

# Export Prices of U.S. Firms

James Harrigan<sup>1</sup>   Xiangjun Ma<sup>2</sup>   Victor Shlychkov

<sup>1</sup>University of Virginia, Sciences Po, and NBER

<sup>2</sup>University of International Business and Economics (UIBE)

National Bank of Belgium, 5 October 2012

# Export price heterogeneity

- Lots of product-level evidence shows that traded goods prices vary tremendously
  - For a given importing country, across source countries for imports (Schott 2004)
  - For a given exporting country, across export markets (Hummels and Skiba 2004, Baldwin and Harrigan 2011)
  - Baldwin and Harrigan (2011) find U.S. export prices increase strongly with distance, decrease with market's size and remoteness.

# Export price heterogeneity

- Why would product-level export prices vary across destinations?
  - Arithmetically, some mix of composition (different firm market shares in different destinations) and price discrimination (different prices by same firm across destinations).
  - Explanation must involve firm heterogeneity.
  - To disentangle mix, need firm-level data.
- Who cares? implications for
  - Trade theory: how do exporters compete?
  - Implications for measurement of international prices

# Export price heterogeneity

- Summary of our findings
  - Data: U.S. firm-level exports, manufacturing firm characteristics, country characteristics
  - Focus on firm $\times$ product export prices across export destinations
  - Correct for selection into export markets
  - Product-level correlations of export prices with country characteristics mainly due to composition, not price discrimination
  - Export prices slightly higher for larger and richer markets, and substantially higher for markets other than Canada and Mexico
  - Export prices higher for more productive, skill intensive firms, lower for capital intensive firms

# Export price heterogeneity

- Implications for trade theory
  - Composition explanation based on models of heterogeneous firms where stronger firms charge higher prices than weaker firms, instead of lower.
  - Consistent with models of heterogeneous firms and quality competition (Verhoogen 2008, Kugler and Verhoogen forthcoming, Hallak and Sivadasan 2009, Johnson 2010, Baldwin and Harrigan 2011).

# Export price heterogeneity

- Implications for measurement of international prices
  - Recent macro models incorporate extensive margin of trade (Ghironi and Melitz 2005, Feenstra, Obstfeld, Russ 2009).
  - Implications for observed prices depend on mode of competition: if firms compete on quality rather than price, entry lowers observed price indexes at margin.

# Data

- U.S. firm-level HS10 exports in 2002
  - Confidential, analyzed at Census Research Data Center in New York and North Carolina
  - Data pioneered by Bernard, Jensen, Schott (2005), Bernard, Jensen, Redding, Schott (2007)
  - Firm-level export data aggregated up from transaction-level
  - Value, quantity, intra-firm or arm's-length, export destination, date, transportation mode

# How much export price variation?

- Within HS10 product codes exported by U.S. firms in 2002, how much price variation?
- standard deviation of log prices across firms and destinations = 1.52
- With normality, implies 90-10 ratio = 48.



# How much export price variation?

- How much of variation due to variance across firms?
- standard deviation of log prices within firms, across destinations = 0.71
- With normality, implies 90-10 ratio = 6.
- Most of variation is across firms, but within firm variation too big to be price discrimination.

# What is a product?

examples of HS10 product categories

- 8703.10.50.30      Golf carts
- 8708.30.50.20      Brake drums
- 8501.10.60.20      Small electric motors, alternating current
- 9006.53.01.10      35mm film cameras, with built in flash

Within a firm-HS10, clearly much room for different products.

# Export price decomposition across destinations

- Average price of product exported to destination  $d$ , a quantity-weighted average of prices charged by all  $N_d$  firms  $f$  that export to  $d$ ,

$$\bar{p}_d = \sum_{f=1}^N w_{fd} p_{fd}, \quad w_{fd} = \frac{q_{fd}}{\sum_{g=1}^N q_{gd}}$$

- $p_{fd}$  and  $q_{fd}$  are price and quantity of good sold by  $f$  in  $d$ ,  $N$  is number of exporting firms selling the good, weight  $w_{fd}$  is firm  $f$ 's quantity market share in market  $d$ .

# Export price decomposition across destinations

- Difference in average prices between destination  $d$  and the world average for any good is

$$\bar{p}_d - \bar{p} = \underbrace{\sum_{f=1}^N (p_{fd} - \bar{p}_f) \bar{w}_f}_{\text{price discrimination}} + \underbrace{\sum_{f=1}^N (w_{fd} - \bar{w}_f) \bar{p}_f}_{\text{market share}} + \underbrace{\sum_{f=1}^N (w_{fd} - \bar{w}_f)(p_{fd} - \bar{p}_f)}_{\text{interaction}}$$

- If firms charge same price in all destinations, first and third summations in zero, and  $\bar{p}_d$  will differ only because of differences in the quantities sold.
- More generally,  $\bar{p}_d$  will differ if firms charges different prices in different destinations.

# Export price decomposition across destinations

## ● Data

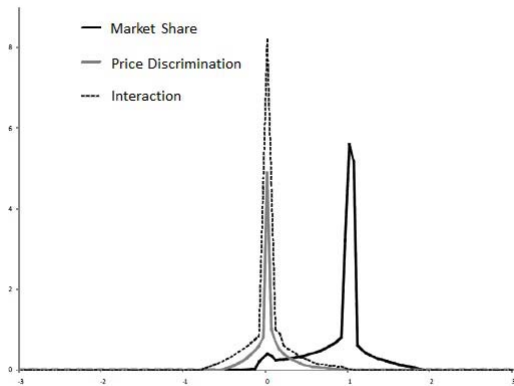
- U.S. firm-level HS10 exports in 2002
- Confidential, analyzed at Census Research Data Center in New York and North Carolina
- Data pioneered by Bernard, Jensen, Schott (2005), Bernard, Jensen, Redding, Schott (2007)
- Firm-level export data aggregated up from transaction-level
- Value, quantity, intra-firm or arm's-length, export destination, date, transportation mode

# Export price decomposition across destinations

- Quantiles

Percentile	Price Discrimination	Market Share	Interaction
0.05	-0.416	-0.552	-1.680
0.10	-0.053	-0.003	-0.528
0.25	0.000	0.575	-0.003
0.50	0.000	1.000	0.000
0.75	0.057	1.000	0.276
0.90	0.536	1.336	0.854
0.95	1.107	2.072	1.568

# Export price decomposition across destinations



# Export prices and destination characteristics

- Firms enter a market if it is profitable. Conditional on observables, positive demand shock leads to
  - Greater probability of entry
  - Higher price
- Consistent estimation of effects of observables on prices must control for selection



# Export prices and destination characteristics

- Reduced form export volume equation, estimated across firms  $f$  and destinations  $d$

$$\ln y_{ifd} = \max[0, \alpha_{2i} + \delta X_d + u_{ifd}]$$

- $y_{ifd}$  is sales of product  $i$  by firm  $f$  in destination  $d$ .
- two-stage Heckman estimation of export volume equation

## Export prices and destination characteristics

- Fixed effects price equations, pooled across firms  $f$  destinations  $d$  products  $i$ , errors clustered by destination, selection correction term  $\hat{u}_{ifd}$  from export volume equation

- Product fixed effects

$$\ln p_{ifd} = \alpha_{1i} + \beta X_d + \gamma \hat{u}_{ifd} + \varepsilon_{ifd}$$

- Product  $\times$  firm fixed effects

$$\ln p_{ifd} = \alpha_{1if} + \beta X_d + \gamma \hat{u}_{ifd} + \varepsilon_{ifd}$$

- Generalization of two-stage estimator from Wooldridge (1995). Price equations identified even without exclusion restriction. Intuition:  $\hat{u}_{ifd}$  contains information from  $\ln y_{ifd}$ , which is excluded from the final stage.

# Export prices and destination characteristics

- Country level data
- *Trade costs*: kilometers from Chicago to capital city of importer
- *Market size*: real GDP, real GDP per worker
- *Remoteness*: motivated by CES price level effects
 
$$R_d = \sum_{o=1}^C [Y_o d_{oc}^{-1}]^{-1}$$
- $Y_o$  real GDP in origin country  $o$ ,  $d_{oc}$  distance between  $o$  and  $c$

# Export prices and destination characteristics

- Product fixed effects/product  $\times$  firm fixed effects, all countries, OLS with/without selection correction. Standard errors clustered at the country level appear in parentheses.

	Simple OLS		Selection Correction	
	Product FE	Firm-Product FE	Product FE	Firm-Product FE
log distance	<b>0.263***</b> (0.016)	<b>0.195***</b> (0.021)	<b>0.248***</b> (0.016)	<b>0.168***</b> (0.021)
log real GDP	0.027** (0.011)	-0.020*** (0.007)	<b>0.036***</b> (0.011)	<b>-0.004</b> (0.008)
log real GDP/worker	0.079*** (0.025)	-0.017 (0.016)	<b>0.093***</b> (0.025)	<b>0.010</b> (0.015)
log remoteness	-2.495*** (0.347)	-1.343*** (0.191)	-2.365*** (0.336)	<b>-1.183***</b> (0.184)
$R^2$ (within)	0.030	0.015	0.035	0.019

# Destination Market Characteristics

	Simple OLS		Selection Correction	
	Product FE	Firm-Product FE	Product FE	Firm-Product FE
1<km≤4,000	<b>0.326***</b> (0.111)	<b>0.386***</b> (0.093)	<b>0.204</b> (0.133)	<b>0.261**</b> (0.105)
4,000<km≤7,800	<b>0.584***</b> (0.091)	<b>0.485***</b> (0.091)	<b>0.323**</b> (0.139)	<b>0.239**</b> (0.115)
7,800<km≤14,000	<b>0.603***</b> (0.095)	<b>0.493***</b> (0.089)	<b>0.339**</b> (0.144)	<b>0.248**</b> (0.115)
14,000<km	<b>0.632***</b> (0.084)	<b>0.473***</b> (0.088)	<b>0.390***</b> (0.131)	<b>0.248**</b> (0.111)
log real GDP	0.039*** (0.013)	-0.010* (0.005)	<b>0.100***</b> (0.018)	<b>0.046***</b> (0.009)
log real GDP/worker	0.046	-0.006	<b>0.126***</b>	<b>0.071***</b>
...	...	...	...	...

# Export prices and destination characteristics

- Four other studies estimate effects of distance on firm-level export prices. How do our results compare?

	log distance
United States	0.168*** (0.021)
China	0.010*** (0.002)
France	0.050*** (0.010)
Portugal	0.053*** (0.013)
Hungary	0.056** (0.023)

# Export prices and firm characteristics

- Reduced form export volume equation

$$\ln y_{ifd} = \max[0, \alpha_{2i} + \delta_{1i}X_d + \delta_{2i}X_f + u_{ifd}]$$

- Product fixed effects

$$\ln p_{ifd} = \alpha_{1i} + \beta X_d + \beta X_f + \gamma \hat{u}_{ifd} + \varepsilon_{ifd}$$

- Destination-product fixed effects

$$\ln p_{ifd} = \alpha_{1id} + \beta X_f + \gamma \hat{u}_{ifd} + \varepsilon_{ifd}$$

# Export prices and firm characteristics

- Firm level data
  - 2002 Census of Manufactures.
  - value of shipments, employment, production and nonproduction workers, cost of materials, 6-digit NAICS.
  - Annual Survey of Manufactures data 1991 to 2002 to construct capital stocks.
  - firm-level productivity computed a la Olley-Pakes (1996)



# Firm Characteristics

	Simple OLS	Selection Correction
log TFP	<b>0.342***</b> (0.048)	<b>0.350***</b> (0.048)
log S/L	<b>0.162***</b> (0.011)	<b>0.163***</b> (0.011)
log K/L	<b>-0.072***</b> (0.011)	<b>-0.083***</b> (0.011)
log total employment	<b>-0.007</b> (0.004)	<b>-0.009**</b> (0.004)
$R^2$ (within)	0.011	0.018
N	684,000	643,000

# Export price heterogeneity: conclusions

- First to analyze firm-level data on export pricing decisions of U.S. exporters.
- Three-stage panel Tobit estimator to control for firm selection into different export markets.
- Findings
  - ① more productive and skill intensive firms charge higher prices, capital intensive firms charge lower prices
  - ② the very large correlation between distance and export prices found by Baldwin and Harrigan (2011) is due to a composition effect
  - ③ U.S. firms charge slightly higher prices to larger and richer markets, and substantially higher prices to markets other than Canada and Mexico