Spatial Price Discrimination in International Markets: from Models to Data

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Plan

Motivations

- *At the product level*, *fob* unit values increase with the distance. [Baldwin & Ito (2008), Mayer & Ottaviano (2008), Hummels & Klenow (2002), Schott (2004)]
- Existing models failed to predict this positive relationship.
- Theoretical explanation : quality composition effects. [Baldwin & Harrigan (2007), Hummels & Skiba (2002)]

- What happens *at the firm level*? *i.e.* How does the distance impact *fob* trade prices ?
- Theory : all is possible so which are the key determinants ?
- Empirically : we don't know, so what about French exporters.

About firm pricing policy and distance

- Spatial price discrimination : a well known behavior.
- International markets : countries are segmented and distance matters.
- *fob* data to get rid of country specific retail margins or taxes.
- Strategies :
  - Mill pricing (constant *fob* price)
  - Dumping (*fob* price decreases with the distance)
  - Reverse dumping (*fob* price increases with the distance)

Contributions and Results

- Pricing policy (theory) : formulation of transport costs matters.
- Pricing policy (empiric) : evidence from French exporters.
  $\Rightarrow$ **Reverse Dumping** (prices increase with the distance)
- Pricing policy (back to theory) : existing models fail to predict this relationship, even when introducing quality.
- Pricing policy (back to theory) : we need an additive part in the trade costs.
  Rightarrow bad news for the iceberg cost.

Related literature

- IO : mill pricing, dumping and reverse dumping might appear. All depend on the preferences. [Hoover (1937)]
- Trade : dumping in a few (but important) models.
  [Brander & Krugman (1983), Melitz Ottaviano (2008)]
- Trade : mill pricing because CES and iceberg trade costs are more tractable.
  [Krugman (1980), Melitz (2003)]
- IO : Reverse dumping is possible ! [Greenhut et al. (1985)]

Related literature (Cont'd)

- Trade : iceberg vs additive transport costs [Samuelson (1954), Hummels & Klenow (2002)]
  "this is a major simplifying assumption" (Krugman, 1980)
- Empiric IO : spatial price discrimination is common practice [Greenhut (1981)]
- Pricing policy ? what about quality ?
  [Hallak & Sivadasan (2008), Verhoogen (2008)]

What I do

- Study iceberg, additive and 'mixed' trade costs .
- Derive the elasticity of price to distance depending on (i) the form of the preferences, (ii) the formulation of trade costs.
- Use firm level data to evaluate the role of distance on prices. (pooled sample and individual regressions)
- Discuss an alternative explanation : prices increase with the distance since quality increases with the distance.

What I don't do

- Model firm heterogeneity
- Model a transport sector
- Structural estimation

Plan

Iceberg transport cost

- Samuelson (1954) "*as only a fraction of ice exported reaches its destination*", only a fraction of the exported good reaches its destination.

$$p_{ij}^{cif} = \tau_{ij} p_{ij}^{fob} \ , \quad \tau \geq 1$$

- Drawbacks : i) technology ii) proportional to the price :

$$p_{cif} - p_{fob} = (\tau_{ij} - 1) p_{fob}$$

- $\Rightarrow$ Bottazzi & Ottaviano (1996) : "*we wonder whether the passive devotion to the iceberg approach is covering some of the most relevant issues that arise when trying to think realistically about the liberalization of world trade*"

Alternative trade costs

- Additive trade costs : Independent of the price, used with quasi linear demand

$$p_{ij}^{cif} = p_{ij}^{fob} + f_{ij}$$

- 'Mixed' trade costs :

$$p_{ij}^{cif} = p_{ij}^{fob}\tau_{ij} + f_{ij}$$

$$p_{ij}^{fob} = \frac{p_{ij}^{cif} - f_{ij}}{\tau_{ij}}$$

Distance and transport costs

- Distance is highly correlated with the transport costs (Lafourcade, 2006)
- Assumptions : f and τ two differentiable and increasing functions of the distances :

$$\begin{aligned} f : \Re_+ &\longrightarrow \Re_+ \\ dist &\longrightarrow f(dist) \\ \tau : \Re_+ &\longrightarrow [1, \infty[\\ dist &\longrightarrow \tau(dist) \end{aligned}$$

- τ and f are exogenous (for the producer).

Production side

- Profit function

$$\pi_{ij} = \left[p_{ij}^{fob} - w\right] q_{ij}$$

$$\Rightarrow \pi_{ij} = \left[\frac{p_{ij}^{cif} - f_{ij}}{\tau_{ij}} - w\right] q_{ij}$$

$$\Rightarrow p_{ij}^{cif} = \frac{\epsilon}{\epsilon - 1}[f_{ij} + w\tau_{ij}]$$

$$\Rightarrow p_{ij}^{fob} = \left(\frac{1}{\epsilon^{cif} - 1}\right)\frac{f_{ij}}{\tau_{ij}} + \left(\frac{\epsilon^{cif}}{\epsilon^{cif} - 1}\right) w$$

- ϵ is the elasticity of demand to *cif* price.

Elasticity of price to distance

$$\underbrace{\frac{\partial log(p^{fob})}{\partial log(dist)}}_{elasticity\ of\ price\ to\ distance}) = \overbrace{\left[\frac{\partial log(f)}{\partial log(dist)} - \frac{\partial log(\tau)}{\partial log(dist)}\right] / \left[1 + \frac{\tau}{f}\epsilon c\right]}^{elasticity\ of\ trade\ costs\ to\ distance} - \underbrace{\left(\frac{\partial log(\epsilon)}{\partial log(dist)}\right)}_{elast.\ of\ elas.\ of\ dmd} \underbrace{\left(\frac{\epsilon}{\epsilon - 1}\right)\left(\frac{1}{\frac{f}{\tau} + \epsilon c}\right)\left(\frac{f}{\tau} + c\right)}_{positive\ term} \tag{1}$$

CES and Quadratic utility functions

Utility function	Trade costs	*fob* Price	elasticity	sign
CES	iceberg	$\frac{\sigma}{\sigma-1} w$	0	nil
CES	additive	$f_{ij} \frac{1}{\sigma-1} + \frac{\sigma}{\sigma-1} w$	$\frac{f_{ij}}{p_{ij}^{fob}} \frac{1}{\sigma-1}$	+
Quadratic	iceberg	$\frac{a+cP_j}{2\tau_{ij}(b+cN)} + \frac{1}{2} w$	$\frac{-1}{\tau_{ij} p_{ij}^{fob}} \frac{a+cP_j}{2(b+cN)}$	-
Quadratic	additive	$\frac{a+cP_j}{2(b+cN)} + \frac{1}{2} w - \frac{1}{2} f_{ij}$	$\frac{-1}{2} \frac{f_{ij}}{p_{ij}^{fob}}$	-

The CES case

- Elasticity of demand is constant ! !

$$p_{ij}^{fob} = \frac{1}{\sigma - 1}\frac{f_{ij}}{\tau_{ij}} + \frac{\sigma}{\sigma - 1}w$$

- elasticity :

$$\frac{\partial log(p^{fob})}{\partial log(dist)} = \left(\frac{\partial log(f)}{\partial log(dist)} - \frac{\partial log(\tau)}{\partial log(dist)}\right) / \left(1 + \frac{\tau\sigma w}{f}\right) \quad (2)$$

- iceberg case : $f = 0$

Elasticity to distance signs

additive part (f)	iceberg part (τ)	elasticity to distance
f=0	$\frac{\partial log(\tau)}{\partial log(dist)}>0$	0
$\frac{\partial log(f)}{\partial log(dist)} = 0$, $f > 0$	$\frac{\partial log(\tau)}{\partial log(dist)}>0$	-
$\frac{\partial log(f)}{\partial log(dist)} > 0$	$\tau=1$	+
$\frac{\partial log(f)}{\partial log(dist)} > 0$	$\frac{\partial log(\tau)}{\partial log(dist)}>0$	sign of $\frac{\partial log(f)}{\partial log(dist)} - \frac{\partial log(\tau)}{\partial log(dist)}$

Plan

- linear regression :
  $log(uv_{fkjt}) = \alpha log(dist_{fj}) + FE_{fkt} + controls + \epsilon_{fkjt}$

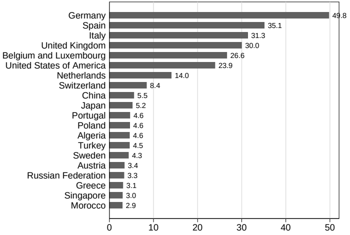
- by interval regressions :
  $log(uv_{fkjt}) = \beta D[1, 1500] + \gamma D[1500, 3000] + \eta D[3000, 6000] + \nu D[6000, ...] + FE_{fkt} + \epsilon_{fkjt}$

- market specificity controls (GDP, GDPC, mean uv, nb of French competitors..)
- non linearity (squared terms)
- clustered variance

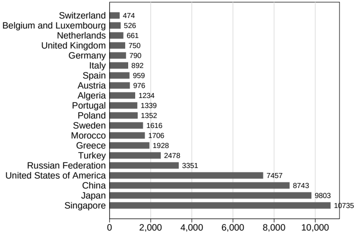
- French custom data : 305,661 firms, 13,507 CN8 products, over 1995-2005
- Value of French exports : 3,16 trillion euro
- Data : firm, CN8 product, destination country, year
- price proxy : unit value $p_{fjkt}^{fob} = \frac{v_{fjkt}^{fob}}{q_{fjkt}}$

- CEPII's distance measures (Mayer & Zignago)
- BACI, to compute mean unit values (Gaulier & Zignago)

Top 20 of French partners (2005)



Exports, (billions of Euro)



Distances in kilometers

Plan

Basic regression (FE regressions)

Dep. var.			Price (log)			
Dist.	0.030[a]	0.032[a]	0.032[a]	0.037[a]	0.041[a]	0.048[a]
	(54.33)	(43.47)	(27.28)	(62.73)	(53.05)	(35.79)
GDP				-0.004[a]	-0.004[a]	-0.001[c]
				(-9.76)	(-7.18)	(-1.82)
GDPc				0.017[a]	0.032[a]	0.026[a]
				(32.54)	(32.66)	(16.98)
Cons.	-0.001[a]	0.000	-0.009[a]	-0.001[b]	-0.005[a]	-0.009[a]
	(-2.61)	(0.87)	(-12.95)	(-2.27)	(-9.59)	(-13.59)
Obs.	14196464	10554957	6795574	14196464	10554957	6795574
R^2	0.002	0.003	0.002	0.003	0.004	0.002

Controlling for the mean uv (FE regressions)

Dep. var.	Price (log)					
Dist.	0.035[a]	0.013[a]	0.035[a]	0.013[a]	0.041[a]	0.026[a]
	(91.91)	(18.17)	(91.35)	(18.61)	(104.42)	(28.69)
Mean uv			0.015[a]	0.005[a]	0.011[a]	0.004[a]
			(38.90)	(9.03)	(28.56)	(8.61)
GDP					-0.003[a]	-0.002[a]
					(-14.86)	(-7.81)
GDPc					0.043[a]	0.029[a]
					(75.84)	(24.19)
Cons.	2.548[a]	2.597[a]	2.509[a]	2.583[a]	2.681[a]	2.636[a]
	(944.75)	(549.15)	(863.33)	(521.78)	(611.30)	(397.62)
	OECD	Eurozone	OECD	Eurozone	OECD	Eurozone

By interval regressions (FE regressions)

Dep. var.	Price (log)			
$1 < km < 1000$	-0.002[a]	-0.002[a]	-0.002[a]	-0.002[a]
	(-96.50)	(-96.51)	(-107.90)	(-116.20)
$1000 < km < 3000$	-0.001[a]	-0.001[a]	-0.002[a]	-0.002[a]
	(-46.19)	(-35.16)	(-50.34)	(-44.34)
$3000 < km < 6000$	0.001[a]		0.001[a]	
	(17.58)		(26.59)	
$6000 < km < 9000$	0.003[a]	0.005[a]	0.004[a]	0.005[a]
	(58.47)	(56.89)	(73.48)	(55.43)
$9000 < km$	0.005[a]	0.008[a]	0.005[a]	0.008[a]
	(89.78)	(99.59)	(90.15)	(96.70)
GDP (log)			-0.004[a]	-0.004[a]
			(-30.11)	(-24.56)
Gdpc (log)			0.011[a]	0.012[a]
			(46.45)	(35.39)
Sample :	all	OECD	all	OECD

- by firm and product regressions, year 2005.
- only the firms serving at least 15 (30) markets.
- 56% of the coefficients are positive.
- GDP and GDPc do not change the main result : more than 50% of the coefficients are positive.

Plan

Spatial quality discrimination

- Models where firms quality-discriminate.
  [Verhoogen (2008), Hallak & Sivadasan (2008)]
- Iceberg trade costs : quality (so prices) decrease with the distance.
- Add an additive costs in the Hallak Sivadasan model leads to a positive relationship between quality (so prices) and distance.

Alchian Allen effect

- Alchian Allen effect modeled by Hummels and Skiba 2002 might be modeled at the firm level.
- The firm produces at least two grade of a given good, the relative price of the high quality version of the good decreases with the distance (with additive trade costs).
- Assumption 1 : trade costs are the same whatever the quality.
- Assumption 2 : perfect competition

Pricing strategy or quality ?

- Quality stories assumes that firm level unit values (8digit) measure different quality.
- Hummels & Skiba : estimation of the elasticity of price to distance in pure PTM : 0.007. Their product level data reject PTM in favor of Alchian Allen effect. Firm level data lead me to accept PTM.
- Price discrimination seems more relevant than quality discrimination when thinking about the whole exports.
- Anyway one needs additive trade costs.

Plan

- Theoretically, the choice of the transport cost formulation is essential to determine firm pricing policy.
- French exporters are likely to adopt reverse dumping strategy.
- The most popular models of international trade (DSK and Ottaviano et al models) are not convenient to describe firm pricing behavior.
- Recent models with quality also fail to generate such stylized fact.
- Additive costs seem necessary to replicate this fact.