focus (pharmaceuticals) limits generalizability
- Pharmaceuticals have unusual characteristics: high regulation, patents, inelastic demand in some cases
- Would similar patterns hold in industries with weaker scale economies?

Measurement Issues

- Sales data combine exports and foreign affiliate sales
- Cannot distinguish between "production HME" and "headquarters HME"
- Where exactly do the scale economies operate: production, R&D, or marketing?

Strong HME Evidence

- Evidence for strong HME ($\beta_X > \beta_M$) is less robust than for weak HME
- Statistical significance disappears in some specifications
- Suggests the strong version may be context-dependent

Policy Implications and Extensions

Trade Policy Implications

- Supports the theoretical possibility of “import protection as export promotion”
- Industrial policy may be effective in sectors with significant scale economies
- However: Welfare effects depend on market structure and policy details
- Strategic trade policy arguments gain some empirical support

Industrial Organization

- Scale economies appear to operate at the industry level rather than firm level
- Has implications for antitrust policy in innovation-intensive industries
- Suggests potential tradeoffs between competition and efficiency

Development Economics

- Countries may develop comparative advantage based on domestic market characteristics
- Demographic transitions could shape future export specialization patterns