Pricing to market when quality matters

Roberto Basile  
roberto@isae.it  
Sergio de Nardis  
s.denardis@isae.it  
Alessandro Girardi  
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

\[
q_{l,j} = \text{quantity differentiated goods} \quad U_l = q_{l,u} + \alpha \int_{j \in \Omega} z_j^j q_{l,j} dj - \frac{\gamma_l}{2} \int_{j \in \Omega} \left( z_j^j q_{l,j} \right)^2 dj - \frac{\eta}{2} \left( \int_{j \in \Omega} z_j^j q_{l,j} dj \right)^2
\]

\( z_j \) = quality level of the differentiated goods

\( 0 \leq \delta_i \leq 1 \) intensity of preference for quality of consumers in country \( l \); both \( z_j > 1 \) and \( \delta_i > 0 \) 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 \( l \)

\[
q_{l,j}^{\text{dem}} = \frac{L_l}{\gamma_l z_j^j \left( \gamma_l + \eta N_l \right)} - \frac{L_l}{\gamma_l z_j^j z_j^j} \frac{P_o,j,l E_o,j \tau_{o,l}}{\gamma_l z_j^j z_j^j}
\]

\( P_{o,j,l} E_{o,l} \tau_{o,l} = \) fob price \( \times \) exchange rate \( \times \) 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 \( l \)

\( \bar{P}_l = \frac{\bar{P}_l}{z_j^j} \) = quality-adjusted average price across varieties sold by competitors in \( l \)

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

\[
\left( \frac{P_{o,j,l} E_{o,l} \tau_{o,l}}{z_j^j} \right)_{\text{max}} = \frac{\alpha \gamma_l + \eta \bar{P}_l}{\gamma_l + \eta N_l} = M_l
\]
Supply

Labour input (=marginal cost)

firms draw quality-adjusted unit labour \( a_{l,j} \) coefficients from a random distribution \( G(d_l) \)
common to all competitors in \( l \)

Cutoff quality-adjusted marginal costs

At home and in the export market

Quality is linked to marginal cost
Baldwin-Harrigan: \( z_j = a_{j}^{\theta} \) with \( \theta \geq 0 \)

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

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

\[
\frac{\bar{P}}{E_o, \bar{a}^0, \delta^k} = \frac{2k+1}{2(k+1)} \left( \frac{\gamma_i}{L_i} \right)^{\phi} \left( \frac{1}{a_m^\delta} \right)^{k/\phi} \left( \frac{1}{1+\tau^k} \right)^{l/\phi} \phi
\]

\(\bar{a}_i = \text{average marginal cost across competitors in destination market}\)

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

\[
P_{o,l,j} = \frac{1}{2} \left( \frac{\tilde{a}_{l,j}^{V_i}}{C_l} + a_j \right)
\]

Price: \(C_l = \frac{E_o}{\bar{P}} \tau_{o,l}\)

Quality: \(V_i = \delta_i \theta\)

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

\[ P_{o,l,j} = K \frac{\tilde{a}_l^V}{C_l} + a_j \]

Price competition

\[ C_l = \frac{E_{o,l}}{P_l} \tau_{o,l} \]

Quality competition

\[ V_l = \delta_l \theta \]

Heterogeneity

\[ \tilde{a}_{i,j} = \left( \frac{a_j}{\bar{a}_l} \right) \]

1. Change in price competition factors: negative sign, tougher-competition effect

\[ \frac{\partial p_{o,l,j}}{\partial C_l} = -K \left( \frac{a_j}{\bar{a}_l} \right)^V / 2C_l^2 < 0 \]

2. Change in quality factors: sign depends on relative quality vis-à-vis competitors

\[ \frac{\partial p_{o,l,j}}{\partial V_l} = K \left( \frac{a_j}{\bar{a}} \right)^V \ln \left( \frac{a_j}{\bar{a}} \right) / 2C_l > 0 \text{ or } < 0 \text{ if } \tilde{a}_{i,j} > 1 \text{ or } \tilde{a}_{i,j} < 1 \]

3. Impact of firm heterogeneity \((a_j)\) on the response of fob prices to price competition shocks

\[ -V_l = 0 \text{ all firms react the same way (basic M–O case)} \]

\[ -V_l > 0 \text{ response to tougher price competition stronger for higher quality firms} \]

4. Impact of firm heterogeneity \((a_j)\) on the response of fob prices to quality competition shocks

\[ a_j > \bar{a}_l \text{ positive response to higher quality taste is stronger for higher quality firms} \]

\[ a_j < \bar{a}_l \text{ negative response to higher quality taste is less or more negative depending on quality–gap vs competitors and strength of quality tastes in destination mkt} \]
PTM: home vs abroad and linearization

\[ R_{j,t} = p_{H,F,j,t} - p_{H,H,j,t} = \frac{K}{2} \left( \frac{\tilde{a}_{F,j}^{V_F}}{C_{F,t}} - \frac{\tilde{a}_{H,j}^{V_H}}{C_{H,t}} \right) \beta_0 + \beta_1 \left( C_{F,t} \right) + \beta_2 \left( C_{H,t} \right) + \beta_3 \left( V_{F,t} \right) + \beta_4 \left( V_{H,t} \right) \]

\[ \beta_{1,j} = \frac{K}{2C_F} \tilde{a}_{F,j}^{V_F} < 0 \quad \beta_{2,j} = \frac{K}{2C_F} \tilde{a}_{H,j}^{V_H} > 0 \quad \beta_{3,j} = \frac{K}{2C_F} \tilde{a}_{F,j}^{V_F} \ln \tilde{n}_{F,j} > 0 \text{ or } < 0 \quad \beta_{4,j} = \frac{K}{2C_H} \tilde{a}_{H,j}^{V_H} \ln \tilde{n}_{H,j} > 0 \text{ or } < 0 \]

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

<table>
<thead>
<tr>
<th></th>
<th>Shock effect</th>
<th>Level effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>pcf</td>
<td>-0.0612 **</td>
<td>-0.4332 ***</td>
</tr>
<tr>
<td></td>
<td>(0.0278)</td>
<td>(0.0397)</td>
</tr>
<tr>
<td>npc</td>
<td>0.0193</td>
<td>0.3126 ***</td>
</tr>
<tr>
<td></td>
<td>(0.0271)</td>
<td>(0.0444)</td>
</tr>
<tr>
<td>emp</td>
<td>0.5112 ***</td>
<td>0.1490 ***</td>
</tr>
<tr>
<td></td>
<td>(0.1577)</td>
<td>(0.0486)</td>
</tr>
<tr>
<td>emp2</td>
<td>-0.0556 ***</td>
<td>-0.0165 ***</td>
</tr>
<tr>
<td></td>
<td>(0.0191)</td>
<td>(0.0064)</td>
</tr>
<tr>
<td>emp × inp</td>
<td>-0.7475</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.6036)</td>
<td></td>
</tr>
<tr>
<td>emp × pcf</td>
<td>0.7384</td>
<td>-0.9038 ***</td>
</tr>
<tr>
<td></td>
<td>(0.6463)</td>
<td>(0.1246)</td>
</tr>
<tr>
<td>emp × npc</td>
<td>0.2816</td>
<td>1.0198 ***</td>
</tr>
<tr>
<td></td>
<td>(0.9779)</td>
<td>(0.1745)</td>
</tr>
<tr>
<td>σ−inp</td>
<td>0.9466 ***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0085)</td>
<td></td>
</tr>
<tr>
<td>σ−pcf</td>
<td>0.4335 ***</td>
<td>0.0854 ***</td>
</tr>
<tr>
<td></td>
<td>(0.0236)</td>
<td>(0.0240)</td>
</tr>
<tr>
<td>σ−npc</td>
<td>0.5540 ***</td>
<td>0.7776 ***</td>
</tr>
<tr>
<td></td>
<td>(0.0222)</td>
<td>(0.0244)</td>
</tr>
<tr>
<td>μ</td>
<td>3.2532 ***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0118)</td>
<td></td>
</tr>
<tr>
<td>Log Lik</td>
<td>-16,199</td>
<td></td>
</tr>
</tbody>
</table>

- **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
- **σ'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 \textit{wrt} low-quality producers?
Conclusions

• Empirical test of the hypotheses against a dataset on a sample of Italian firms
  – positive answers to questions \textit{i)} and \textit{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 \textit{iii)} and \textit{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