TRADE COSTS AND MARK-UPS IN MARITIME SHIPPING

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Motivation

- Maritime shipping is the most important mode of transportation for international trade.
- Main problem
  - International trade is highly dependent on an industry in which suppliers are widely believed to exert market power.

    Low number carriers per shipping route | Steady number of carriers in the market
- How do these market conditions affect the transportation costs for trade?
- Previous studies demonstrate that carriers exert market power (e.g. Fink (2002), Hummels et. al (2009).).
- What the literature still lacks are absolute measures of the maritime shipping mark-ups that allow:
  - A decomposition of the freight cost on shipping cost and shipping mark-ups.
  - A comparison with other trade costs (e.g. tariffs).
  - A quantification of its effects on trade flows and economic welfare.
  - An evaluation if their effect disproportionately affects developing and/or countries geographically distant from destination markets.

Research Questions

Main Question

- How much higher are freight rates than they would be without non-competitive pricing behavior?

Secondary Questions

- What is the effect of shipping mark-up on trade flows?
- What is the welfare costs of these mark-ups?
- How large are mark-ups, relative to tariffs?
- Do developing countries pay higher shipping mark-ups?
- Are shipping mark-ups larger on longer routes?

Most Related Literature | Main Stylized Fact

Most Related Literature

- **Market Power in the Maritime Shipping Industry**

  [Clyde and Reitzes, 1998], [Fink, 2002], [Hummels, Skiba and Lugovskyy, 2009], [Asturias, 2019]

- **Transportation Costs for International Trade**

  [Amjadi and Yeats, 1995],[Radelet and Sachs, 1998], [Limao and Venables, 2001], [Micco and Perez, 2001], [Sanchez et al., 2003], [Anderson and van Wincoop, 2004], [Clark et al., 2004], [Hummels and Skiba, 2004], [Wilmsmeier et al., 2006], [Hummels, 2007], [Martinez-Zarsoso et al.,2008], [Wilmsmeier and Hoffmann, 2008], [Korinek and Sourdin, 2009], [Kumar and Hoffmann, 2013]

- **Operationalization of Pass-Through Rates for Identifying and analyzing Intermediaries Market Power**

  [Atkin and Donaldson, 2015], [Bergquist, 2017], [Pless and van Benthem, 2017]

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Main Stylized Fact

Table 1: *Ad-Valorem* Freight Charges from China and Loading Cargo of U.S. Imports to U.S. Ports located in U.S. West Coast - 2017

	Seattle	**Los Angeles**	**San Francisco**
Panel A.			
Ad-Valorem Freight Charges			
Cell Phones	0.7%	0.8%	5.2%
Televisions	1.9%	2.3%	2.8%
Bicycles	5.4%	6.5%	8.1%
Car Tires	14.0%	13.5%	14.0%
Panel B.			
Number of Transactions (Millions)	15	107	19
Total Volume Imported (Million tons)	154	995	425
Total Value Imported - FOB (US$ Billion)	508	3,116	566

Theoretical Framework

Shipping Carriers - Maximization Problem

A maritime shipping carrier ℓ maximizes the following profits function with respect to the amount $q_r^{\ell,k}$ it ships of product k through route r:

$$\max_{q_r^{\ell,k}} \pi^\ell = \sum_r \sum_k \left[f_r^k(Q_r^k, \Theta_r^k) - c^\ell(\chi_r^k) \right] q_r^{\ell,k} - FC_r^\ell \tag{1}$$

where the optimal shipping freight rate $f_r^{\ell,k}$ that a carrier ℓ charges for shipping a product k in a route r is given by:

$$f_r^{\ell,k} = c^\ell(\chi_r^k) - \frac{\partial f_r^k}{\partial Q_r^k} \frac{\partial Q_r^k}{\partial q_r^{\ell,k}} q_r^{\ell,k} \tag{2}$$

Theoretical Challenge: how to separately identify the shipping costs and shipping mark-ups implicitly charged in the freight costs

Theoretical Framework - cont'd

Theoretical Identification Strategy of AD (2015)

Atkin and Donaldson (2015) show that firms' marginal costs and mark-ups are theoretically identifiable, when is consider the short-run pass-though rate ρ of costs to prices.

$$\underbrace{P_{od}^k - P_o^k}_{f_r^{\ell,k}} = c^\ell(\chi_r^k) + \mu_r^k\left(c^\ell(\chi_r^k), \phi_r^k, \Theta_r^k\right) \tag{3}$$

Evaluating the effect of a cost shifter x_r^k theoretically has two effects:

$$\frac{\partial f_r^{\ell,k}}{\partial x_r^k} = \underbrace{\rho \frac{\partial c^\ell(\chi_r^k)}{\partial x_r^k}}_{\text{Direct Effect – Observed}} + \underbrace{\frac{\partial \mu_r^k}{\partial \phi_r^k}\frac{\partial \phi_r^k}{\partial x_r^k} + \frac{\partial \mu_r^k}{\partial \Theta_r^k}\frac{\partial \Theta_r^k}{\partial x_r^k}}_{\text{Indirect Effect – Unobserved}} \tag{4}$$

where:

- ρ_r^k is the short-run pass through rate and is equal to $\frac{\partial f_r^{\ell,k}}{\partial c^\ell}$
- $\phi_r^k = \frac{L}{\partial Q/\partial q} = \frac{L}{\theta}$

Theoretical Framework - cont'd

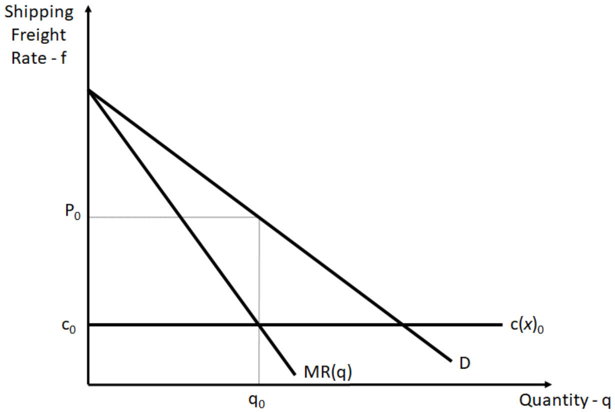


Figure 1: Linear Demand, initial scenario

Theoretical Framework - cont'd

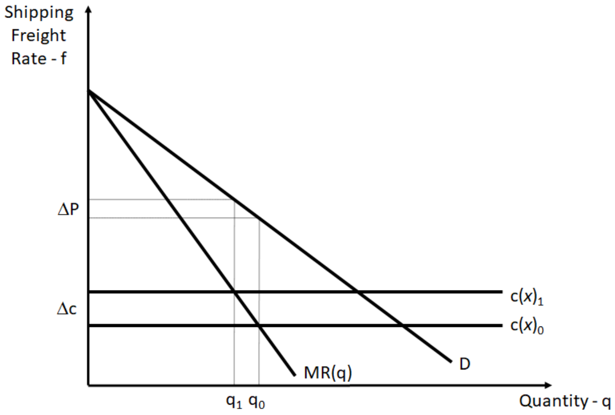


Figure 2: Linear Demand, new scenario

Theoretical Framework - cont'd

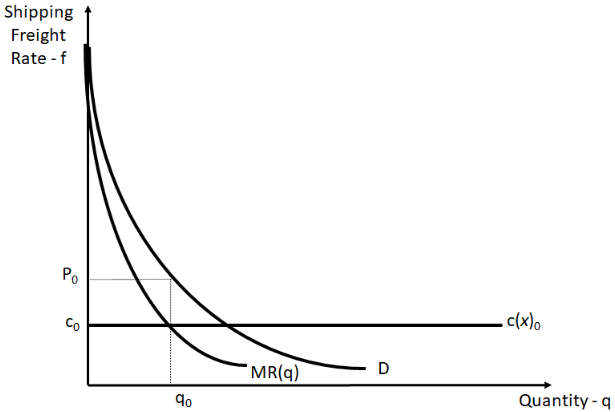


Figure 3: Convex Demand, initial scenario

Theoretical Framework - cont'd

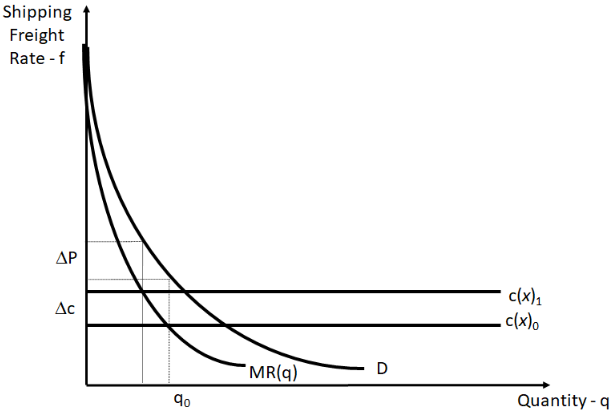


Figure 4: Convex Demand, new scenario

Theoretical Framework - cont'd

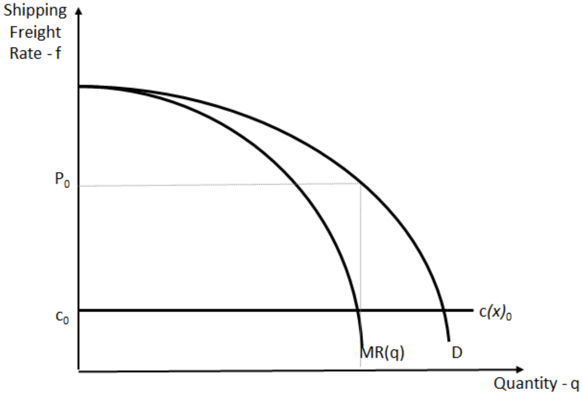


Figure 5: Concave Demand, initial scenario

Theoretical Framework - cont'd

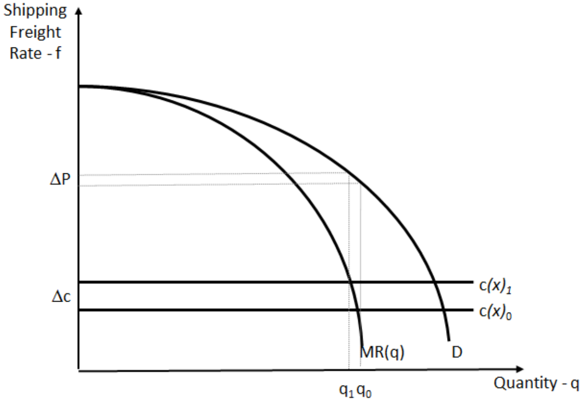


Figure 6: Concave Demand, new scenario

Theoretical Framework- cont'd

Short-Run Pass-Through rate ρ

The short-run pass through rate ρ is structurally defined as:

$$\rho_r^k = \frac{\partial f_r^k}{\partial c(\chi_r^k)} = \left[1 + \frac{1 + E_r^k(f_r^k)}{\phi_r^k}\right]^{-1} \tag{5}$$

To operationalize ρ, consumers' preferences are modeled with a the Bulow and Pfleiderer (1983) inverse demand system, using the demand for imports.

$$P_{od}^k(Q_{od}^k, \Theta_{od}^k) = \begin{cases} a_{od}^k - b_{od}^k (Q_{od}^k)^{\delta_{od}^k}, \text{if } \delta_{od}^k > 0 \text{ and } a_{od}^k > P_{od}^k > 0, b_{od}^k > 0, 0 < Q_{od}^k < \left(\frac{a_{od}^k}{b_{od}^k}\right)^{\frac{1}{\delta_{od}^k}} \\ a_{od}^k - b_{od}^k \ln(Q_{od}^k), \text{if } \delta_{od}^k = 0 \text{ and } a_{od}^k > P_{od}^k > 0, b_{od}^k > 0, 0 < Q_{od}^k < e^{\left(\frac{a_{od}^k}{b_{od}^k}\right)} \\ a_{od}^k - b_{od}^k (Q_{od}^k)^{\delta_{od}^k}, \text{if } \delta_{od}^k < 0 \text{ and } P_{od}^k > a_{od}^k \geq 0, b_{od}^k < 0, 0 < Q_{od}^k < \infty \end{cases} \tag{6}$$

Theoretical Framework- cont'd

Separated Optimal Pricing Rule

The optimal pricing-rule for carriers can be written as:

$$
\begin{aligned}
f_r^{\ell,k} &= c^{\ell}(\chi_r^k) - \frac{\partial f_r^k}{\partial Q_r^k}\frac{\partial Q_r^k}{\partial q_r^{\ell,k}} q_r^{\ell,k} \\
&= \underbrace{\rho_r^k c^{\ell}(\chi_r^k)}_{Mg.costs} + \underbrace{(1-\rho_r^k)(a_{od}^k - P_o^k)}_{Mark-Ups}
\end{aligned}
\tag{7}
$$

such that this expression theoretically separates marginal shipping costs and shipping mark-ups.

Data

U.S. Merchandise Imports moved by sea

- Each observation compiles information disaggregated by:
  1. Commodity at the HS6-digit product code.
  2. Country of origin.
  3. U.S. customs district of arrival.
  4. Year.
  5. Imports' FOB value.
  6. Shipping weight
  7. Shipping charges.
- Three periods of analysis:
  - Pre-date global crisis period (2002-2007).
  - Global crisis period (2008-2012).
  - Post-date global crisis period (2013-2017).
- Type of delivered products – Rauch (1999) classification:
  - Differentiated products $\rightarrow$ Liner Shipping Service
- Other data sources are CEPII, BACI, the World Cities Database and the U.S. BLS and IMF.

Summary Statistics | Estimation Strategy | Estimation Mark-Ups | Results

Estimation Strategy

The optimal pricing-rule for carriers is given by:

$$f_r^{\ell,k} = \rho_r^k c^\ell(\chi_r^k) + (1-\rho_r^k)(a_{od}^k - P_o^k)$$

Applying the *Two Stage Method* of Atkin and Donaldson (2015)

1. Estimate the pass-through rate $\widehat{\rho}$ for each product k origin county o shipped to U.S. coast c.

$$P_{od}^k = \rho_r^k P_o^k + \rho_r^k c^\ell(\chi_r^k) + (1-\rho_r^k)a_{od}^k \tag{8}$$

2. Estimate an adjusted expression of the shipping freight rate considering for variable mark-ups.

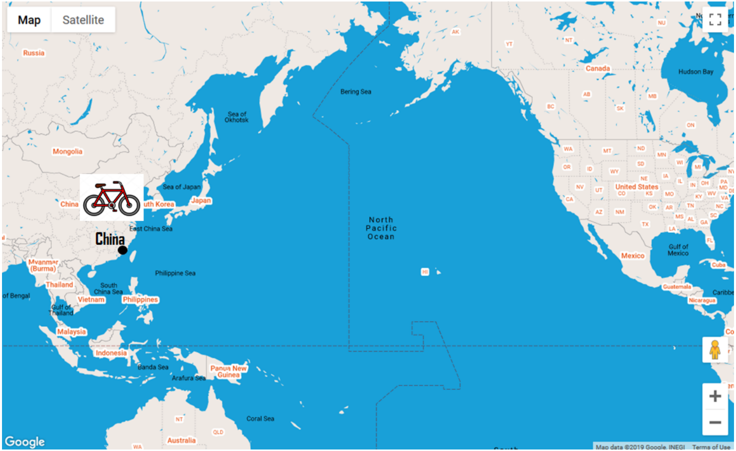
$$\frac{P_{od}^k - \widehat{\rho_o^k} P_o^k}{\widehat{\rho_r^k} P_o^k} = T^\ell(\chi_r^k) + \frac{(1-\widehat{\rho_r^k})}{\widehat{\rho_r^k} P_o^k} a_{od}^k \tag{9}$$

where $c^\ell(\chi_r^k) = P_o^k T^\ell(\chi_r^k)$, assuming ad valorem shipping costs.

Estimation Details - Stage 1 | Estimation Details - Stage 2 | Estimation Mark-Ups

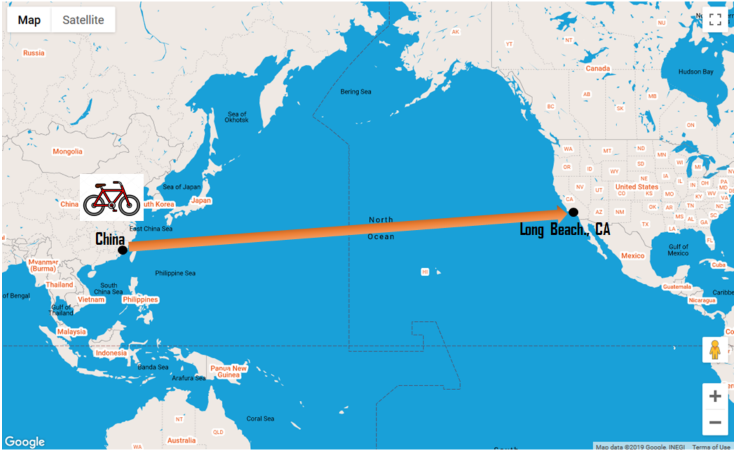
Mapping: Estimation Strategy

Stage 1: Short-Run Pass-Through Rate ρ



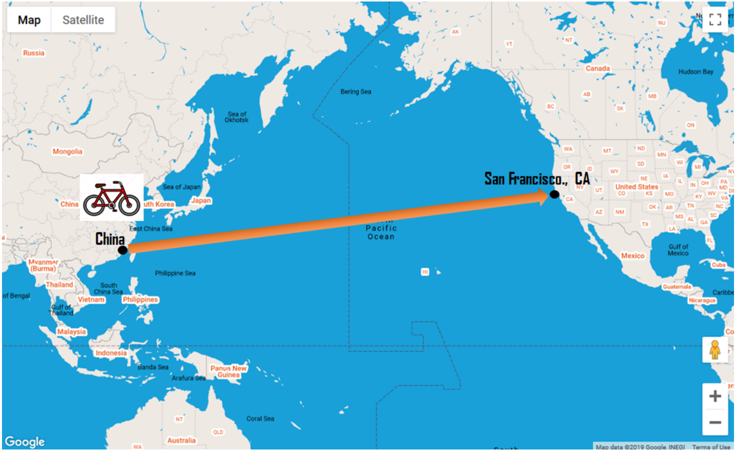
Mapping: Estimation Strategy

Stage 1: Short-Run Pass-Through Rate ρ



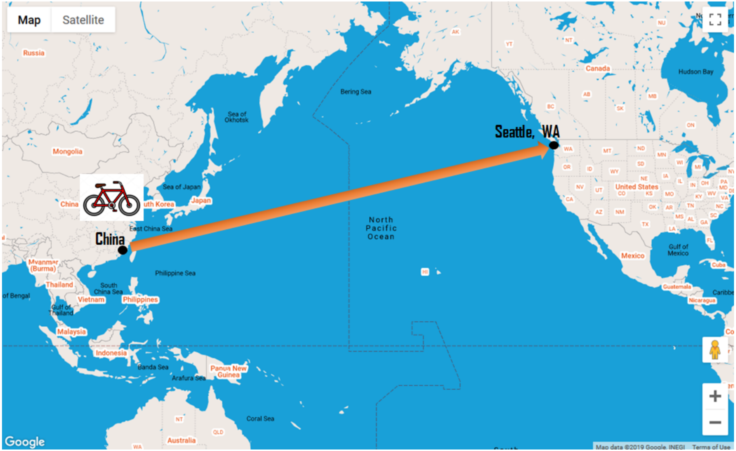
Mapping: Estimation Strategy

Stage 1: Short-Run Pass-Through Rate ρ



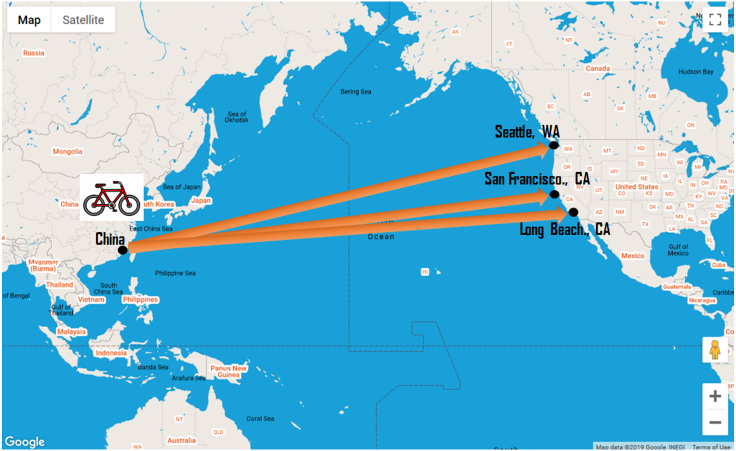
Mapping: Estimation Strategy

Stage 1: Short-Run Pass-Through Rate ρ



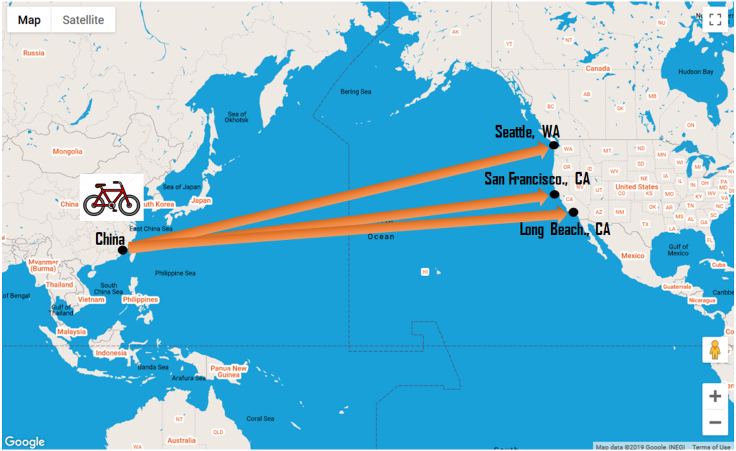
Mapping: Estimation Strategy

Stage 1: Short-Run Pass-Through Rate ρ



Mapping: Estimation Strategy

Stage 1: Short-Run Pass-Through Rate ρ

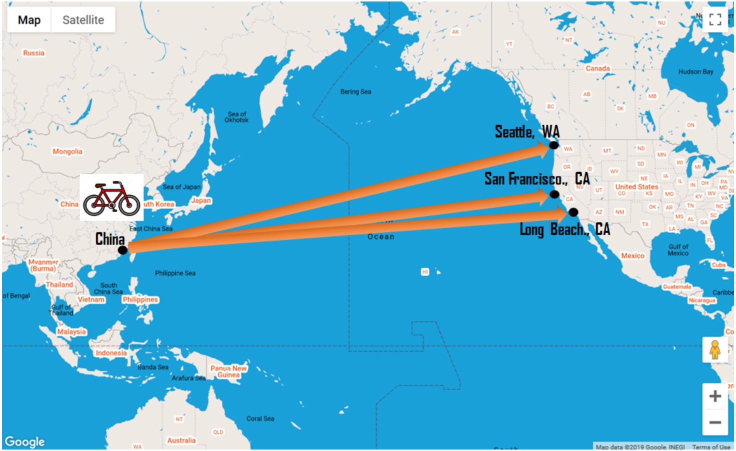


$$P_{od}^{k,c} = \rho_o^{k,c} P_o^{k,c} + \sum_d (\gamma_{od}^{k,c} + \gamma_{od}^{k,c} t) + \epsilon_{od}^{k,c} \tag{10}$$

Back | Estimation Details - Stage 1

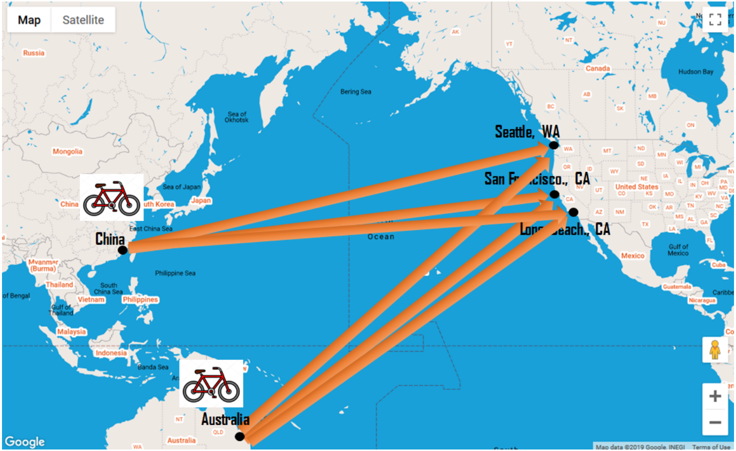
Mapping: Estimation Strategy

Stage 2: Adjusted Shipping Freight Rate



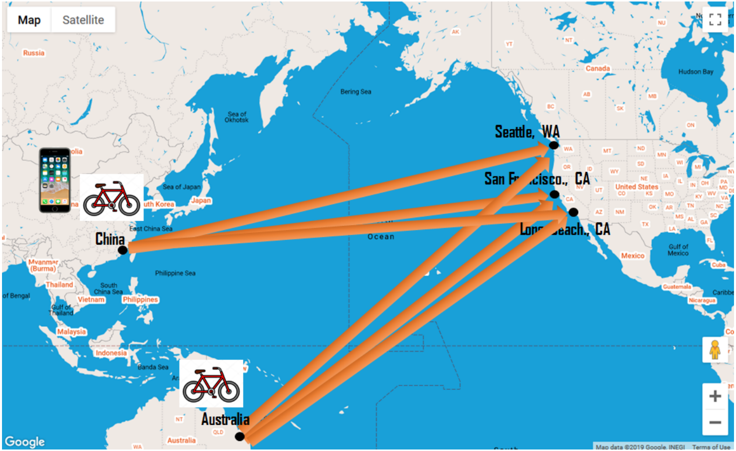
Mapping: Estimation Strategy

Stage 2: Adjusted Shipping Freight Rate



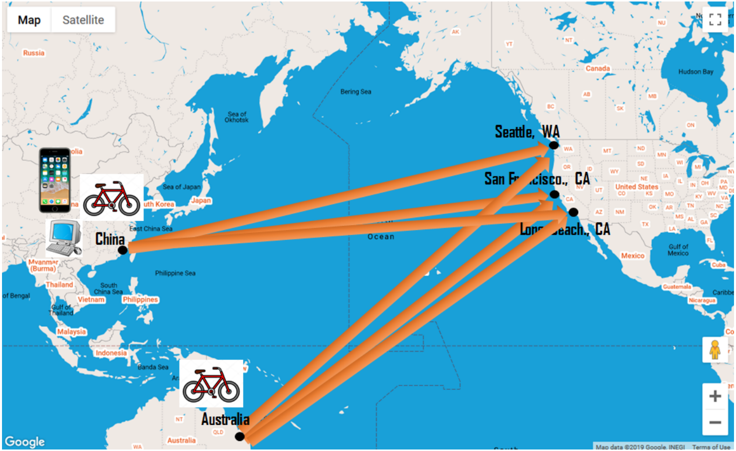
Mapping: Estimation Strategy

Stage 2: Adjusted Shipping Freight Rate



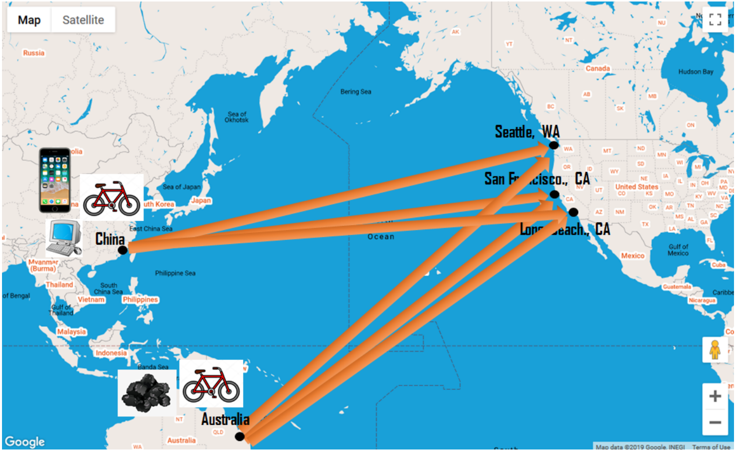
Mapping: Estimation Strategy

Stage 2: Adjusted Shipping Freight Rate



Mapping: Estimation Strategy

Stage 2: Adjusted Shipping Freight Rate



Mapping: Estimation Strategy

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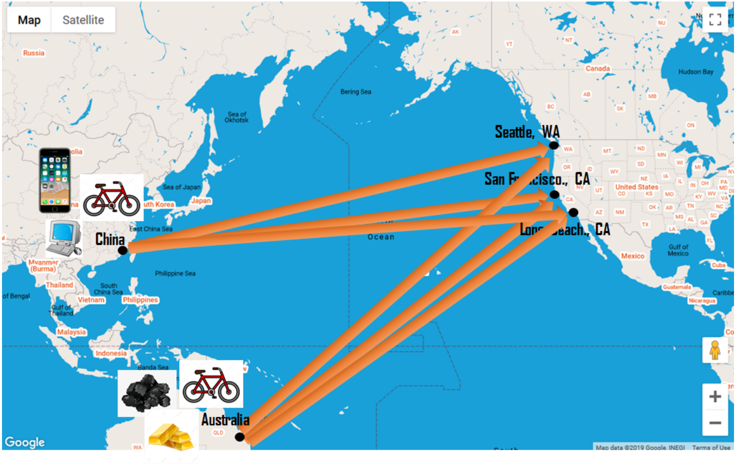
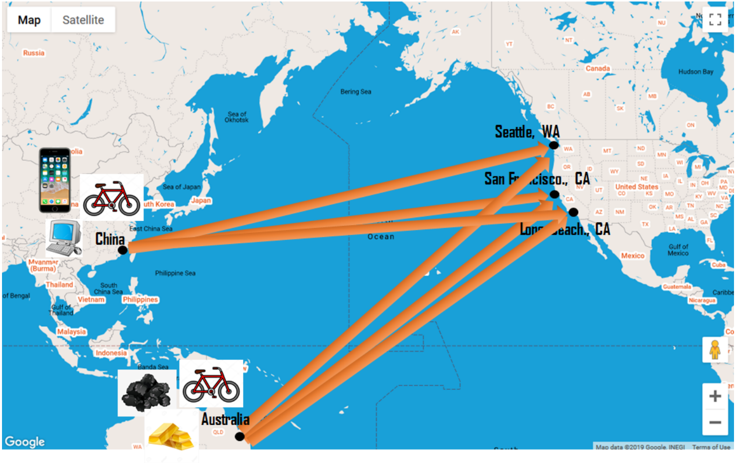


Mapping: Estimation Strategy

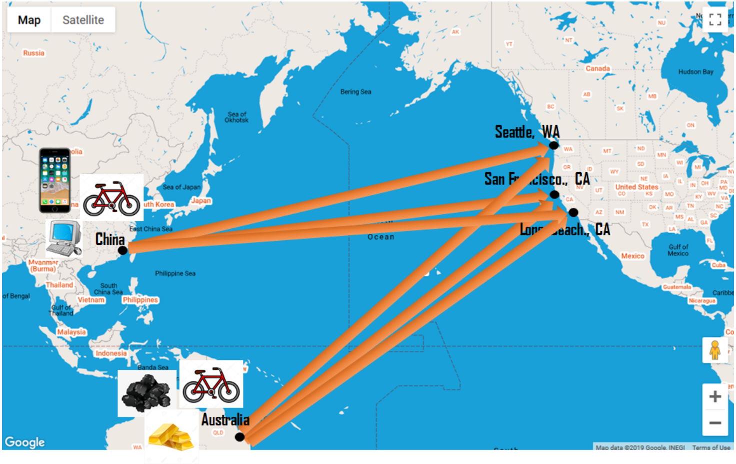
Stage 2: Adjusted Shipping Freight Rate



$$P_{od}^{k,c} = \widehat{\rho_o^{k,c}} P_o^{k,c} + \widehat{\rho_o^{k,c}} c^{\ell}(\chi_r^k) + (1 - \widehat{\rho_o^{k,c}}) a_{od}^{k,c} \tag{11}$$

Mapping: Estimation Strategy

Stage 2: Adjusted Shipping Freight Rate



$$\frac{P_{od}^{k,c} - \widehat{\rho_o^{k,c}} P_o^{k,c}}{\widehat{\rho_o^{k,c}} P_o^{k,c}} = T^{\ell}(\chi_r^{k,c}) + \frac{(1 - \widehat{\rho_o^{k,c}})}{\widehat{\rho_o^{k,c}} P_o^{k,c}} a_{od}^{k,c}$$

Back | Estimation Details - Stage 2

Estimation Strategy

Estimation – Maritime Shipping Carriers Mark-Ups - μ

Given that the optimal pricing-rule is equal to:

$$f_r^{\ell,k} = \rho_r^k c^\ell(\chi_r^k) + (1-\rho_r^k)(a_{od}^k - P_o^k) \tag{12}$$

Maritime shipping mark-ups are calculated as a standard Lerner Index:

$$\begin{aligned} \mu_r^{\ell,k} &= \frac{f_r^{\ell,k} - \widehat{c^\ell(\chi_r^k)}}{f_r^{\ell,k}} \\ &= \frac{(1-\widehat{\rho_o^{k,c}})(\widehat{a_{od}^{k,c}} - (1+\widehat{T^\ell(\chi_r^{k,c}}))P_o^{k,c})}{P_{od}^{k,c} - P_o^{k,c}} \end{aligned} \tag{13}$$

Results

Results

Short-Run Pass Through Rate ρ

	U.S. East Coast								
	2002-2007			2008-2012			2013-2017		
	OLS	2SLS	GC	OLS	2SLS	GC	OLS	2SLS	GC
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Mean	1.09	1.10	1.42	1.07	1.14	1.10	1.06	1.10	1.16
Median	1.02	1.02	1.01	1.02	1.01	1.01	1.01	1.01	1.01
Std Deviation	1.30	2.04	31.98	1.22	4.23	2.73	0.77	3.55	9.78
Percentile 1%	0.59	0.49	0.43	0.60	0.49	0.44	0.62	0.51	0.46
Percentile 99%	2.00	2.26	2.71	1.94	2.36	2.54	1.91	2.26	2.47
Number Obs.	44,555	42,966	55,212	39,642	37,474	48,578	42,914	41,400	52,277

	U.S. West Coast								
	2002-2007			2008-2012			2013-2017		
	OLS	2SLS	GC	OLS	2SLS	GC	OLS	2SLS	GC
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Mean	1.09	1.10	1.11	1.06	1.36	1.06	1.12	1.14	1.13
Median	1.02	1.02	1.01	1.01	1.01	1.00	1.01	1.01	1.00
Std Deviation	1.77	1.85	3.14	1.73	41.62	1.73	8.86	9.09	8.61
Percentile 1%	0.58	0.51	0.46	0.58	0.52	0.44	0.61	0.51	0.46
Percentile 99%	1.90	2.11	2.30	1.78	2.07	2.09	1.81	2.11	2.14
Number Obs.	27,971	26,992	31,823	24,398	23,112	27,520	25,603	24,673	28,819

Estimates - HS10

Results cont'd

Adjusted Ad-Valorem Freight Rates Function

	U.S. East Coast			U.S. West Coast		
	2002-2007	2008-2012	2013-2017	2002-2007	2008-2012	2013-2017
	(1)	(2)	(3)	(4)	(5)	(6)
log (Distance)	0.0342***	-0.00438	-0.00248	-0.0365**	-0.00633	0.0363
	(0.00446)	(0.00861)	(0.00421)	(0.0152)	(0.0244)	(0.0313)
log (Oil Price)	0.0325***	-0.0219	-0.0327***	-0.0545*	0.0300	0.117
	(0.00837)	(0.0179)	(0.00766)	(0.0315)	(0.0490)	(0.0764)
log (Distance) $\times$ log (Oil Price)	-0.00299***	0.00385**	0.00366***	0.00614*	-0.00210	-0.0123
	(0.000899)	(0.00189)	(0.000826)	(0.00338)	(0.00526)	(0.00816)
log (Weight/Value)	0.0120***	0.00817***	0.00827***	0.0111***	0.0112***	0.00976***
	(0.000743)	(0.00103)	(0.000689)	(0.000933)	(0.000901)	(0.00124)
log (Vol. Route)	-0.00135***	-0.00113***	-0.000934***	-0.000996**	-0.00161***	-0.000151
	(0.000249)	(0.000230)	(0.000228)	(0.000387)	(0.000471)	(0.00118)
log (Vol. Destination Port)	-0.00356***	-0.00304***	-0.00289***	-0.00356***	-0.00201***	-0.00385***
	(0.000369)	(0.000374)	(0.000296)	(0.000429)	(0.000524)	(0.000965)
constant	-0.0871**	0.187**	0.226***	0.630***	0.243	-0.0897
	(0.0404)	(0.0798)	(0.0388)	(0.141)	(0.228)	(0.277)
N	873,922	700,917	778,280	296,375	231,678	244,074
R-sq	0.996	0.993	1.000	1.000	0.999	0.995

Standard errors in parenthesis clustered by product-origin country, product-year and product-U.S. customs district of entry.

*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$

Note: these model excludes the imports of oil and related products, pooled on the HS2 digit-code sector 27.

Results cont'd

Average % Maritime Shipping Mark-ups in U.S. imports Freight Charges

U.S. East Coast

	2002-2007	2008-2012	2013-2017
	(1)	(2)	(3)
Gaussian Copula	43.4	38.2	34.1
OLS	86.6	71.0	71.5
2SLS	83.0	67.6	61.3

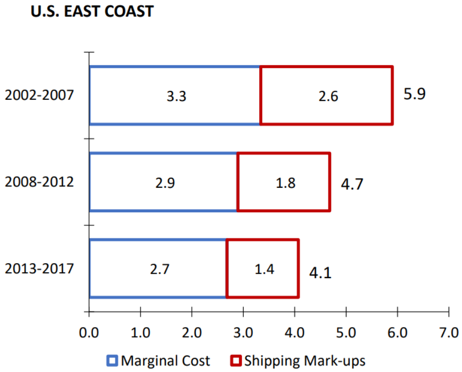
U.S. West Coast

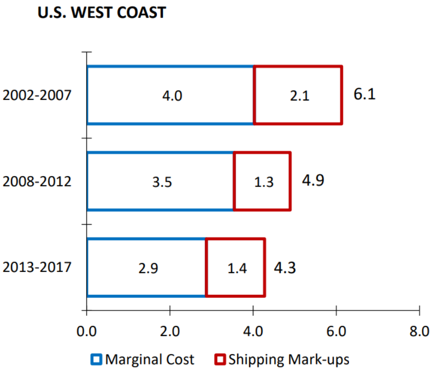
	2002-2007	2008-2012	2013-2017
	(4)	(5)	(6)
Gaussian Copula	34.2	27.5	32.7
OLS	74.7	77.7	74.5
2SLS	48.9	65.0	65.9

Estimates - HS10

Results - cont'd

Composition of Ad-Valorem % Maritime Shipping Freights





Determinants of Shipping Mark-ups

2002-2007 2008-2012 2013-2017

Results - cont'd

Potential U.S. Import Growth without Shipping Mark-Ups for Differentiated Products

Assumed Trade Elasticity (σ)	2002-2007	2008-2012	2013-2017
$\sigma = 3$	7.0%	4.7%	4.2%
$\sigma = 5$	11.6%	7.8%	7.0%

Results - cont'd

Cost of Maritime Shipping Mark-ups for Welfare (% of GDP)

Change in welfare $\widehat{W}$ is estimated as follows, using Arkalokis et al. (2012)

$$\widehat{W} = \lambda_{mark-ups}^{-1/\epsilon} - \lambda_{NOmark-ups}^{-1/\epsilon} \tag{14}$$

where:

- λ is the share on the domestic expenditure (about 84% to 87% in the U.S.)
- ϵ is the trade elasticity

Assumed Trade Elasticity (σ)	2002-2007	2008-2012	2013-2017
$\sigma = 3$	0.20%	0.13%	0.14%
$\sigma = 5$	0.20%	0.13%	0.14%

Conclusions

- As a qualitative matter, it widely known that non-competitive pricing behavior in the maritime shipping industry raises the cost of freight [Hoffmann and Kummar, 2013; UNCTAD, 2017].
- This paper quantifies the effect of the non-competitive pricing behavior in the maritime shipping on the freight cost.
- Main takeaways:
  - Freight mark-ups represent 1/3 of the *ad-valorem* freight rates, equivalent to an *ad-valorem* tariff of 1.4%-2.6%.
  - U.S imports of differentiated products would be 4% to 12% higher in without maritime shipping mark-ups
  - The cost in terms of welfare of shipping mark-up is 0.1%-0.2% of consumers' real income.
  - Maritime shipping mark-ups disproportionately affect developing and remote countries

Questions

Motivation - cont'd

% Acum. Share of Shipping Routes Attended per Number of Carriers

	2006	2008	2010	2012	2014	2016
0 carriers	0.0	0.0	0.0	0.5	0.0	0.0
1 carrier	26.5	27.5	32.2	20.0	17.1	14.6
2 carries	50.6	50.3	57.1	37.4	33.8	33.4
3 carriers	64.1	66.4	71.4	51.8	49.6	46.9
4 carriers	76.9	76.2	79.8	64.9	65.0	61.1
5 carriers	83.1	82.7	84.7	71.0	73.8	69.6
10 carriers	95.2	95.4	96.2	90.9	90.1	90.1

Note: These shares specifically correspond to carriers shipping containerized products.

Source: Own calculations using data from UNCTAD (2017).

Motivation

Motivation - cont'd

Median Number of Carriers Shipping Containerized Products per Country

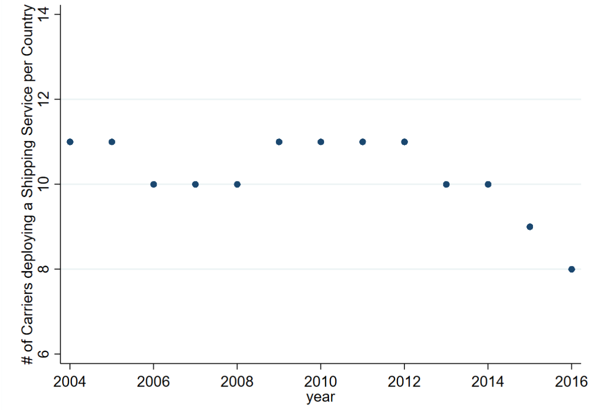


Figure 7: Source: Own calculations using data from UNCTAD(2017)

Motivation

Estimation Strategy in Detail - Stage 1

Stage 1: Two Stage Method of Atkin and Donaldson (2015)

$$P^k_{od} = \rho^k_r P^k_o + \rho^k_r c^{\ell}(\chi^k_r) + (1 - \rho^k_r) a^k_{od} \tag{15}$$

where

- terms in blue are unobservable.
- To solve this problem, I use fixed effects approach following AD.

The final specification estimated for each combination product k-origin country o-U.S. coast c:

$$P^{k,c}_{od} = \rho^{k,c}_o P^{k,c}_o + \sum_d (\gamma^{k,c}_{od} + \gamma^{k,c}_{od} t) + \epsilon^{k,c}_{od} \tag{16}$$

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Estimation Strategy in Detail - Stage 1

Econometric Strategy for estimating ρ

- The FOB prices ($P_o^{k,c}$) used to estimate ρ are likely endogenous to the freight charges.

- To investigate this possibility, three set of ρ's are estimated using a:
  1. OLS approach as in AD (2015)
  2. 2SLS approach, considering as IVs: (1) GDP pc, (2) U.S. tariffs, (3) WES, and (4) RCA.
  3. Gaussian Copula method, and instrument free technique.

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Estimation Strategy in Detail - Stage 1

Gaussian Copula (GC) method

- The endogeneity bias is corrected, using the joint distribution between an endogenous variable and the residuals of the estimation $\rightarrow f(P_o^{k,c}, \epsilon_{od}^{k,c})$.
  - Using non-parametric techniques and applying Gaussian copulas, this distribution is modeled a standard bivariate normal $f(P_o^{k,c^*}, \epsilon_{od}^{k,c^*})$ with correlation ϱ.

- Exploiting the orthogonality between the variation of these variables ω (similar to Feenstra (1994)), the endogeneity is removed.

- The predicted joint distribution can be written as:

$$\begin{pmatrix} P_o^{k,c^*} \\ \epsilon_{od}^{k,c^*} \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ \varrho & \sqrt{1-\varrho^2} \end{pmatrix} \begin{pmatrix} \omega_{p^*} \\ \omega_{\epsilon^*} \end{pmatrix}, \begin{pmatrix} \omega_{p^*} \\ \omega_{\epsilon^*} \end{pmatrix} \sim N\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \right)$$

such that the this method actually estimates the following modified version of the oprimal price condition .

$$P_{od}^{k,c} = \rho_o^{k,c} P_o^{k,c} + \sum_d (\gamma_{od}^{k,c} + \gamma_{od}^{k,c} t) + \sigma_\epsilon \varrho P_{od}^{k,c^*} + \sigma_\epsilon \sqrt{1-\varrho^2}\omega_\epsilon \qquad (17)$$

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Estimation Strategy in Detail - Stage 2

Stage 2: Two Stage Method of Atkin and Donaldson (2015)

Rearranging terms in the optimal price rule condition, an adjusted expression for the freight rate is given by:

$$\frac{P_{od}^{k,c} - \widehat{\rho_o^{k,c}} P_o^{k,c}}{\widehat{\rho_o^{k,c}} P_o^{k,c}} = T^{\ell}(\chi_r^{k,c}) + \frac{(1 - \widehat{\rho_o^{k,c}})}{\widehat{\rho_o^{k,c}} P_o^{k,c}} a_{od}^{k,c} \tag{18}$$

where

- terms in blue blue are unobservable
- $c^{\ell}(\chi_r^k)$ is assumed *ad valorem* equal to $P_o^{k,c} \times \; T^{\ell}(\chi_r^{k,c})$ and modelled with a parametric function to solve this problem:

$$T^{\ell}(\chi_r^{k,c}) = \kappa_o^{s,c} + \theta_1 ln(DIST_r^c) + \theta_2 ln(POil_t) + \\ + \theta_3 \left[ln(DIST_r^c) \times ln(POil_t) \right] + \theta_4 ln(WV_{rt}^{k,c}) + \theta_5 ln(V_{rt}^c) + \theta_6 ln(VH_{dt}^c) \tag{19}$$

- I use fixed effects approach to control for the variation on the pairs product-time, product-destination and product-origin.

$$a_{od}^{k,c} = \alpha_t^{k,c} + \alpha_d^{k,c} + \alpha_o^{k,c} + \upsilon_{od}^{k,c} \tag{20}$$

Determinants of Shipping Mark-ups

Do Developing and/or Remote Countries pay higher Shipping Mark-Ups? 2002-2007

	2002-2007					
	Freight Rate		Mark-ups			
	Ad Valorem		*Ad Valorem*		Equivalent Tariff	
	(1)	(2)	(3)	(4)	(5)	(6)
log GDP per capita	-0.154***		0.00341		-0.151***	
	(0.00165)		(0.00209)		(0.00235)	
log Distance	0.231***		-0.0607***		0.170***	
	(0.00461)		(0.00589)		(0.00635)	
log σ		-0.0586***		-0.00162		-0.0603***
		(0.0124)		(0.00625)		(0.0146)
_cons	0.881***	1.591***	4.622***	4.095***	0.897***	1.081***
	(0.0484)	(0.00973)	(0.0630)	(0.00347)	(0.0675)	(0.0128)
N	896,701	668,898	896,701	668,898	896,701	668,898
R-sq	0.313	0.073	0.136	0.018	0.329	0.071
FE: Destination	N	Y	N	Y	N	Y
FE: Year	N	Y	N	Y	N	Y
FE: Origin	N	Y	N	Y	N	Y
FE: Product & Destination	Y	N	Y	N	Y	N
FE: Product & Time	Y	N	Y	N	Y	N

Standard errors in parenthesis clustered by product-time and product-U.S customs district of entry in columns with an odd number. Standard errors clustered by origin, U.S. customs district of entry and year in columns with an even number.

*p $<$ 0.1, **p $<$ 0.05, ***p $<$ 0.01

Note: *Ad valorem* freight rate is calculated as the ratio cost of freight to imports FOB value. *Ad valorem* mark-ups is calculated as the ratio estimated mark-ups to cost of freight. The equivalent tariff to the estimated mark-ups is calculated to the ratio estimated mark-ups to imports FOB value.

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Determinants of Shipping Mark-ups - cont'd

Do Developing and/or Remote Countries pay higher Shipping Mark-Ups? 2008-2012

	2008-2012					
	Freight Rate		Mark-ups			
	Ad Valorem		*Ad Valorem*		Equivalent Tariff	
	(7)	(8)	(9)	(10)	(11)	(12)
log GDP per capita	-0.161***		0.0272***		-0.134***	
	(0.00236)		(0.00283)		(0.00308)	
log Distance	0.192***		-0.0479***		0.144***	
	(0.00581)		(0.00716)		(0.00745)	
log σ		-0.0484**		0.00602		-0.0424**
		(0.0128)		(0.00843)		(0.0127)
constant	1.100***	1.342***	4.265***	4.074***	0.760***	0.811***
	(0.0649)	(0.00945)	(0.0804)	(0.00606)	(0.0820)	(0.00967)
N	683,896	491,701	683,893	491,698	683,893	491,698
R-sq	0.285	0.054	0.141	0.021	0.316	0.059
FE: Destination	N	Y	N	Y	N	Y
FE: Year	N	Y	N	Y	N	Y
FE: Origin	N	Y	N	Y	N	Y
FE: Product & Destination	Y	N	Y	N	Y	N
FE: Product & Time	Y	N	Y	N	Y	N

Standard errors in parenthesis clustered by product-time and product-U.S customs district of entry in columns with an odd number. Standard errors clustered by origin, U.S. customs district of entry and year in columns with an even number.

*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$

Note: *Ad valorem* freight rate is calculated as the ratio cost of freight to imports FOB value. *Ad valorem* mark-ups is calculated as the ratio estimated mark-ups to cost of freight. The equivalent tariff to the estimated mark-ups is calculated to the ratio estimated mark-ups to imports FOB value.

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Determinants of Shipping Mark-ups - cont'd

Do Developing and/or Remote Countries pay higher Shipping Mark-Ups? 2013-2017

	2013-2017					
	Freight Rate		Mark-ups			
	Ad Valorem		*Ad Valorem*		Equivalent Tariff	
	(13)	(14)	(15)	(16)	(17)	(18)
log GDP per capita	-0.148***		0.0388***		-0.110***	
	(0.00273)		(0.00326)		(0.00339)	
log Distance	0.190***		-0.0763***		0.114***	
	(0.00619)		(0.00834)		(0.00737)	
log σ		-0.0635***		-0.00323		-0.0667**
		(0.0130)		(0.00972)		(0.0151)
constant	0.902***	1.246***	4.469***	4.127***	0.765***	0.768***
	(0.0701)	(0.00974)	(0.0930)	(0.00641)	(0.0837)	(0.0124)
FE: Destination	N	Y	N	Y	N	Y
FE: Year	N	Y	N	Y	N	Y
FE: Origin	N	Y	N	Y	N	Y
FE: Product & Destination	Y	N	Y	N	Y	N
FE: Product & Time	Y	N	Y	N	Y	N

Standard errors in parenthesis clustered by product-time and product-U.S customs district of entry in columns with an odd number. Standard errors clustered by origin, U.S. customs district of entry and year in columns with an even number.

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Note: *Ad valorem* freight rate is calculated as the ratio cost of freight to imports FOB value. *Ad valorem* mark-ups is calculated as the ratio estimated mark-ups to cost of freight. The equivalent tariff to the estimated mark-ups is calculated to the ratio estimated mark-ups to imports FOB value.

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Robustness - Short Run Pass-Through Rates

Summary Statistics - Short Run Pass Through-Rate ρ (HS6 digit-code vs HS10 digit-code, Gaussian Copula Estimates)

U.S. East Coast				
	2002-2007		2013-2017	
	HS6	HS10	HS6	HS10
	(1)	(2)	(5)	(6)
Mean	1.42	1.56	1.16	1.38
Median	1.01	1.01	1.01	1.01
Std Deviation	31.98	53.42	9.78	31.79
Percentile 1%	0.43	0.39	0.46	0.40
Percentile 99%	2.71	2.98	2.47	2.71
Number Obs.	55,212	107,719	52,277	103,990

U.S. West Coast				
	2002-2007		2013-2017	
	HS6	HS10	HS6	HS10
	(1)	(2)	(5)	(6)
Mean	1.11	1.36	1.13	1.13
Median	1.01	1.01	1.00	1.00
Std Deviation	3.14	47.99	8.61	8.27
Percentile 1%	0.46	0.43	0.46	0.44
Percentile 99%	2.30	2.36	2.14	2.36
Number Obs.	31,823	60,813	28,819	55,637

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Robustness - Shipping Mark-ups

Median Maritime Shipping Mark-up - % of Maritime Shipping Freight (HS6 digit-code vs HS10 digit-code, Gaussian Copula Estimates)

	U.S. East Coast		U.S. West Coast	
	2002-2007	2013-2017	2002-2007	2013-2017
	(1)	(2)	(3)	(4)
HS6 digit-code	43.4	34.1	34.2	32.7
HS10 digit-code	38.0	28.2	37.9	30.1

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