…in one cloud…

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FIW Research Conference

Verti-zontal Differentiation in Monopolistic Competition

Francesco Di Comite Jacques-François Thisse Hylke Vandenbussche

Université Catholique de Louvain, Louvain-la-Neuve

Wien, 10 / 12 / 2010

Presentation Outline

- ❖ **MOTIVATION – are current trade models fully satisfactory?**
- ❖ **PROPOSAL – yet another intra-industry trade model?**
- ❖ **APPLICATIONS and IMPLICATIONS – so what?**

Research Objectives

Main research objectives:

- **Accommodate recent empirical findings on micro-level trade data:**

> - Productivity and sales appear to be weakly correlated;
> - Heterogeneity in response of firms to trade protection;
> - Vertical differentiation alone doesn't suffice to explain trade flows.

- **Fill the gap between I.O. theories of product differentiation and trade models of monopolistic competition:**

> - Differentiation can be explicitly measured and accounted for;
> - A unified framework (*from Hotelling to Melitz*) can be developed;
> - *Micro* characteristics can then be aggregated into *macro* outcomes.

Intra-industry

Table VI.1. Manufacturing intra-industry trade as a percentage of total manufacturing trade

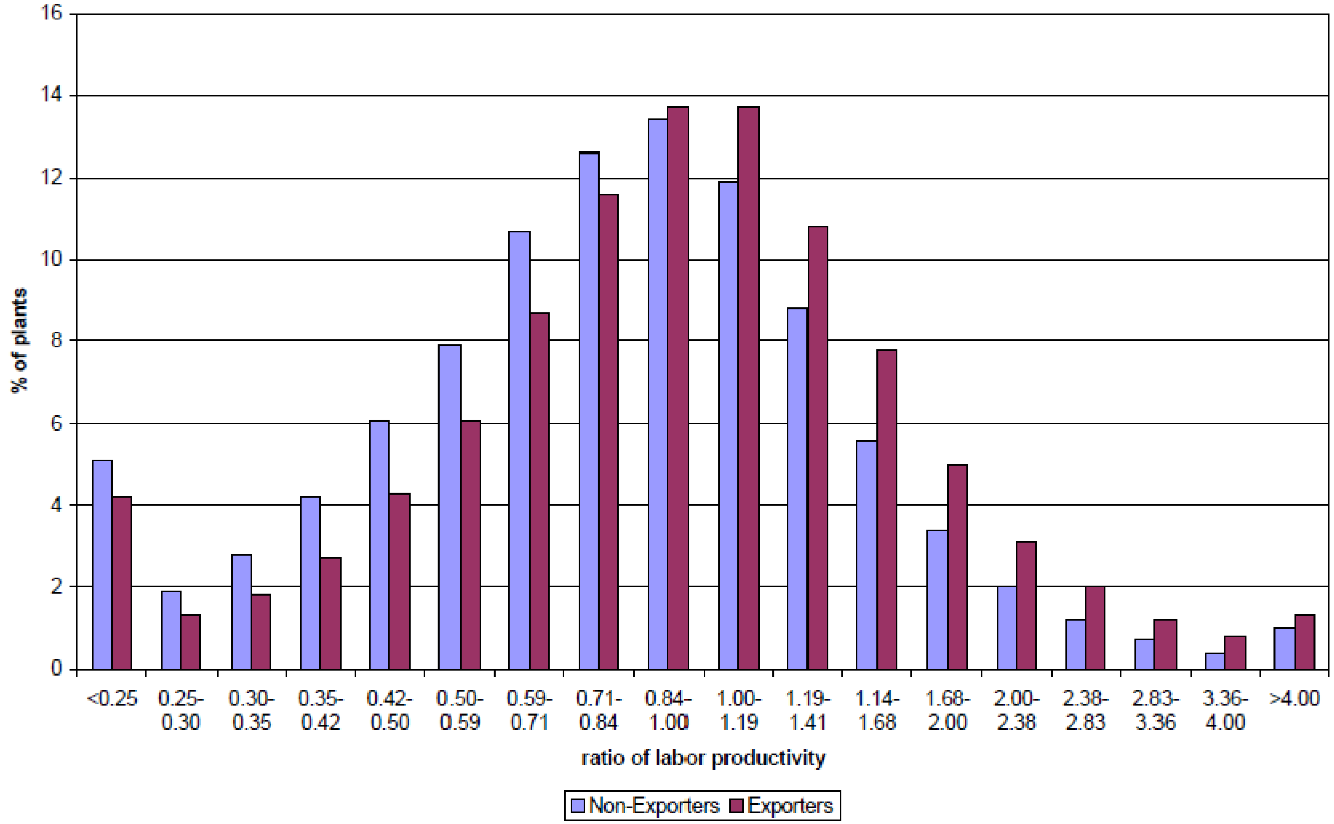
	1988-91	1992-95	1996-2000	Change
High and increasing intra-industry trade				
Czech Republic	n.a.	66.3	77.4	11.1
Slovak Republic	n.a.	69.8	76.0	6.2
Mexico	62.5	74.4	73.4	10.9
Hungary	54.9	64.3	72.1	17.2
Germany	67.1	72.0	72.0	5.0
United States	63.5	65.3	68.5	5.0
Poland	56.4	61.7	62.6	6.2
Portugal	52.4	56.3	61.3	8.9
High and stable intra-industry trade				
France	75.9	77.6	77.5	1.6
Canada	73.5	74.7	76.2	2.7
Austria	71.8	74.3	74.2	2.4
United Kingdom	70.1	73.1	73.7	3.6
Switzerland	69.8	71.8	72.0	2.2
Belgium/Luxembourg	77.6	77.7	71.4	-6.2
Spain	68.2	72.1	71.2	3.0
Netherlands	69.2	70.4	68.9	-0.3
Sweden	64.2	64.6	66.6	2.4
Denmark	61.6	63.4	64.8	3.2
Italy	61.6	64.0	64.7	3.1
Ireland	58.6	57.2	54.6	-4.0
Finland	53.8	53.2	53.9	0.1
Low and increasing intra-industry trade				
Korea	41.4	50.6	57.5	16.1
Japan	37.6	40.8	47.6	10.0
Low and stable intra-industry trade				
New Zealand	37.2	38.4	40.6	3.4
Turkey	36.7	36.2	40.0	3.3
Norway	40.0	37.5	37.1	-2.9

Intra-industry trade accounts for most of the manufacturing trade in advanced economies

Source: OECD (2002)

Heterogeneity

Figure 2b: Ratio of Plant Labor Productivity to 4-digit Industry Mean



Firms are heterogeneous in many aspects

(and plants too!)

Source: Bernard, Eaton, Jensen, Kortum (2003), AER - “Plants and Productivity in International Trade”,

Theoretically challenging empirical results:

- Heterogeneous response to Trade Protection;
  [Konings and Vandenbussche, 2008]
- Weak relation between productivity and size;
  [Brooks, 2006; Hallak and Sivadasan 2009; Foster et al., 2008]
- Home bias in consumption;
  [Goldberg and Verboven, 2005; Brooks, 2003; Chung and Song, 2008; Ferreira and Waldfogel, 2010]
- Different "quality ladders" across sectors;
  [Khandelwal, 2009; Bernard et al. 2006; Bresnahan and Reiss 1991]
- Higher prices not necessarily associated with lower (higher) markups and sales.
  [Crozet et al., 2009; Eaton et al., 2007; Hummels and Klenow, 2005; Kugler and Verhoogen, 2007; Kugler, 2008; Manova and Zhang, 2009; Iacovone and Javorcik, 2008; Gorg et al. 2010]

Theoretical Inputs

Early contributions on imperfect competition:

As a reaction to neoclassical paradigm of perfect competition, ***Edgeworth (1925)***, ***Sraffa (1926)*** and ***Schumpeter and Nichol (1934)*** built on the intuitions of ***Cournot (1838)*** and ***Bertrand (1883)*** to lay the basis of a theory of imperfect competition.

Two separate strands of literature emerge from their contributions

Location Theories

Monopolistic Competition

Theoretical Inputs

Location theories and product differentiation:

❖ Hotelling (1929), EJ – "Stability in competition";

❖ Lancaster (1966), JPE – "A new approach to consumer theory";

❖ Gabszewicz, Thisse (1980), JET – "Entry (and exit) in a differentiated industry";

❖ Shaked, Sutton (1982), RES – "Relaxing price competition through product differentiation";

❖ Berry (1994), RAND – "Estimating discrete-choice models of product differentiation".

Monopolistic competition

❖ Early intuitions: Chamberlin (1933), "The Theory of Monopolistic Competition";
Robinson (1933), "The Economics of Imperfect Competition"

❖ Dixit, Stiglitz (1977), AER – "Monopolistic Competition and Optimum Product Diversity";

❖ Krugman (1980), AER – "Scale Economies, Product Differentiation, and the Pattern of Trade";

❖ Ottaviano, Tabuchi, Thisse (2002), IER – "Agglomeration and Trade Revisited";

Theoretical Inputs

Monopolistic Competition then further evolved into theories of firm heterogeneity and dynamics:

- Hopenhayn(1992),*Econometrica* – “Entry,Exit and Firm Dynamics in Long Run Equilibrium”;
- Melitz (2003), *Econometrica* – “The Impact of Trade on Intra-industry Reallocations and Aggregate Industry Productivity”;
- Melitz, Ottaviano (2008), RES – “Market size, trade, and productivity”.

But product differentiation has mainly been kept in the background!

A tentative definition of the ***main ingredients***:

In each market, many firms interact , → **No Collusion**

but products are differentiated. → **No Perfect Competition**

This provides firms with market power → **Operating Profits > 0**

and independent decision making. → **Firms prices setters**

Monopolistic Competition

Competing Models	Utility functions	Demand functions
Krugman/Melitz CES:	$U_i = Q_i^{\mu} Z_i^{1-\mu} \quad where$ $Q_i = [\int_0^N q_i(s)^{\frac{\sigma-1}{\sigma}} ds]^{\frac{\sigma}{\sigma-1}}$	$q_{ji}(s) = \frac{p_{ji}(s)^{-\sigma}}{P_i^{1-\sigma}} \mu Y_i$
Ottaviano, Tabuchi, Thisse (2002) Quadratic Utility:	$U_i = \alpha \int_0^N q_i(s)ds - \frac{\beta-\gamma}{2} \int_0^N [q_i(s)]^2 ds - \frac{\gamma}{2}[\int_0^N q_i(s)ds]^2 + q_0$	$q_{ji}(s) = [a - (b + cN)p_{ji}(s) + cP_i]$

CES Utility Functions

Characteristics of a standard CES utility function:

- **Prices unaffected by the level of demand** and the intensity of competition;

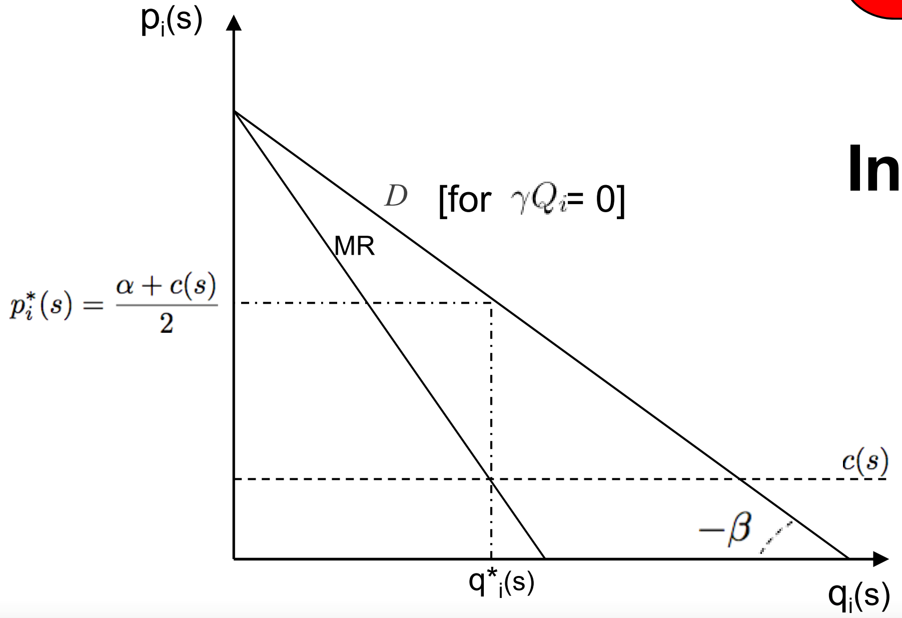
- **Constant markups** over costs;

- Own-price **elasticities of demands are constant**, identical to the elasticities of substitutions, and equal to each other across all differentiated products.

Recent versions of CES functions overcome some of these problems, but still provide a very rigid framework to work with at a micro level.

Quadratic Utility Functions

$$U_i = \alpha \int_{s \in S_i} q_i(s) ds - \frac{\beta}{2} \int_{s \in S_i} q_i^2(s) ds - \frac{\gamma}{2} \left[\int_{s \in S_i} q_i(s) ds \right]^2 + q_0$$



Linear demand: $\boxed{p_i(s) = \alpha - \beta q_i(s) - \gamma Q_i}$

Interesting properties:

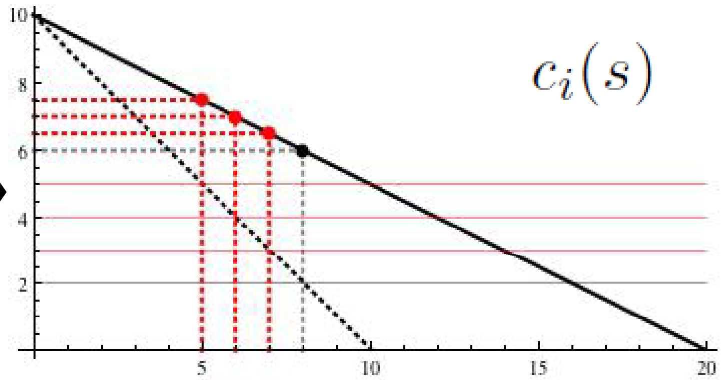
- Non-constant markups;
- Elasticity of demand decreasing in p;
- Extremely tractable and flexible.

In the standard interpretation, parameters α and γ represent preferences for the differentiated type of good (vis-à-vis the numèraire), β the differentiation.

Limits of Quadratic Utility

- **Same prices and quantities for all the goods in a sector;**
- **Fixed ratio between markups and quantities;**
- **Scale effects: bigger countries necessarily more efficient.**

SUPPLY-SIDE SOLUTION
Melitz, Ottaviano (2008) solves the first issue through ***cost heterogeneity***



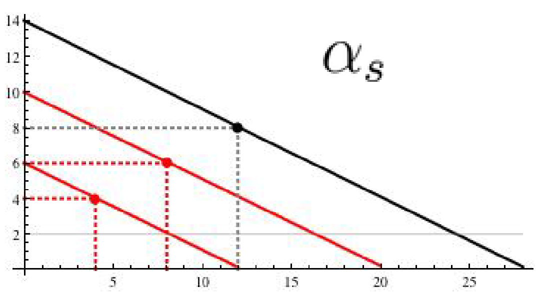
Verti-zontal Differentiation

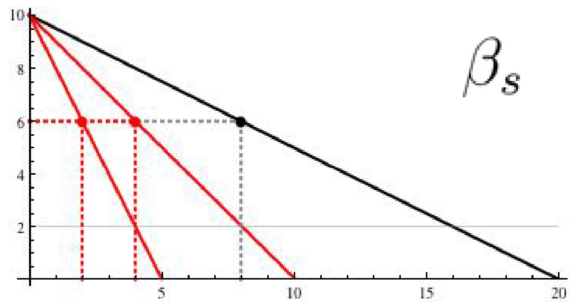
DEMAND SIDE SOLUTION

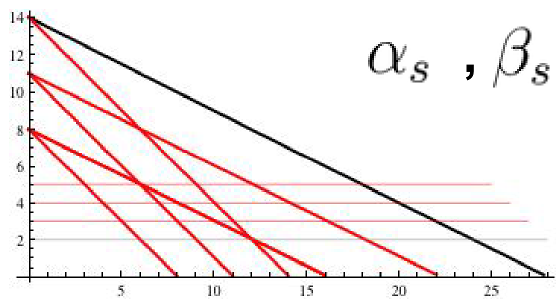
Idiosyncratic parameters

$$U_i = \alpha \int_{s \in S_i} q_i(s)ds - \frac{\beta}{2} \int_{s \in S_i} q_i^2(s)ds - \frac{\gamma}{2} \left[\int_{s \in S_i} q_i(s)ds \right]^2 + q_0$$

$$U_i = \int_{s \in S_i} \alpha(s) q_i(s)ds - \int_{s \in S_i} \frac{\beta_i(s)}{2} q_i^2(s)ds - \frac{\gamma}{2} \left[\int_{s \in S_i} q_i(s)ds \right]^2 + q_0$$







Towards a unified theory of differentiation and trade

Functional Form

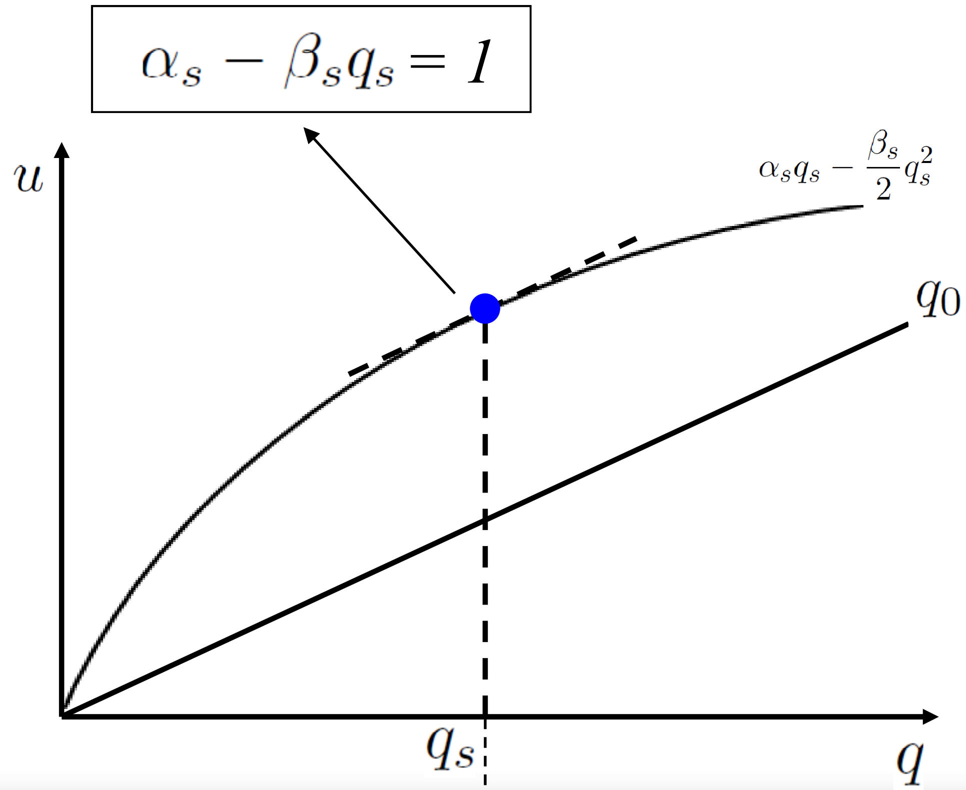
Consider only 1 market (to get rid of subscript *i*):

$$\boxed{U = \int_S \alpha_s q_s ds - \frac{1}{2}\int_S \beta_s q_s^2 ds - \frac{\gamma}{2}\left(\int_S q_s ds\right)^2 + q_0}$$

This can be seen as the *aggregation in S* of: $\boxed{u_s = \alpha_s q_s - \frac{\beta_s}{2} q_s^2 - \frac{\gamma}{2} q_s \left[\int_S q_r dr\right] + q_0}$

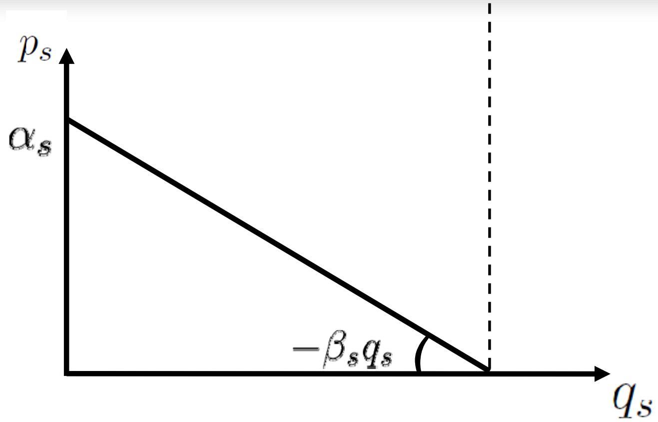
which is the multi-variety equivalent of: $\boxed{u_s = \alpha_s q_s - \frac{\beta_s}{2} q_s^2 + q_0}$

Pure monopoly



$$u_s = \alpha_s q_s - \frac{\beta_s}{2} q_s^2 + q_0$$

subject to $p_s q_s + q_0 = Y$

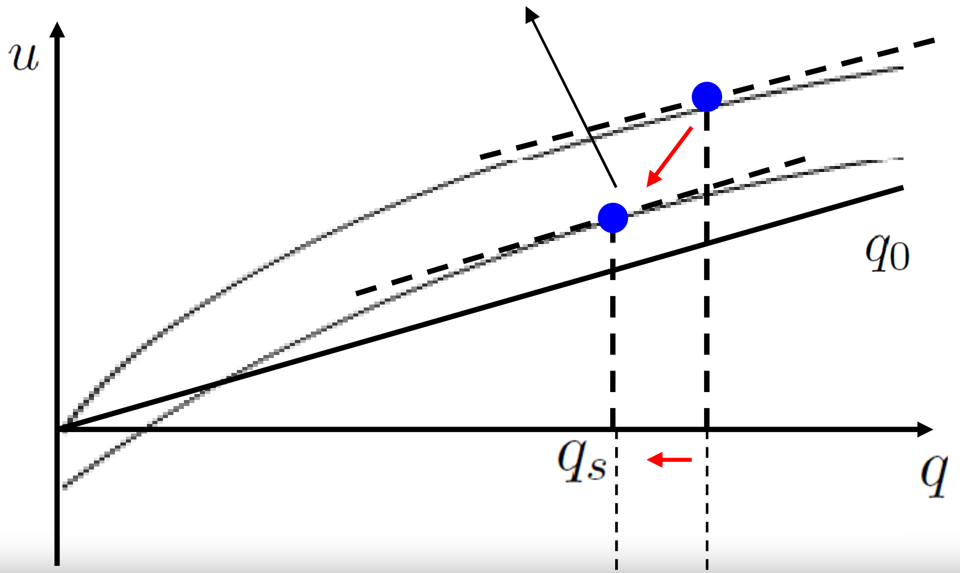


$$p_s = \max\{\alpha_s - \beta_s q_s, 0\}$$

$$q_s = \max\left\{\frac{\alpha_s - p_s}{\beta_s}, 0\right\}$$

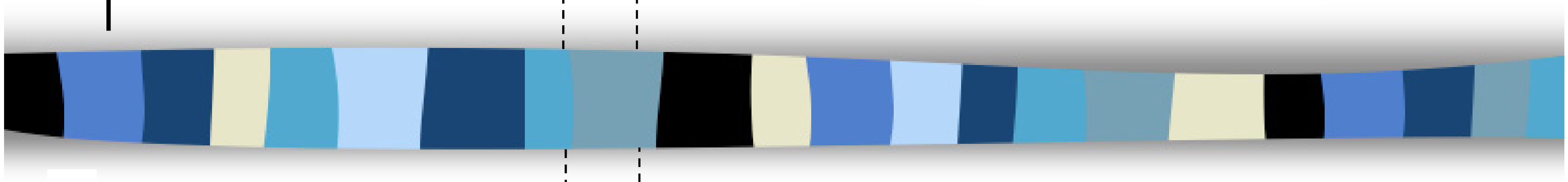
$$\alpha_s \boxed{- \frac{\gamma}{2}Q} - \beta_s q_s = 1$$

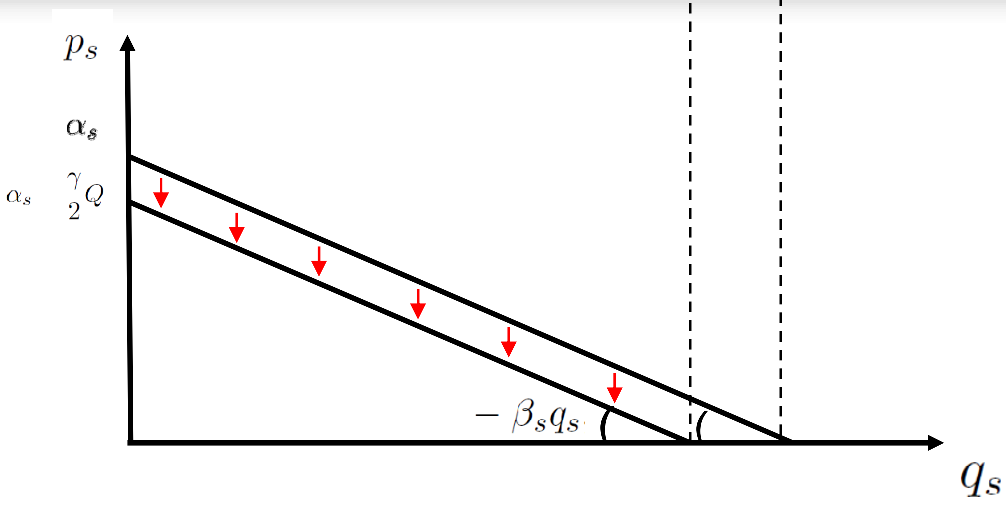
Monopolistic Competition



$$u_s = \alpha_s q_s - \frac{\beta_s}{2} q_s^2 - \frac{\gamma}{2} q_s \left[\int_S q_r dr \right] + q_0$$

$$p_s q_s + q_0 = Y$$

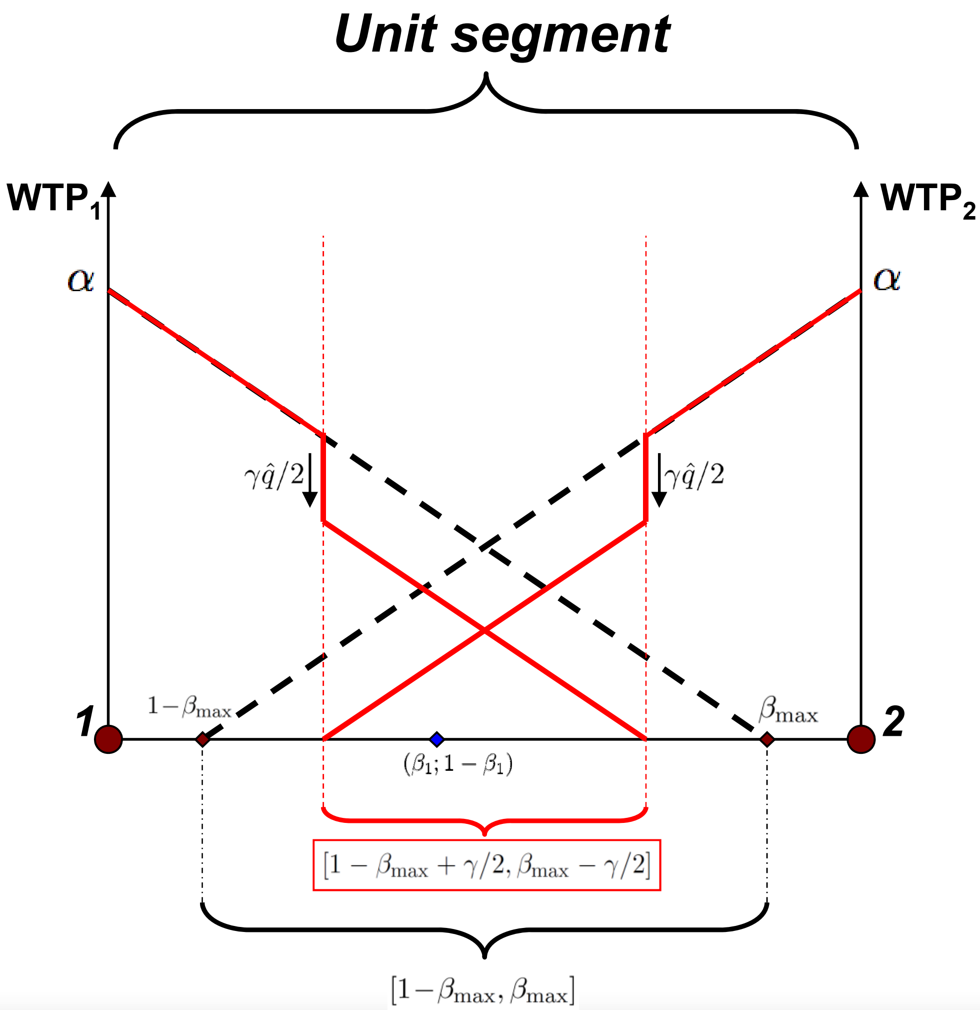




$$p_s = \alpha_s - \frac{\gamma}{2}Q - \beta_s q_s$$

$$q_s = \max\left\{ \frac{\alpha_s - p_s - \frac{\gamma}{2}Q}{\beta_s}, 0 \right\}$$

Hotelling-like Framework



Main characteristics:

- ***Unit segment***

$$\beta_2 = 1 - \beta_1$$

-***Identical varieties at the ends***

$$\alpha_1 = \alpha_2 = \alpha$$

- ***Fixed quantities,*** $\hat{q}$

$$p_s = \alpha - \beta_s \hat{q} - \frac{\gamma}{2} Q$$

β can be interpreted as the distance to "walk", with $\beta_{\max} = \alpha/\hat{q} - \gamma/2$

Role of Parameters

Where

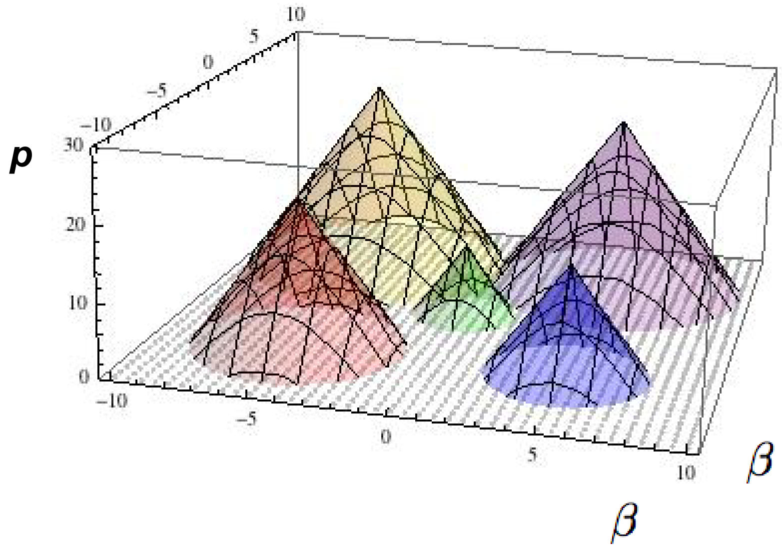
- α : Vertical Dimension → ***"QUALITY" (s)***
  "Value" of the first marginal unit
- β : Horizontal Dimension → ***"TASTE MISMATCH" (s,i)***
  Determines quantities consumed
  No direct effect on optimal prices
- γ : Degree of substitutability → ***"SUBSTITUTABILITY"***
  Competitive pressure

Following Gordon (2010): quality, efficiency and personalization/differentiation appear to be the main strategic dimensions of competition for firms.

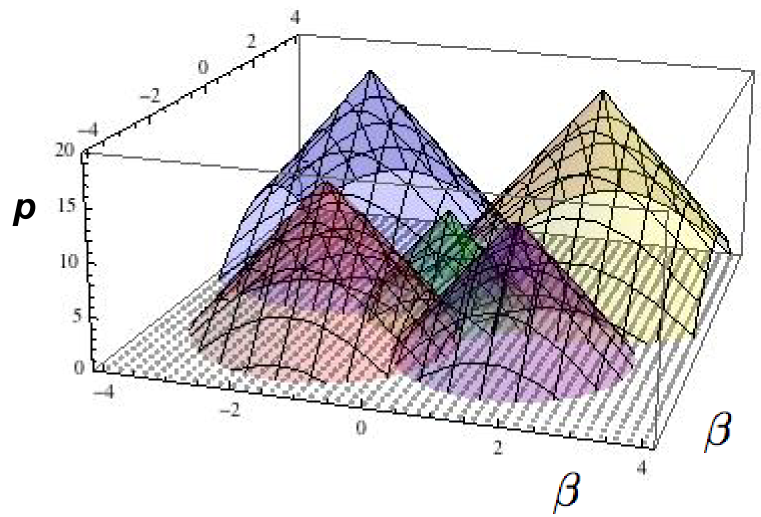
New layers of flexibility in modelling

Graphical Intuition

Price of first unit of a certain variety consumed



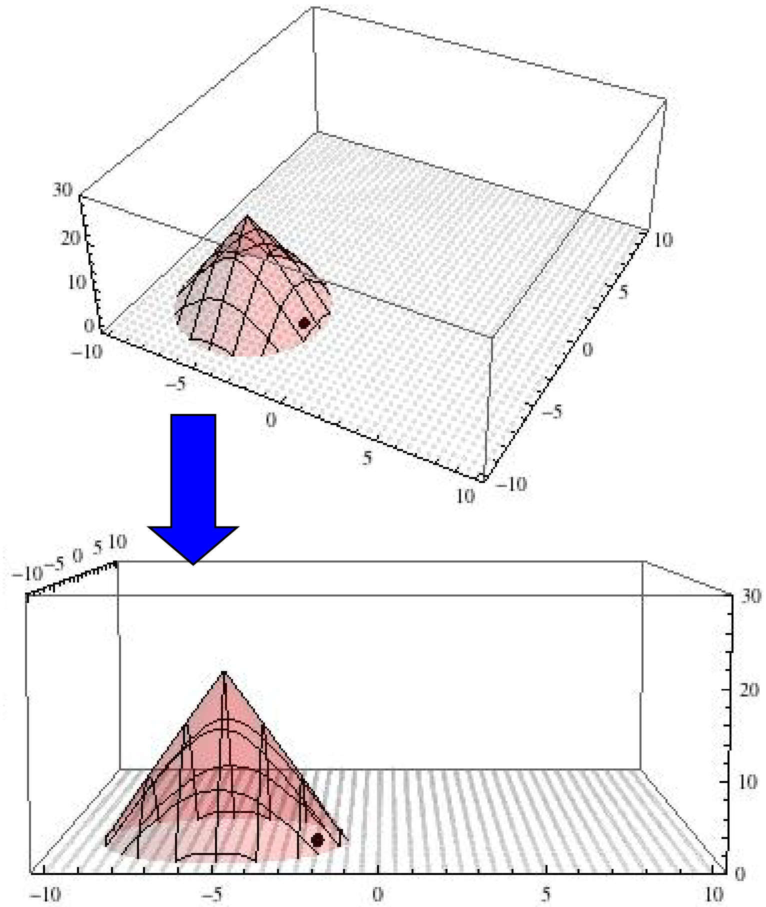
Idiosyncratic $[\alpha; \beta]$ world

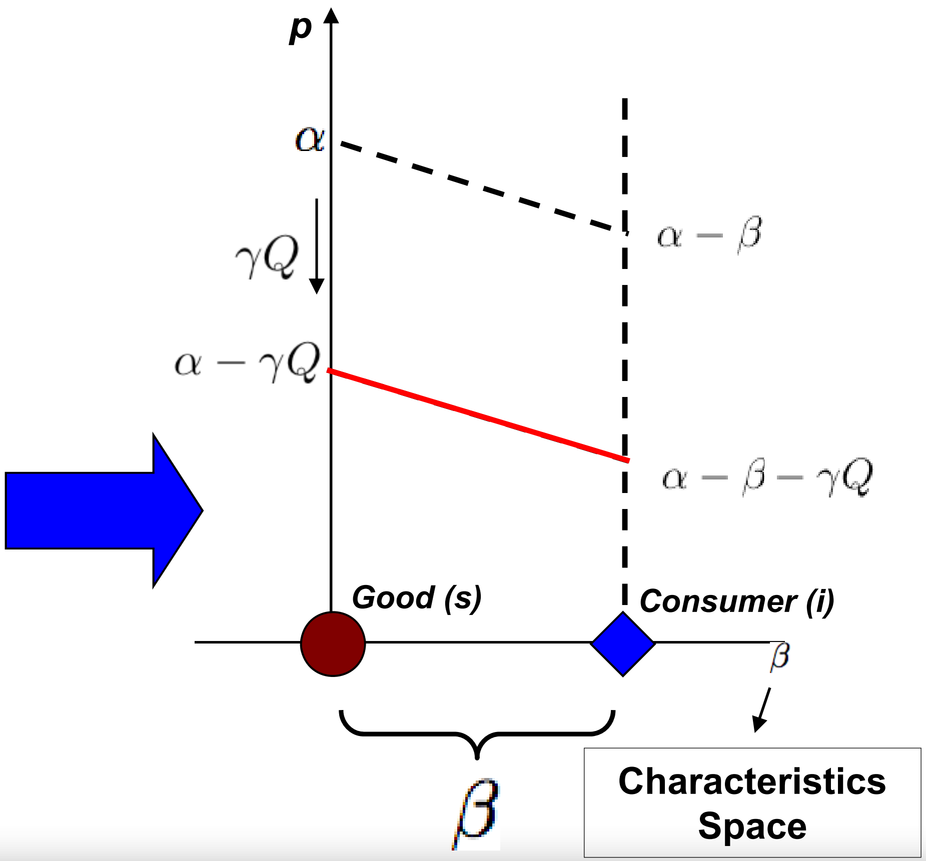


Adding γQ dimension

Price of the first unit consumed in function of β

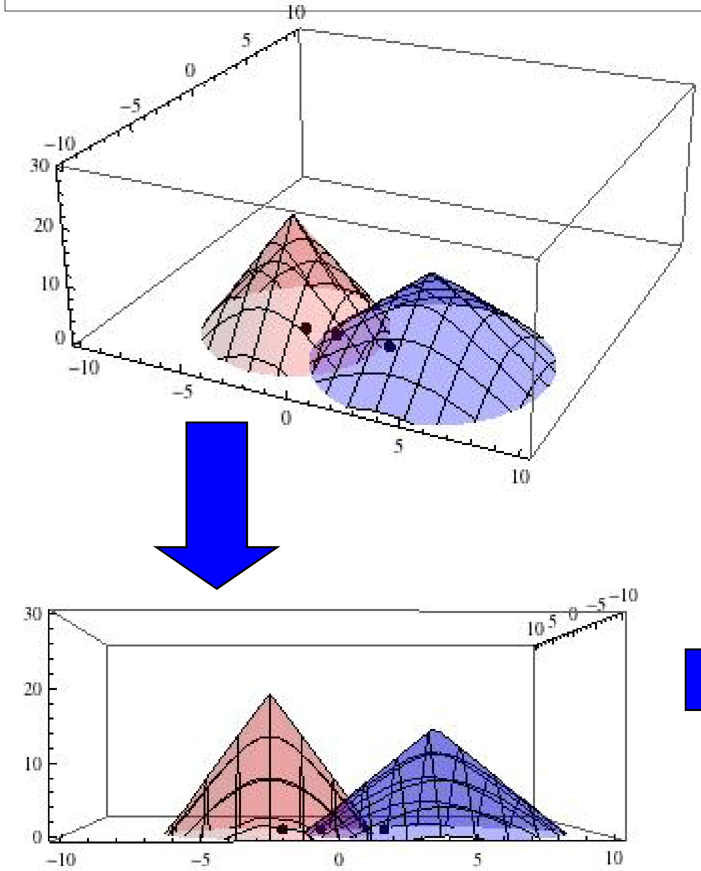
Graphical Intuition

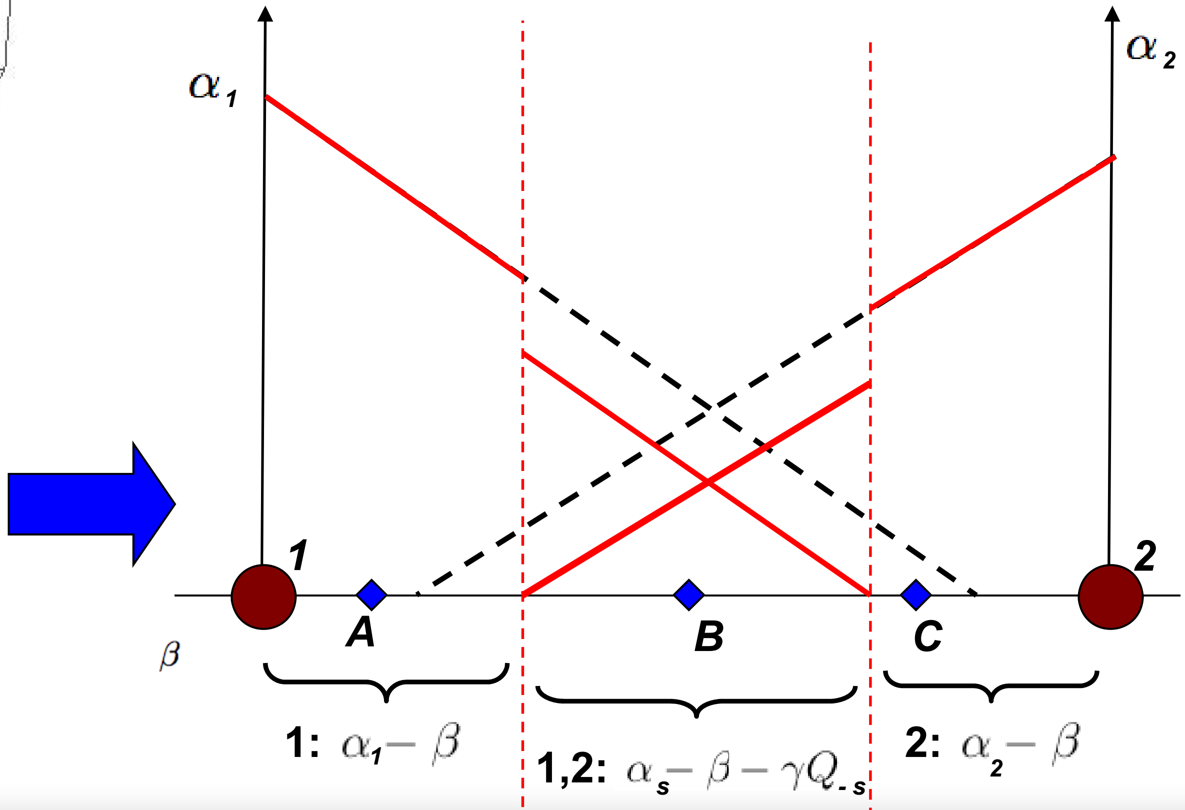




Graphical Intuition

Price of the first unit consumed in function of β





Building Blocks

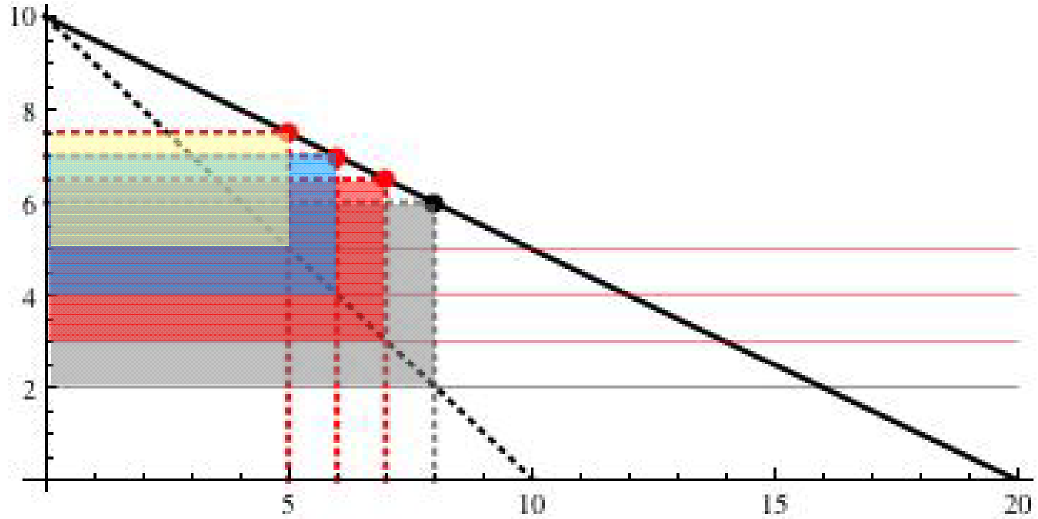
❖ Baseline Model: Cost Heterogeneity ➡ $\neq \underbrace{c_{s,i}}_{c_{s,i} = c_s + t_{s,i}}$

❖ Vertical Differentiation ➡ $\neq \alpha_s$;

❖ Horizontal Differentiation ➡ $\neq \beta_{s,i}$.

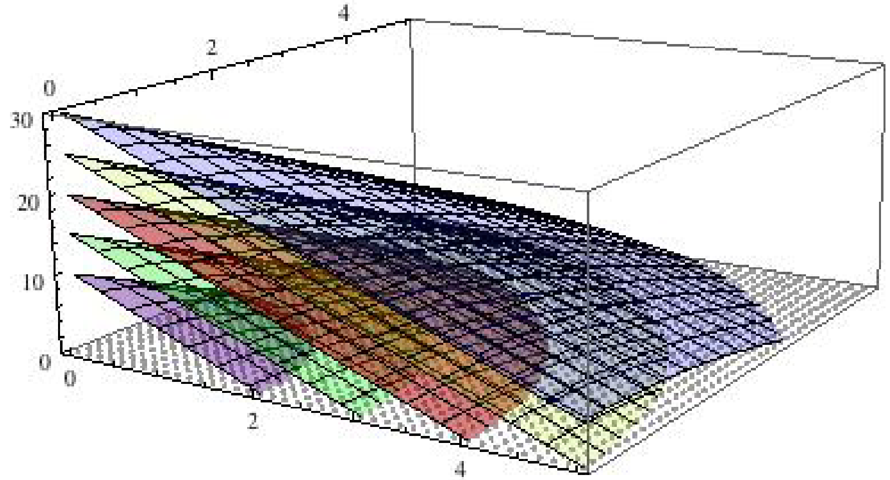
➡ ***Verti-zontal Differentiation in Monopolistic Competition***

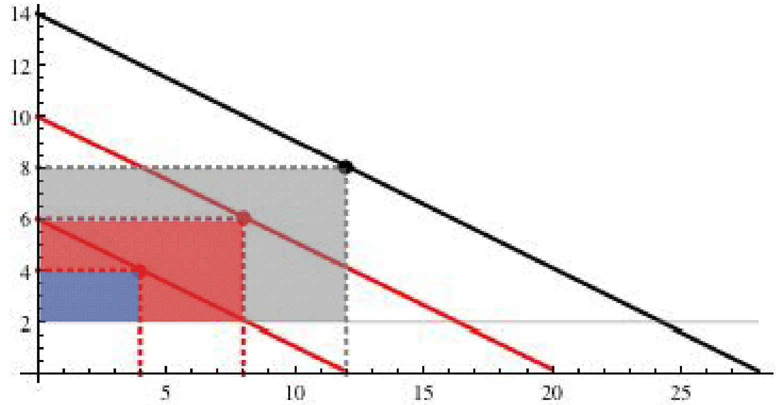
Cost Heterogeneity



As in Melitz,Ottaviano(2008), supply-side heterogeneity: c_S

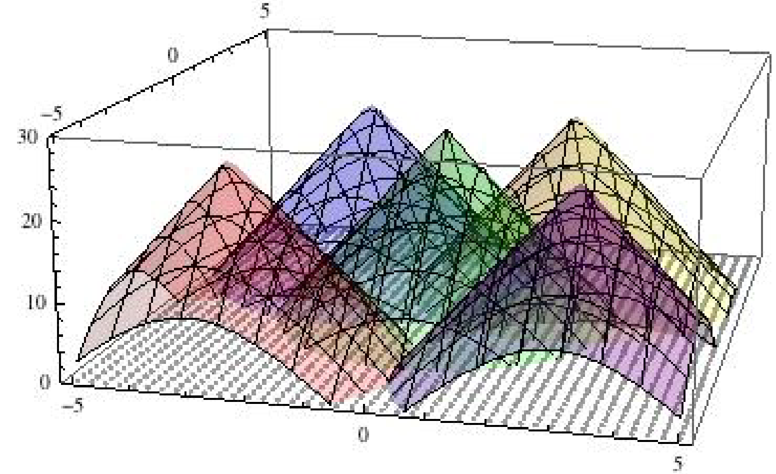
Vertical Differentiation

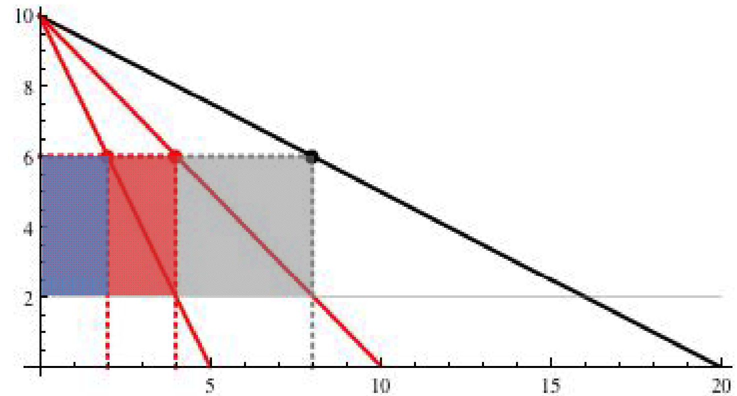




As in Foster,Haltiwanger,Syverson(2008), heterogeneity in <u>quality</u>: α_s

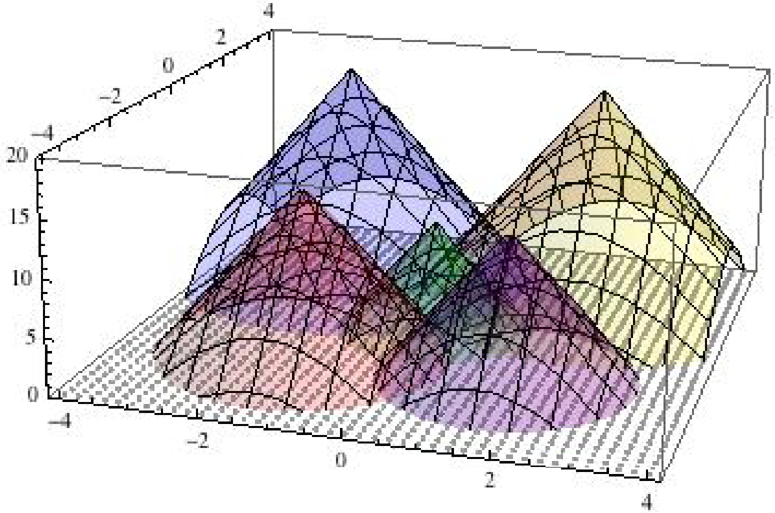
Horizontal Differentiation

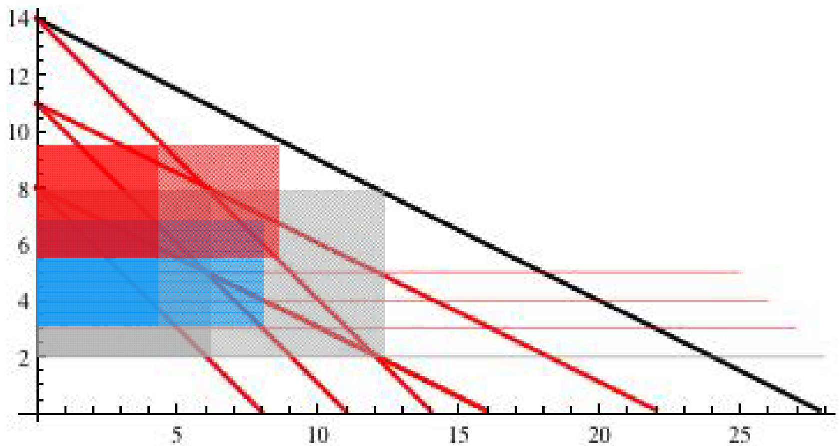




Heterogeneity in “taste mismatch”: β_s

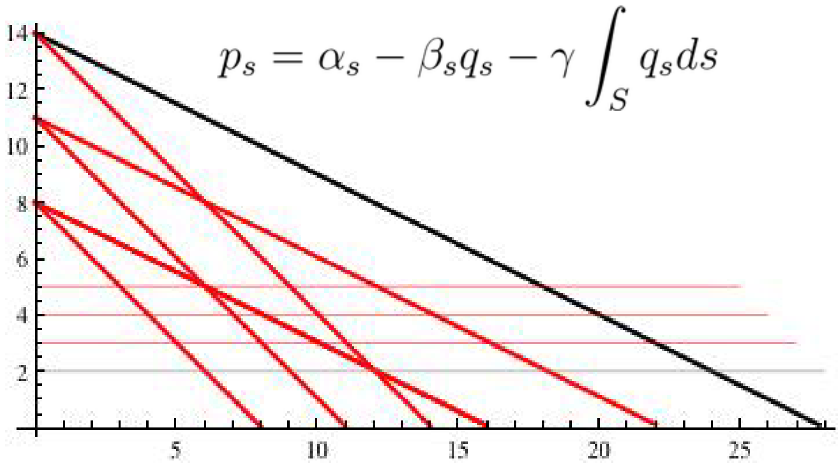
Verti-zontal Differentiation





Heterogeneity in quality and taste mismatch: α_s , β_s

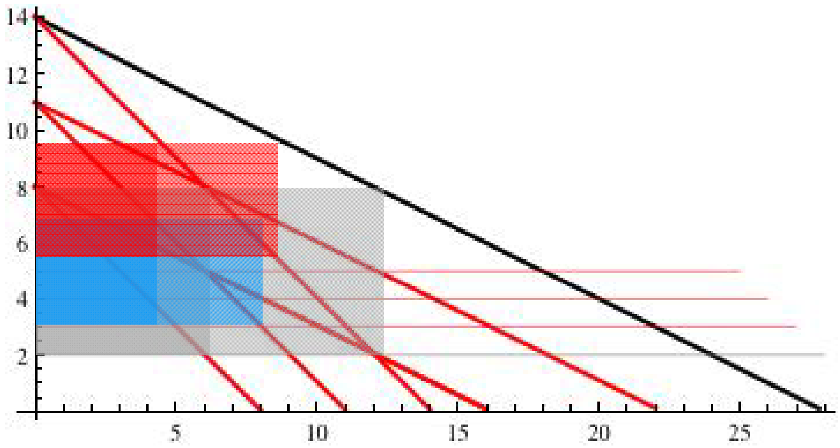
Verti-zontal Differentiation



$$p_s^*(\mathbb{P}) = \frac{\alpha_s}{2} + \frac{c_s}{2} - \frac{\gamma(\mathbb{A} - \mathbb{P})}{2(1 + \gamma\mathbb{N})}$$

$$\mathbb{N} = \int_S \frac{ds}{\beta_s} \;\; ; \; \mathbb{P} = \int_S \frac{p_s^*}{\beta_s} ds \, ; \; \mathbb{A} = \int_S \frac{\alpha_s}{\beta_s} ds$$

$$U = \int_S \alpha_s q_s ds - \frac{1}{2} \int_S \beta_s q_s^2 ds - \frac{\gamma}{2} \left[\int_S q_s ds \right]^2 + q_0$$



$$p_s^* = \boxed{\frac{\alpha_s}{2}} + \boxed{\frac{c_s}{2}} - \frac{\gamma \mathbb{N} \left(\frac{\tilde{\alpha}-\tilde{c}}{2}\right)}{2+\gamma \mathbb{N}}$$

$$q_s = \boxed{\frac{1}{\beta_s}} (p_s^* \boxed{- c_s})$$

Verti-zontal Differentiation

- Different quantities sold even for equal prices ($\beta_s \longrightarrow q_s^*$)
- Market Size Effect + Distribution of Costs and Quality ($\mathbb{C}$, $\mathbb{A} \longrightarrow \mathbb{P}$)
- High prices don't necessarily imply low markups ($\alpha_s \longrightarrow p_s^*$)

- Data requirements

Weighted average price: $\tilde{p} = \mathbb{P}/\mathbb{N} = \tilde{\alpha}\dfrac{1}{2+\gamma\mathbb{N}} + \tilde{c}\dfrac{1+\gamma\mathbb{N}}{2+\gamma\mathbb{N}}$

Comparisons

Taste-weighted indices

- Number of Firms, $N = \int_S ds$ $\Rightarrow$ $\mathbb{N} = \int_S \frac{ds}{\beta_s}$
- Price Index, $P = \int_S p_s^* ds$ $\Rightarrow$ $\mathbb{P} = \int_S \frac{p_s^*}{\beta_s} ds$
- Cost Index, $C = \int_S c_s ds$ $\Rightarrow$ $\mathbb{C} = \int_S \frac{c_s}{\beta_s} ds$
- Quality Index, $A = \int_S \alpha_s ds$ $\Rightarrow$ $\mathbb{A} = \int_S \frac{\alpha_s}{\beta_s} ds$

Note that $\beta_i(s)$ is identifiable through markups and quantities!

Comparisons

Prices:

From

Baseline Model

$$p_s^* = \frac{c_s}{2} + \frac{\alpha\beta + \gamma N \frac{\bar{c}}{2}}{2(\beta + \gamma N)}$$

to

Verti-zontal Differentiation

$$p_s^* = \frac{\alpha_s}{2} + \frac{c_s}{2} - \frac{\gamma \mathbb{N}\left(\frac{\tilde{\alpha}-\tilde{c}}{2}\right)}{2 + \gamma \mathbb{N}}$$

Passing through differentiation

Vertical : $p_s^* = \frac{\alpha_s}{2} + \frac{c_s}{2} - \frac{\gamma N\left(\frac{\bar{\alpha}-\bar{c}}{2}\right)}{2\beta + \gamma N}$

Horizontal : $p_s^* = \frac{c_s}{2} + \frac{\alpha + \gamma \mathbb{N}\frac{\tilde{c}}{2}}{2 + \gamma \mathbb{N}}$

Quantities:

Always $q_s^* = \frac{1}{\beta_s}(p_s^* - c_s)$

Verti-zontal Differentiation

Some papers recently developed similar demand specifications:

Only **quality**: α

- *Foster, L., Haltiwanger, J. and Syverson (2008),* "Reallocation, firm turnover, and efficiency: Selection on productivity or profitability?";

Only **differences in substitutability/taste**: β

- *Altomonte, Colantone, Pennings (2010),"*International trade with heterogenous firms and asymmetric product varieties";

Restricted **quality and substitutability/taste**: $[\alpha; \beta]$, augmented by the same parameter

- *Antoniades (2008),* "Heterogeneous Firms, Quality, and Trade";
- *Kneller, Yu (2008),* "Quality Selection, Chinese Exports and Theories of Heterogeneous Firm Trade".

Having a first look at the data

Model Identification

❖ **Taste mismatch:**

$$\boxed{q_s^* = \frac{(p_s^* - c_s)}{\beta_s}}$$

❖ **Quality:**

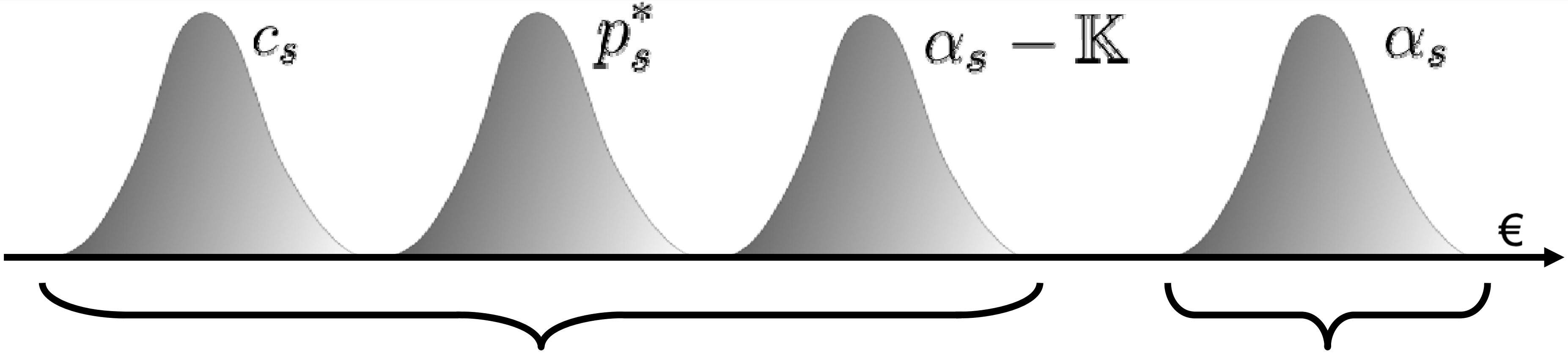
$$\boxed{\alpha_s - \alpha_r = 2\{[p_s^* - c_s] - [p_r^* - c_r]\}}$$

Data requirement: Information on (or estimates of) marginal costs and markups

Model Identification

From $p_s^* = \frac{\alpha_s}{2} + \frac{c_s}{2} - \frac{\gamma\mathbb{N}\left(\frac{\tilde{\alpha}-\tilde{c}}{2}\right)}{2+\gamma\mathbb{N}}$

$$p_s^* = \frac{c_s}{2} + \frac{\alpha_s - \mathbb{K}}{2}$$ where $\mathbb{K} = \frac{\gamma\mathbb{N}\left(\frac{\tilde{\alpha}-\tilde{c}}{2}\right)}{2+\gamma\mathbb{N}}$



"Observable" in each market!

"Absolute quality" generally unobservable

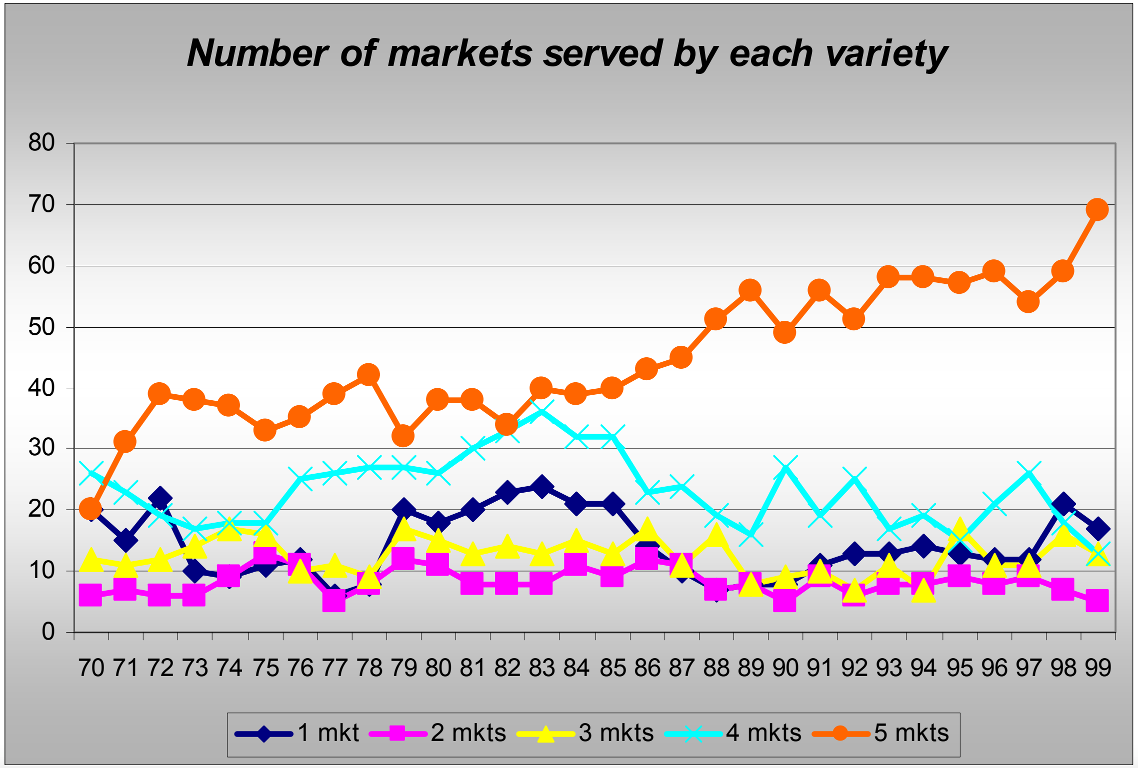
A look at the data

Working assumptions:

- Markets are segmented;
- Single varieties are assumed to be “negligible” for market indices;
- Prices are profit maximizing;
- Firm-market specific marginal costs are negligible
- Market-specific marginal costs (distribution, regulation, etc.) affect all the varieties in a similar way.

Dataset: ***European car market***, used in Goldberg and Verboven(2001), freely available on Professor Verboven’s personal homepage

A look at the data



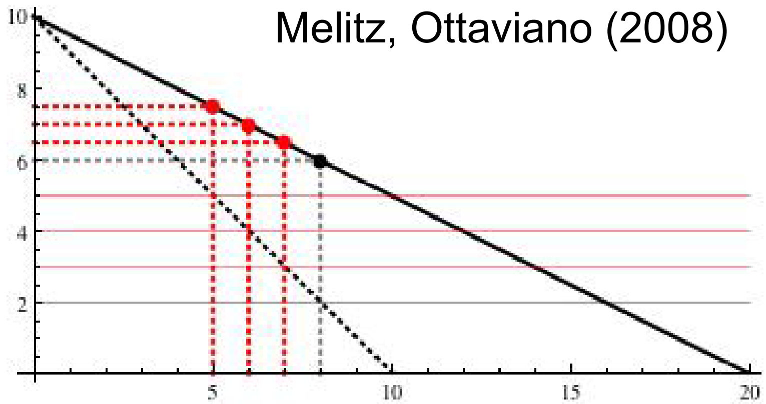
Data selection:

- **Car sector;**
- **Only year 1999;**
- **Only 71 “varieties” sold in the 5 markets.**

Countries in the dataset: Belgium, France, Germany, Italy and the U.K.
Total time span: 1970-1999

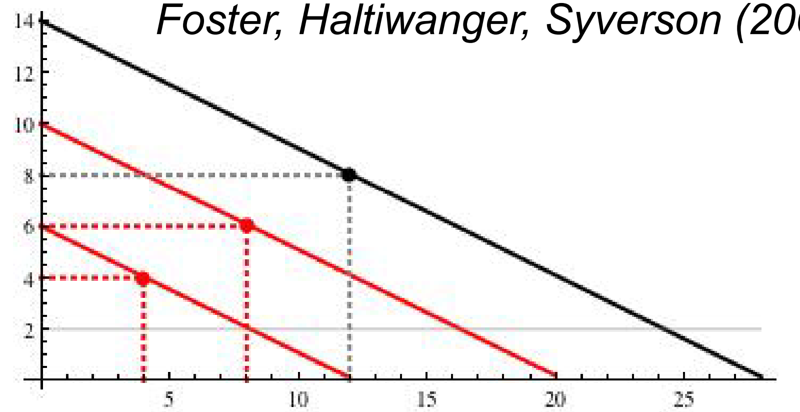
Existing Theories

Melitz, Ottaviano (2008)



- Constant demand;
- Varying marginal costs.

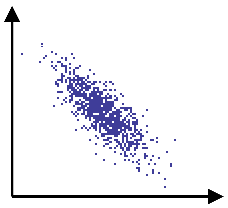
Foster, Haltiwanger, Syverson (2008)



- Constant marginal costs;
- Varying demand.

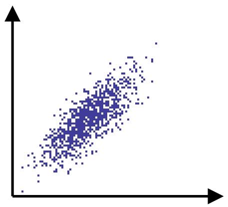
$$corr[rank_i(p_s); rank_i(q_s)] = -1$$

Expected scatter plot of p- and q-ranking

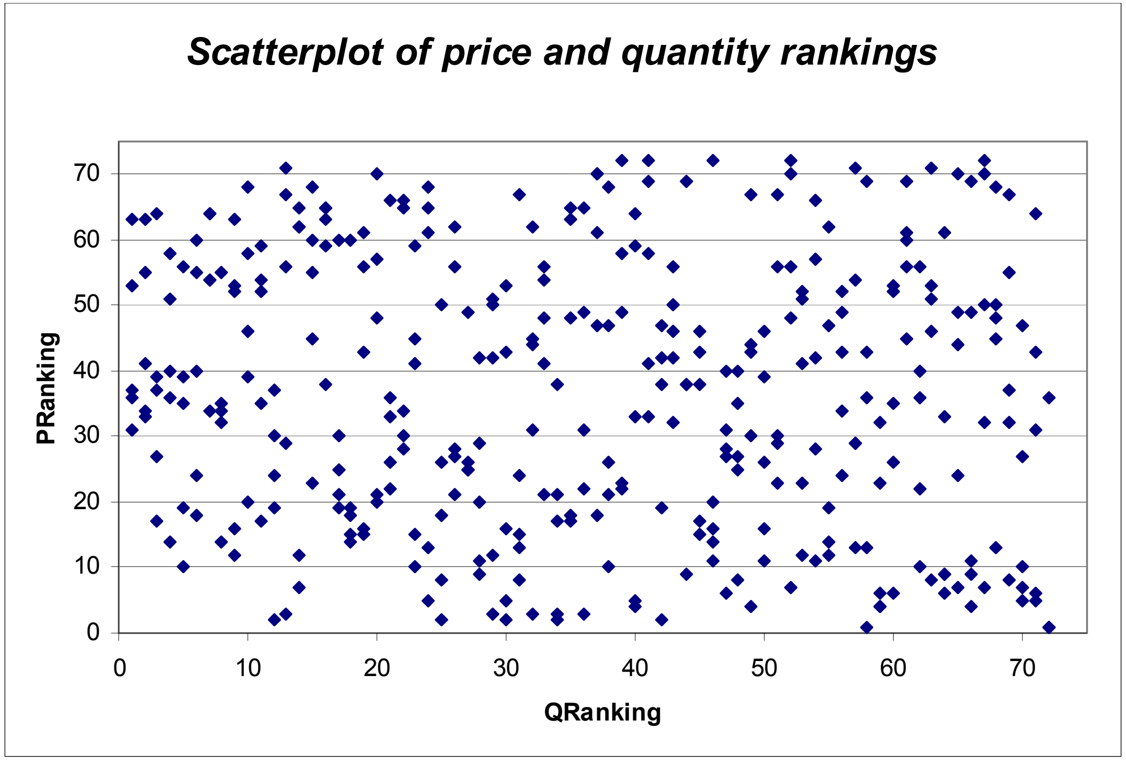


$$corr[rank_i(p_s); rank_i(q_s)] = 1$$

Expected scatter plot of p- and q-ranking



Explanatory power



$$corr[rank_i(p_s); rank_i(q_s)] = -0.106$$

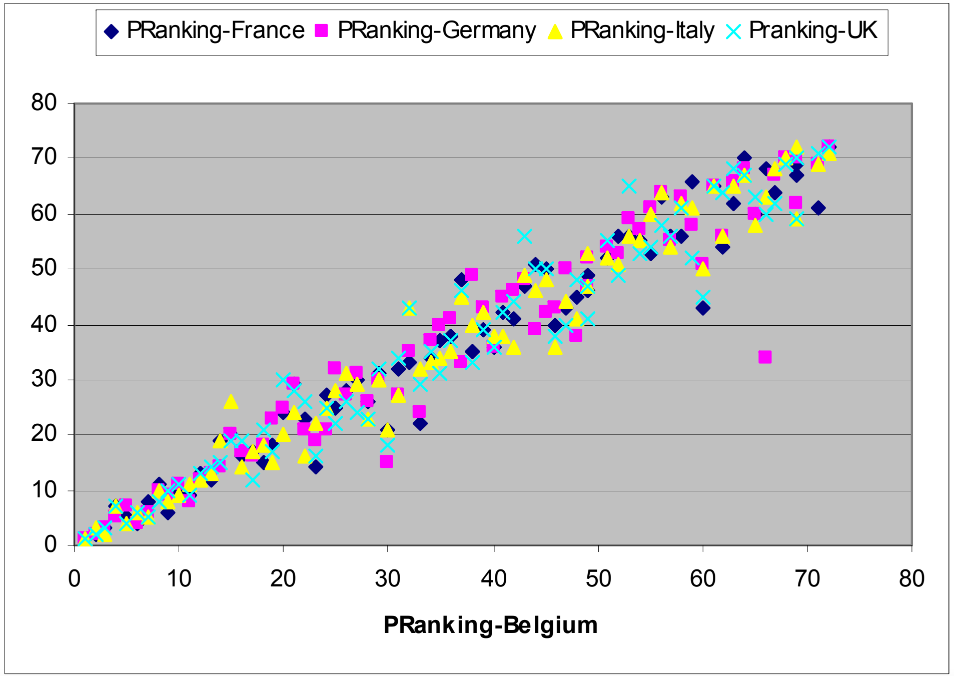
• Neither of the two theories appear sufficient on their own.

Quality ***(demand shifters)*** **and** ***Efficiency*** ***(marginal costs)*** **need to be considered together**

But are these two sources of heterogeneity enough?

$$\begin{cases} corr[rank_i(p_s); rank_j(p_s)] = 1 \\ corr[rank_i(q_s); rank_j(q_s)] = 1 \end{cases}$$

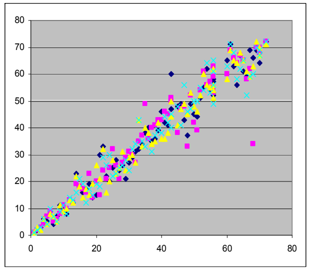
P-ranking correlations



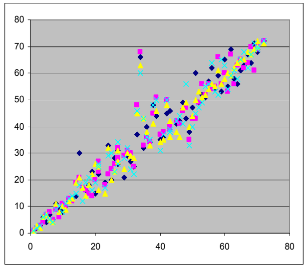
Pairwise correlations range from 95.72% to 98.25%!

So, $corr[rank_i(p_s); rank_j(p_s)] = 1$ seems not so far from reality.

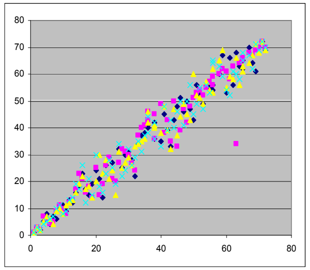
France



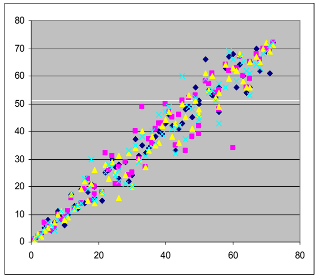
Germany



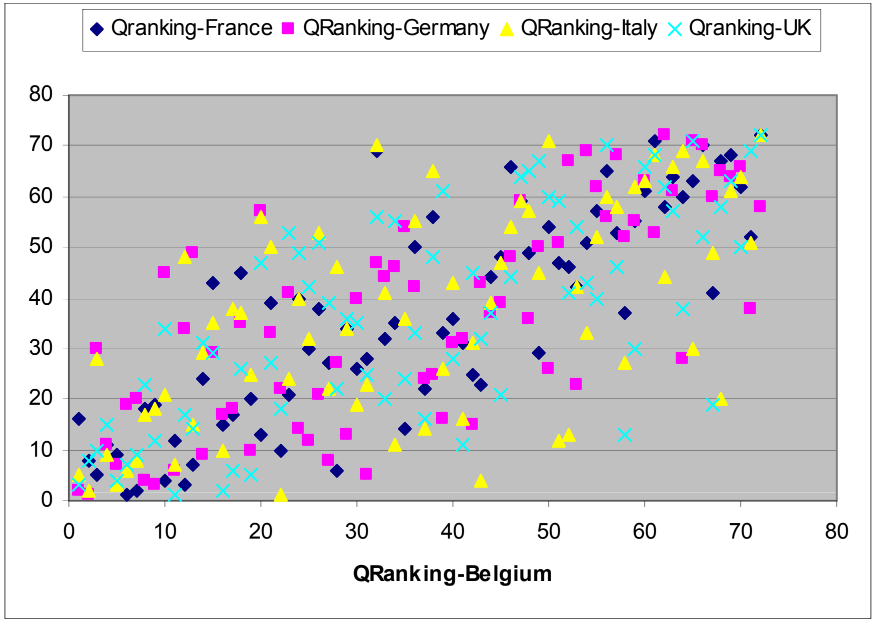
Italy



UK



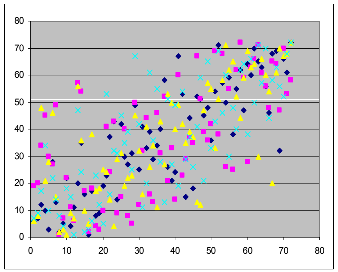
Q-ranking Correlations



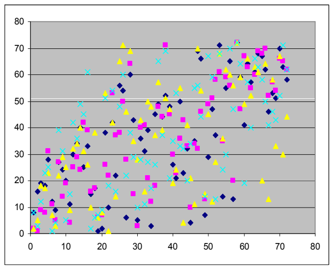
Pairwise correlations run from 49.5% to 83.61%

So that $corr[rank_i(q_s); rank_j(q_s)] = 1$ seems significantly less robust.

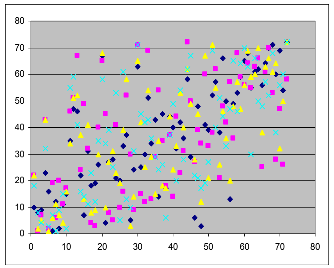
France



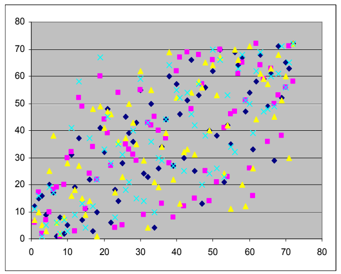
Germany



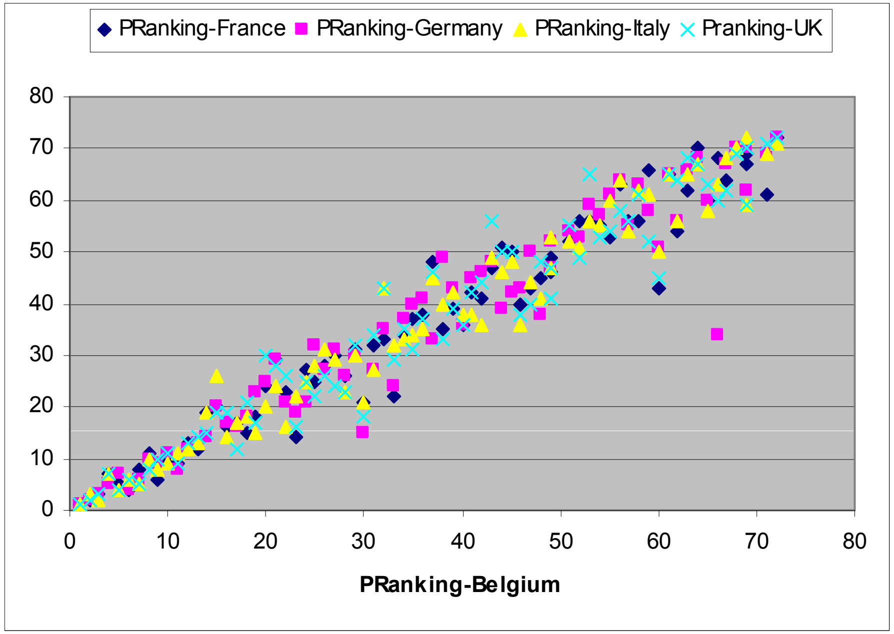
Italy

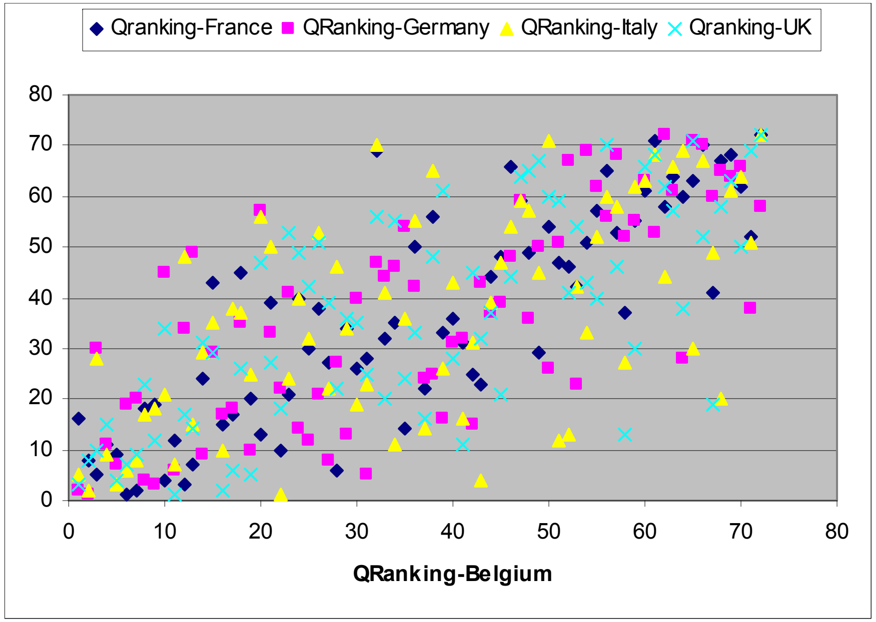


UK



Visual Comparison





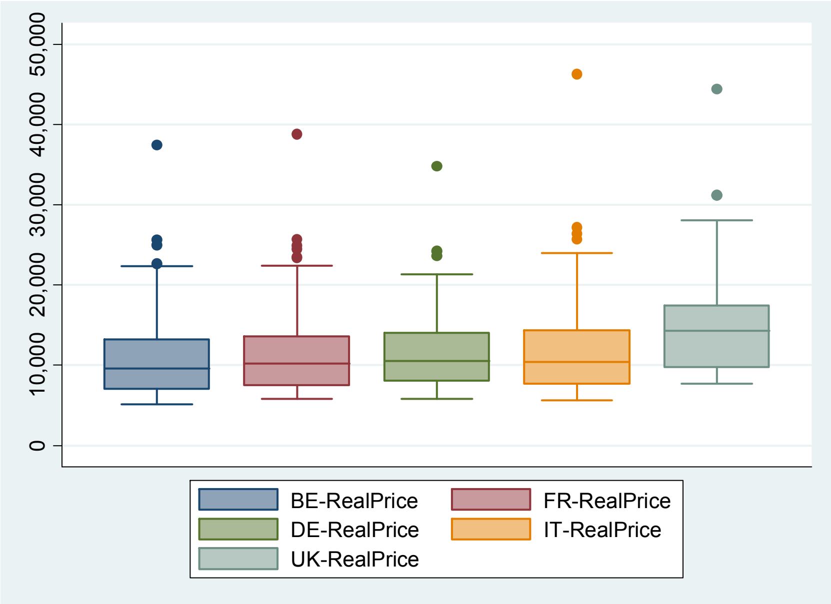
Remember: $p_{s,i} = p(\boxed{\alpha_s}, c_s, \cancel{\mathbb{K}_i})$ and $q_{s,i} = p(\boxed{\alpha_s}, c_s, \cancel{\mathbb{K}_i}, \boxed{\beta_{s,i}})$

ranking *ranking*

Vertical Differentiation

Horizontal Differentiation

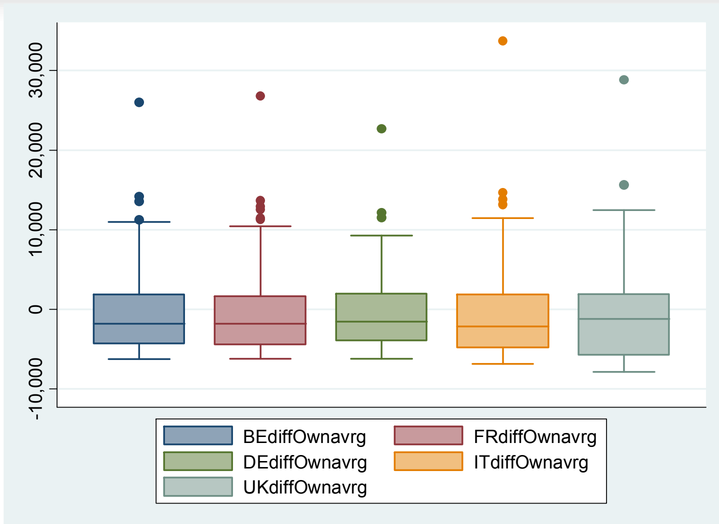
Price Distribution



Effective price distribution, by country

Deviations of each variety from market average, by country

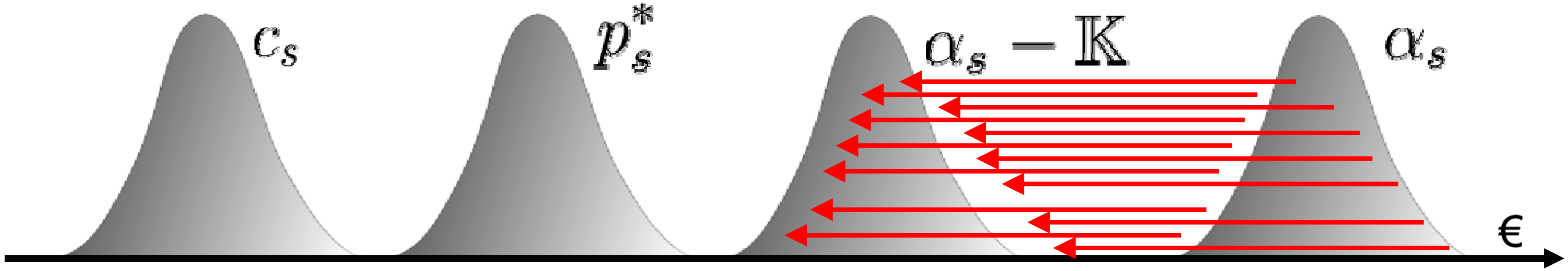
Net of common market effects, prices seem to be distributed similarly across markets.



Price Distribution

In $p_s^* = \frac{c_s}{2} + \frac{\alpha_s - \mathbb{K}}{2}$, the "$-\mathbb{K}$" term appears reasonable

Market effects appear to affect price distribution **"additively".**



Price Distribution

Remember: $p_{s,i} = p(\alpha_s, c_s, \mathbb{K}_i)$

Source	SS	df	MS
Model	1.4090e+10	2	7.0449e+09
Residual	286182173	357	801630.738
Total	1.4376e+10	359	40044541.9

Number of obs	=	360
F(2, 357)	=	8788.22
Prob > F	=	0.0000
R-squared	=	0.9801 !
Adj R-squared	=	0.9800
Root MSE	=	895.34

realprice	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
avrgpinmkt	1	.0322741	30.98	0.000	.9365287	1.063471
avrgpacros~s	1	.0077577	128.90	0.000	.9847435	1.015257
_cons	-12725.52	425.0307	-29.94	0.000	-13561.4	-11889.65

Source	SS	df	MS
Model	1.3929e+10	2	6.9647e+09
Residual	446560008	357	1250868.37
Total	1.4376e+10	359	40044541.9

Number of obs	=	360
F(2, 357)	=	5567.90
Prob > F	=	0.0000
R-squared	=	0.9689 !
Adj R-squared	=	0.9688
Root MSE	=	1118.4

realprice	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
avrgpinmkt	1.248324	.0403882	30.91	0.000	1.168895	1.327752
avrgpinoth~s	.993295	.0096841	102.57	0.000	.97425	1.01234
_cons	-15800.25	538.898	-29.32	0.000	-16860.06	-14740.44

Quantity Distribution

Remember: $q_{s,i} = p(\alpha_s, c_s, \mathbb{K}_i, \beta_{s,i})$

Source	SS	df	MS
Model	.000064823	2	.000032412
Residual	.000043168	357	1.2092e-07
Total	.000107992	359	3.0081e-07

Number of obs	=	360
F(2, 357)	=	268.04
Prob > F	=	0.0000
R-squared	=	$\boxed{0.6003}$?
Adj R-squared	=	0.5980
Root MSE	=	.00035

qpercapita	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
avrgqinmkt	1	.3198146	3.13	0.002	.3710429	1.628958
avrgqacros~s	1	.0435892	22.94	0.000	.914276	1.085724
_cons	-.0004368	.0001422	-3.07	0.002	-.0007163	-.0001572

Source	SS	df	MS
Model	.000043284	2	.000021642
Residual	.000064707	357	1.8125e-07
Total	.000107992	359	3.0081e-07

Number of obs	=	360
F(2, 357)	=	119.40
Prob > F	=	0.0000
R-squared	=	$\boxed{0.4008}$?
Adj R-squared	=	0.3975
Root MSE	=	.00043

qpercapita	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
avrgqinmkt	1.199162	.3917726	3.06	0.002	.4286901	1.969634
avrgqinoth~s	.7966499	.0522706	15.24	0.000	.6938529	.8994468
_cons	-.0004349	.0001748	-2.49	0.013	-.0007788	-.0000911

Car Characteristics

Running an exploratory factor analysis:

$$\boxed{p_{s,i}} = p(\underbrace{\alpha_s, c_s}, \mathbb{K}_i)$$

$$\boxed{q_{s,i}} = p(\alpha_s, c_s, \mathbb{K}_i, \underbrace{\beta_{s,i}})$$

Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Factor2	Factor3	Uniqueness
realprice	0.8848	0.0640	0.0146	0.2128
qpercapita	-0.2845	0.8068	0.2662	0.1973
cy	0.9443	0.0376	-0.0282	0.1060
hp	0.9701	0.0005	-0.0314	0.0579
we	0.9109	0.0824	-0.0467	0.1613
le	0.9362	0.0752	-0.0297	0.1169
wi	0.9027	0.1667	-0.0570	0.1541
li	0.9003	-0.0142	0.0244	0.1887
sp	0.9768	0.0508	-0.0531	0.0404
ac	-0.8727	0.1122	-0.0252	0.2252
home	-0.0250	0.7912	0.3690	0.2371
he	-0.0647	-0.3680	0.6999	0.3706
do	0.3224	-0.4057	0.6431	0.3178
pl	0.2897	0.0997	0.3341	0.7945

```
Factor analysis/correlation                        Number of obs    =      350
    Method: principal-component factors            Retained factors =        3
    Rotation: (unrotated)                          Number of params =       39
```

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	7.93700	6.28899	0.5669	0.5669
Factor2	1.64801	0.41354	0.1177	0.6846
Factor3	1.23447	0.22242	0.0882	0.7728
Factor4	1.01205	0.36964	0.0723	0.8451
Factor13	0.04634	0.03050	0.0033	0.9989
Factor14	0.01584	.	0.0011	1.0000

LR test: independent vs. saturated: chi2(91) = 5735.27 Prob>chi2 = 0.0000

Foster, Haltiwanger, Syverson (AER 2008)

TABLE 1—SUMMARY STATISTICS FOR OUTPUT, PRICE, AND PRODUCTIVITY MEASURES

Variables	Trad'l. output	Revenue output	Physical output	Price	Trad'l. TFP	Revenue TFP	Physical TFP	Capital
Correlations								
Traditional output	1.00							
Revenue output	0.99	1.00						
Physical output	0.98	0.99	1.00					
Price	−0.03	−0.03	−0.19	1.00				
Traditional TFP	0.19	0.18	0.15	0.13	1.00			
Revenue TFP	0.17	0.21	0.18	0.16	0.86	1.00		
Physical TFP	0.17	0.20	0.28	−0.54	0.64	0.75	1.00	
Capital	0.86	0.85	0.84	−0.04	0.00	−0.00	0.03	1.00
Standard deviations								
	1.03	1.03	1.05	0.18	0.21	0.22	0.26	1.14

Notes: This table shows correlations and standard deviations for plant-level variables for our pooled sample of 17,669 plant-year observations. We remove product-year fixed effects from each variable before computing the statistics. All variables are in logs. See the text for definitions of the variables.

Source: *US Census of Manufactures*

Products: boxes, bread, carbon black, coffee, concrete, flooring, gasoline, etc…

Data suggest

<u>Three sources of heterogeneity</u> appear to be needed to deal with micro-level trade data:

- ***"Quality"***;
- ***Productive efficiency***;
- Market-specific ***"taste mismatch"***.

Looking at price and quantity distributions, the model proposed may be a good candidate to **<u>fit empirical data</u>**.

Next step: test the model ***"structurally"*** : $q_s^* = \frac{1}{\beta_s}(p_s^* - c_s)$

Some propositions

Propositions

Proposition 1: Market Size Effect on prices

Holding weighted average cost and quality indices constant, an **increase in the effective mass of firms** in a market is associated with **lower weighted average prices**. This market-size effect is **equivalent to an increase in** the degree of **substitutability** between varieties.

Proposition 2: Average Cost/Quality Effects on prices

As formerly separated markets integrate, the **price-abating effect of a larger market size may be reinforced or offset** by changes in weighted average cost or quality index in the different markets, **higher quality and higher costs being associated with higher prices**.

$$\tilde{p}_i = \mathbb{P}_i/\mathbb{N}_i = \tilde{\alpha}_i \frac{1}{2+\gamma_i \mathbb{N}_i} + \tilde{c}_i \frac{1+\gamma_i \mathbb{N}_i}{2+\gamma_i \mathbb{N}_i}$$

Propositions

Proposition 3: Average Cost/Quality Effects on total markups

As formerly separated markets integrate, the **markup-abating effect of a larger market size may be reinforced or offset** by changes in weighted average cost or quality index in the different markets, **higher quality and lower costs being associated with higher markups**.

$$\boxed{\tilde{p}_i - \tilde{c}_i = \frac{\tilde{\alpha}_i - \tilde{c}_i}{2 + \gamma_i \mathbb{N}_i}}$$

Propositions

Proposition 4: From Perfect Competition toMonopoly

As competition becomes more intense, because of a larger mass of firms or a greater degree of substitutability between varieties, **firms' pricing behavior depends more on aggregate behavior**, as **captured by market indices**. Looking at the two extremes, when competition is negligible, firms only according to the absolute value of their idiosyncratic characteristics; when competition is intense, firms' markups depend only on their characteristics relative to the market weighted averages.

Proposition 5 : Average Cost/Quality Effects on individual markups

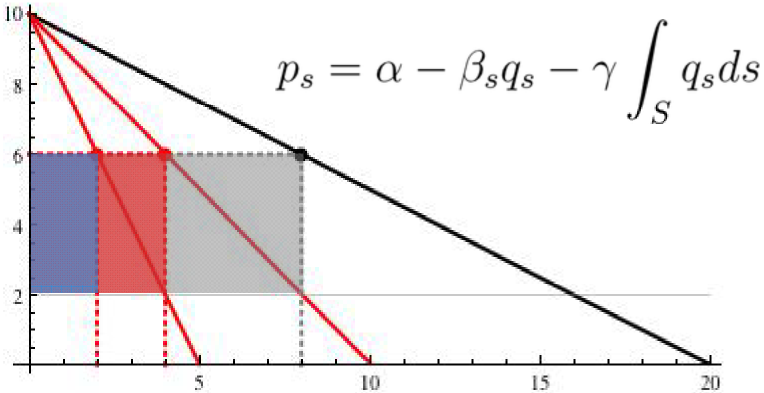
Besides the competitive pressure exerted by the effective number of firms and substitutability, **toughness of competition** in a market **depends on the costs and quality of the varieties serving it**. High quality of domestic varieties may be a barrier to entry as important as low costs.

$$p_s^* = \frac{\alpha_s}{2} + \frac{c_s}{2} - \frac{\gamma \mathbb{N} \left(\frac{\tilde{\alpha} - \tilde{c}}{2}\right)}{2 + \gamma \mathbb{N}}$$

Propositions

Proposition 6: Taste mismatch, Prices and Profits

Taste mismatch doesn't affect the sign of operating profits, but influence their magnitude, thus determining their capacity to cover fixed costs of entry and stay in a market.



$$p_s^* = \frac{c_s}{2} + \frac{\alpha + \gamma \mathbb{N} \frac{\tilde{c}}{2}}{2 + \gamma \mathbb{N}}$$

$$q_s = \boxed{\frac{1}{\beta_s}} (p_s^* - c_s)$$

Explainable observations

Theoretically challenging empirical results:

- ❖ Heterogeneous response to Trade Protection;
  [Konings and Vandenbussche, 2008]
- ❖ Weak relation between productivity and size;
  [Brooks, 2006; Hallak and Sivadasan 2009; Foster et al., 2008]
- ❖ Home bias in consumption;
  [Goldberg and Verboven, 2005; Brooks, 2003; Chung and Song, 2008; Ferreira and Waldfogel, 2010]
- ❖ Different "quality ladders" across sectors;
  [Khandelwal, 2009; Bernard et al. 2006; Bresnahan and Reiss 1991]
- ❖ Higher prices not necessarily associated with lower (higher) markups and sales.
  [Crozet et al., 2009; Eaton et al., 2007; Hummels and Klenow, 2005; Kugler and Verhoogen, 2007; Kugler, 2008; Manova and Zhang, 2009; Iacovone and Javorcik, 2008; Gorg et al. 2010]

Applications

New research questions can be raised:

❖ Are MNEs more likely to emerge in more competitive markets?

❖ Is dumping more common in high-quality sectors?

❖ Can trade liberalization lead to an increase in domestic markups?

❖ Are internationally traded products tailored to advanced countries' tastes?

Finally, different mechanisms can be imagined for

- Investment in **quality** [α_s] à la Antoniades (2008) or Kneller,Yu(2008)
- Market **positioning** [β_s] à la Hotelling (1929)

Summing up

Theoretically:

❖ Models of trade based on quadratic utility can be generalized to capture different sources of "demand heterogeneity";

❖ The resulting model generalizes early IO models of product differentiation.

In order to have a unified theory of trade and differentiation to deal with micro-level data!

Empirically:

❖ At least three sources of heterogeneity seem necessary to fit micro data;

❖ These sources can then be identified to get valuable "taste" information;

❖"Local tastes" can be used to compute more accurate market indices.

Next steps

❖ Multidimensional **demand-side heterogeneity** can be a valid complement to supply-side models **to improve data fitting**;

❖ **Vertical and horizontal differentiation** can be explicitly taken into account in intra-industry trade to enhance **generality** and **flexibility**, while keeping **tractability**;

❖ A clear **link between micro** characteristics of the firms **and macro** characteristics of a market is established through **taste-weighted market indices**;

❖ The model and its structural parameters **can be directly tested** and **estimated** - not just indirectly inferred.

Thank you!

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catholique
de Louvain

Francesco Di Comite