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# **Pricing to market when quality matters**

**Roberto Basile**

[r.basile@isae.it](mailto:r.basile@isae.it)

**Sergio de Nardis**

[s.denardis@isae.it](mailto:s.denardis@isae.it)

**Alessandro Girardi**

[a.girardi@isae.it](mailto:a.girardi@isae.it)

ISAE, Institute for Studies and Economic Analyses

# Motivation, purposes, collocation

- **Aims**
  - To investigate the influence of firm heterogeneity on PTM behaviour
  - To study the role of quality, besides price competition, in affecting price setting in different markets
  - To analyse pricing policies of Italian exporters
- **Recent literature on firm heterogeneity and PTM**
  - Auer-Chaney (2008): perfect competition; consumers have heterogeneous tastes for quality; higher-quality goods characterized by lower exchange rate pass-through than lower-quality ones
  - Atkeson-Burstein (2008): price setting under imperfect competition (nested CES demand system); dependence of markups on firms' market shares gives rise to heterogeneity in PTM
  - Berman-Martin-Mayer (2009): price setting under imperfect competition in presence of distribution costs; high-performance firms do PTM more than low-performance ones
- **A different approach followed in the paper**
  - Adoption of the Melitz-Ottaviano (2008) (M-O) framework to analyse firm-level PTM; it provides a more general scheme with markup endogenous distribution
    - Imperfect competition; Market segmentation; Variable price elasticity in destination markets
  - Basic framework modified as follows
    - Besides variety, consumers love quality: utility rises with quality-adjusted quantities of differentiated goods
    - Consumers' preferences vary according to destination markets
    - Extraction of quality-adjusted marginal costs from market-specific random distributions
    - Quality generation mechanism on the supply side
- **Testing against data on Italian firms**
  - Use of ISAE survey data providing rich set of consistent information about PTM of Italian exporters

# Demand

Consumer's Utility in country  $l$ : quality-augmented version of M-O preference structure

$q_{l,j}$  = quantity differentiated goods

$$U_l = q_{l,n} + \alpha \int_{j \in \Omega} z_j^{\delta_l} q_{l,j} dj - \frac{\gamma_l}{2} \int_{j \in \Omega} (z_j^{\delta_l} q_{l,j})^2 dj - \frac{\eta}{2} \left( \int_{j \in \Omega} z_j^{\delta_l} q_{l,j} dj \right)^2$$

$z_j$  = quality level of the differentiated goods

$0 \leq \delta_l \leq 1$  intensity of preference for quality of consumers in country  $l$ ; both  $z_j > 1$  and  $\delta_l > 0$  necessary for quality to matter

$\gamma_l$  = love for (quality-adjusted) variety in country  $l$

$\alpha \eta$  = degree of substitution between differentiated varieties and the homogenous good

Demand for quantity of variety  $j$  in  $l$

$$q_{l,j}^{dem} = \frac{L_l}{\gamma_l z_j^{\delta_l}} \frac{\alpha \gamma_l + \eta \bar{P}'_l}{(\gamma_l + \eta N_l)} - \frac{L_l}{\gamma_l z_j^{\delta_l}} \frac{p_{o,l,j} E_{o,l} \tau_{o,l}}{z_j^{\delta_l}}$$

$p_{o,l,j} E_{o,l} \tau_{o,l}$  = fob price x exchange rate x transport costs = cif price paid by consumers of  $l$  to buy variety  $j$  from producers located in country  $o$

$L_l$   $N_l$  = number of consumers in  $l$ ; number of varieties in  $l$

$\bar{P}'_l = \frac{\bar{P}_l}{\bar{z}^{\delta_l}}$  = quality-adjusted average price across varieties sold by competitors in  $l$

Maximum quality-adjusted (cif) price in the  $l$ -currency

$$\left( \frac{p_{o,l,j} E_{o,l} \tau_{o,l}}{z_j^{\delta_l}} \right)_{\max} = \frac{\alpha \gamma_l + \eta \bar{P}'_l}{(\gamma_l + \eta N_l)} = M_l$$

# Supply

Labour input (=marginal cost)

firms draw quality-adjusted unit labour coefficients from a random distribution  $G(a_j)$  common to all competitors in  $l$

$$a'_{l,j} = L_j / q_j z_j^{\delta_l} = a_j / z_j^{\delta_l}$$

Cutoff quality-adjusted marginal costs

At home and in the export market

$$\text{domestic} \longrightarrow a'_{o,o}$$

$$\text{foreign} \longrightarrow a'_{o,l} = \frac{a'_{l,l}}{\tau_{o,l} E_{o,l}} = \frac{M_l}{\tau_{o,l} E_{o,l}}$$

Quality is linked to marginal cost

Baldwin-Harrigan:  $z_j = a_j^\theta$  with  $\theta \geq 0$

$$a'_{l,j} = a_j^{1-\theta\delta_l}$$

Pricing rule

Fob price in currency  $o$  = markup on marginal cost

$$p_{o,l,j} = \frac{1}{2} \left( M_l \frac{a_j^{\theta\delta_l}}{E_{o,l} \tau_{o,l}} + a_j \right)$$

Pareto parameterization of technology random distribution+free entry

$$p_{o,l,j} = \frac{1}{2} \left[ \phi \left( \frac{\gamma_l}{L_l} \right)^{1/k+2} \left( \frac{1}{a_m^{\theta\delta_l}} \right)^{k/k+2} \tau_{o,l}^{-1} \left( \frac{1}{1+\tau^{-k}} \right)^{1/k+2} a_j^{\theta\delta_l} + a_j \right]$$

# One more passage to get the relevant equation

Make use of explicit link between average quality-adjusted price (in currency  $o$ ) and market dimension variables...

$$\frac{\bar{P}_l}{E_{o,l} \bar{a}_l^{\theta \delta_l}} = \frac{2k+1}{2(k+1)} \left( \frac{\gamma_l}{L_l} \right)^{1/k+2} \left( \frac{1}{a_m^{\theta \delta_l}} \right)^{k/k+2} \left( \frac{1}{1+\tau^{-k}} \right)^{1/k+2} \phi$$

$\bar{a}_l$  = average marginal cost across competitors in destination market

...to disentangle influence on fob price of price competition from that of quality competition getting relevant equation

$$p_{o,l,j} = \frac{1}{2} \left( K \frac{\tilde{a}_{l,j}^{V_l}}{C_l} + a_j \right)$$

Price:  $C_l = \frac{E_{o,l}}{\bar{P}_l} \tau_{o,l}$

Quality:  $V_l = \delta_l \theta$

Relative quality (cost) vs competitors:  $\tilde{a}_{l,j} = \left( \frac{a_j}{\bar{a}_l} \right)$

Constant:  $K = \frac{2(k+1)}{2k+1}$

# Price setting according to markets

$$P_{o,l,j} = \frac{K \frac{\tilde{a}_{l,j}^{V_l}}{C_l} + a_j}{2}$$

Price competition:  $C_l = \frac{E_{o,l}}{\bar{P}_l} \tau_{o,l}$

Quality competition:  $V_l = \delta_l \theta$

Heterogeneity:  $\tilde{a}_{l,j} = \left( \frac{a_j}{\bar{a}_l} \right)$

- Change in price competition factors: negative sign, tougher-competition effect
 
$$\frac{\partial P_{o,l,j}}{\partial C_l} = -K \left( \frac{a_j}{\bar{a}_l} \right)^{V_l} / 2C_l^2 < 0$$
- Change in quality factors: sign depends on relative quality vis-à-vis competitors
 
$$\frac{\partial P_{o,l,j}}{\partial V_l} = K \left( \frac{a_j}{\bar{a}_l} \right)^{V_l} \ln \left( \frac{a_j}{\bar{a}_l} \right) / 2C_l > 0 \text{ or } < 0 \text{ if } \tilde{a}_{l,j} > 1 \text{ or } \tilde{a}_{l,j} < 1$$
- Impact of firm heterogeneity ( $a_j$ ) on the response of fob prices to price competition shocks
  - $V_l = 0$  all firms react the same way (basic M–O case)
  - $V_l > 0$  response to tougher price competition stronger for higher quality firms
- Impact of firm heterogeneity ( $a_j$ ) on the response of fob prices to quality competition shocks
  - $a_j > \bar{a}_l$  positive response to higher quality taste is stronger for higher quality firms
  - $a_j < \bar{a}_l$  negative response to higher quality taste is less or more negative depending on quality – gap vs competitors and strength of quality tastes in destination mkt

# PTM: home vs abroad and linearization

$$R_{j,t} = p_{H,F,j,t} - p_{H,H,j,t} = \frac{K}{2} \left( \frac{\tilde{a}_{F,j}^{V_{F,t}}}{C_{F,t}} - \frac{\tilde{a}_{H,j}^{V_{H,t}}}{C_{H,t}} \right) \square \beta_{0j} + \beta_{1,j}(C_{F,t}) + \beta_{2,j}(C_{H,t}) + \beta_{3,j}(V_{F,t}) + \beta_{4,j}(V_{H,t})$$

$$\beta_{1,j} = -\frac{K}{2\bar{C}_F^2} \tilde{a}_{F,j}^{\bar{V}_F} < 0 \quad \beta_{2,j} = \frac{K}{2\bar{C}_H^2} \tilde{a}_{H,j}^{\bar{V}_H} > 0 \quad \beta_{3,j} = \frac{K}{2\bar{C}_F} \tilde{a}_{F,j}^{\bar{V}_F} \ln \tilde{a}_{F,j} > 0 \text{ or } < 0 \quad \beta_{4,j} = -\frac{K}{2\bar{C}_H} \tilde{a}_{H,j}^{\bar{V}_H} \ln \tilde{a}_{H,j} > 0 \text{ or } < 0$$

## Hypotheses to test

- i) Do data show classic PTM behaviour predicted by standard open macroeconomic models and featured also in this model?
- ii) Do data show a role of quality in affecting differently pricing policies of firms in destination markets and what is the sign?
- iii) If quality matters, does this make response of firms to shocks to price and quality competition dependent on firm heterogeneity?
- iv) If so, does this work in the direction to increase size of these responses for high-quality producers wrt low-quality ones (or not)?

# Data and variables

- **Source:**
  - Firm-level quarterly data surveyed by ISAE
    - *Period:* from 2003/2 to 2007/3
    - *Number of exporting firms:* 2,755 individuals and 32,087 observations
- **Response variable:**
  - Margin between export and domestic price (*r*)
    - 0, 1, 2 -> price abroad lower, equal and higher than the domestic one
- **Covariates:**
  - Price competitiveness factors (*pcf*):
    - 1 (price as the main competitiveness factor), 0 (otherwise); Negative expected effect - PTM
  - Quality competitiveness factors (*npc*)
    - 1 (quality as the main competitiveness factor), 0 (otherwise); Positive expected effect
  - Firm size (*emp*, *emp2*)
    - number of employees and its square (proxy for labour productivity: Bernard and Jensen, 1995; Bernard et al., 2003; Crinò and Epifani, 2008)
  - Demand conditions
    - cyclical demand conditions in the home and abroad
  - Other individual firm's characteristics
    - export intensity
  - Other controls
    - destination markets
    - sector, regional and yearly dummies

# Econometric issues

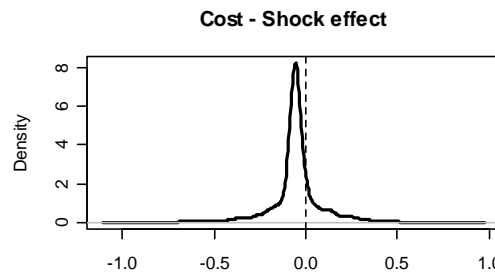
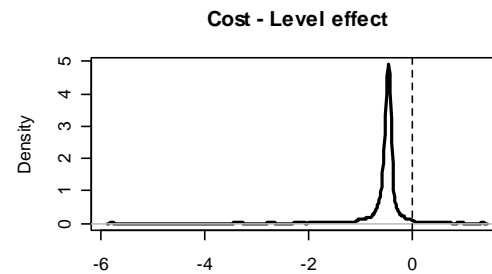
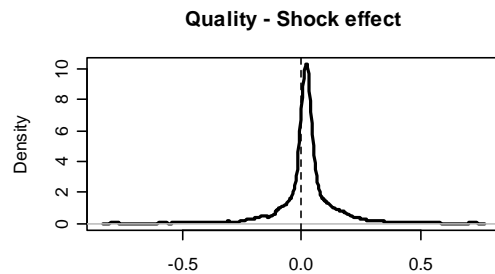
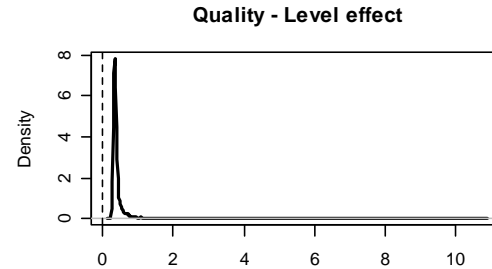
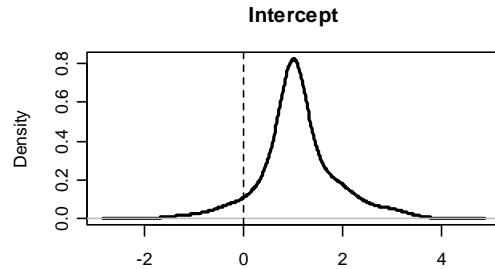
- Ordered Regression Model (*ORM*) for panel data (McKelvey and Zavoina, 1975)
- Empirical strategy...
  - Sample selection:
    - the subset of exporting firms is an unbiased sample
  - Pooled data model
  - Random effect model (*RE-ORM*)
    - capture the effect of unobserved individual heterogeneity (Greene, 2005)
  - Random parameters model (*RP-ORM*)
    - relaxes the assumption of fixed slopes and allows some or all parameters to be specified as random parameters (Greene, 2004; Gourieroux and Monfort, 1996; Train, 2003)
- ...including
  - time averages of the time-varying variables (*level* effects, i.e. the differences *between* individuals)
  - deviations from the averages per individual (*shock* effects or *within* effects) (Wooldridge, 2002)
- Simulated maximum likelihood (ML) procedures
  - unconditioned likelihood function estimated by Monte Carlo simulation using Halton draws (Bhat, 2001)

# Estimation results

	<u>Shock effect</u>	<u>Level effect</u>
<i>pcf</i>	-0.0612 ** (0.0278)	-0.4532 *** (0.0397)
<i>npc</i>	0.0193 (0.0271)	0.3126 *** (0.0444)
<i>emp</i>	0.5112 *** (0.1577)	0.1490 *** (0.0486)
<i>emp2</i>	-0.0556 *** (0.0191)	-0.0165 *** (0.0064)
<i>emp</i> × <i>lnpt</i>	-0.7475 (0.6036)	
<i>emp</i> × <i>pcf</i>	0.7384 (0.6463)	-0.5038 *** (0.1246)
<i>emp</i> × <i>npc</i>	0.2816 (0.9779)	1.0198 *** (0.1745)
$\sigma$ - <i>lnpt</i>	0.9466 *** (0.0085)	
$\sigma$ - <i>pcf</i>	0.4335 *** (0.0236)	0.0854 *** (0.0240)
$\sigma$ - <i>npc</i>	0.3540 *** (0.0222)	0.7776 *** (0.0244)
$\mu$	3.2532 *** (0.0118)	
<i>Log Lik.</i>	-16,199	

- *pcf*:
  - standard PTM strategies
- *npc*:
  - producers selling varieties with higher quality than competitors can set higher prices abroad but...
  - ... the effect of quality is permanent rather than temporary
- *emp*:
  - inverted U-shaped relationship
- *emp* × *npc*:
  - increasing firm size, higher-quality firms able to react to a stronger quality competitiveness abroad by raising *r* more than lower-quality firms and ...
- *emp* × *pcf*:
  - ... to reduce *r* when facing a higher price pressure from foreign competitors
- $\sigma$ 's
  - impact of *npc* and *pcf* varies randomly across exporting firms

# Kernel density plots of RPs



- **Level effects:**
  - despite heterogeneity, always positive (*npc*) or negative (*pcf*)
- **Shock effects:**
  - although the majority of respondents show a negative reaction to *pcf*, around 20% display an opposite behaviour
  - most of firms exhibit a positive reaction to *npc*, but around 25% respond negatively

# Conclusions

- Theoretical model of pricing behaviour
  - predicts classic PTM results and highlights the role of quality competitiveness
  - response to price and quality competition affected by firm heterogeneity:
    - higher-quality firms react more strongly to shifts in price competition than lower quality producers
    - response to changes in tastes for quality stronger for higher-quality firms
  - empirical testable hypotheses:
    - *i)* do data show the classic PTM behaviour?
    - *ii)* do data show a role of quality in affecting pricing policies?
    - *iii)* is the pricing behaviour characterised by firm heterogeneity?
    - *iv)* if so, are responses stronger for higher-quality producers *wrt* low-quality producers?

# Conclusions

- Empirical test of the hypotheses against a dataset on a sample of Italian firms
  - positive answers to questions *i)* and *ii)*
    - Italian exporters able to practice PTM-based pricing policies
    - and to pursue a price setting behaviour which depends on consumers' "appetite for quality" in foreign markets
  - positive answers to questions *iii)* and *iv)*
    - firm heterogeneity affects their reaction to shifts in (price and quality) competitive pressures abroad
    - the influence goes in the direction to provide higher-quality firms with more market power than the lower-quality ones