Quality choice, competition and vertical relationship in a market of Protected Designation of Origin

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Motivation

- Development of an EU labeling policy (PDO, PGI, TSG): support agricultural activity/ valorization and protection of agricultural and food products
- Protected designation of origin : efficient way to capture price premium for agricultural suppliers.
- PDO applies to the final food commodity but the whole production chain (farmers and processors) is involved in PDO development
- Technical requirements (cahier des charges) inherent to specific input (upstream) and manufacturing process (downstream)
- Certification: voluntary collective decision (Collective application for certification and collective choice of cahier des charges)

Literature

Provision of PDO relies on

- benefit: Price premiums are directly linked to GIs. However,
  - Loureiro and McCluskey (2000), Hassan and Monier (2006): price premium is higher for medium-quality GIs than highest-quality ones
  - Hassan et al. (2011), Bonnet and Simioni (2001): French PDO cheeses do not necessarily represent high quality products.
- cost
  - link with certification cost (Marette and Crespi 2003, Moschini et al. 2008)
  - link with production practices: Bouamra and Chaaban (2010), Lence et al. (2007)

Research question:

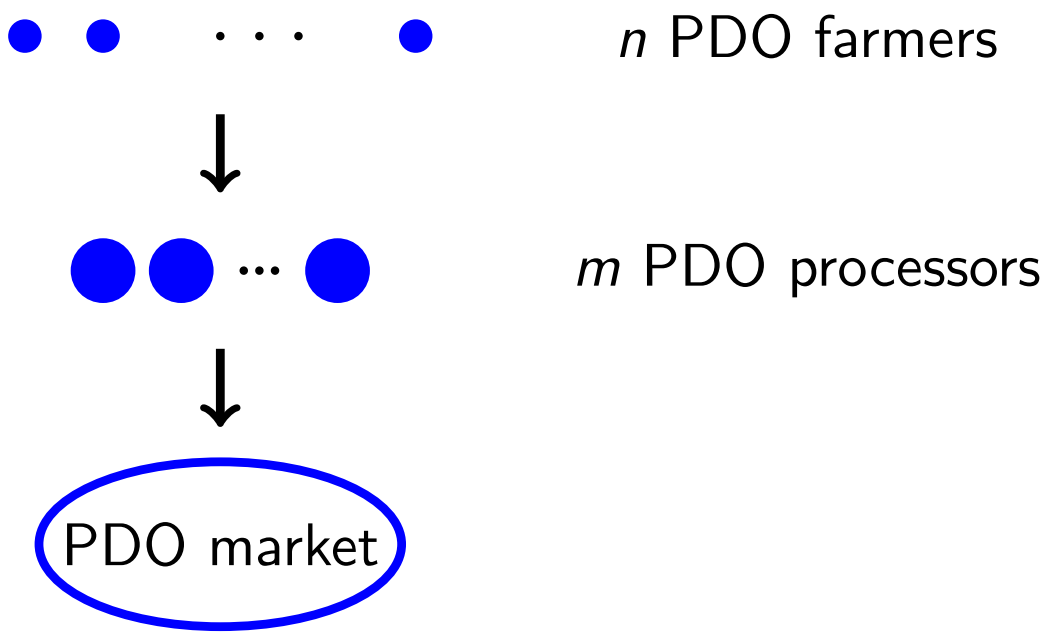
- Will PDO farmers and processors have incentive to impose a stringent production specification?
- Do farmers and processors have the same incentive to control production through production practices?

Competition and choice of quality

- Possibility of quantity control through production requirement:
  - Hayes (2004), Lence et al. (2007)
- Depending on the industry structure and competition types
  - Quality choice of monopoly: Spence (1979), However vertical relationship not considered
  - Demand and supply shift under oligopoly and/or oligopsony competition: Hamilton and Sunding (1998), McCorriston and Sheldon (1991). However, choice of quality not considered
- This paper takes into account
  - Vertical relationship
  - Different degree of competition
  - Choice of production requirements

Structure of the PDO supply chain

- n identical farmers and m identical processors



Consumers

- Assumption: To focus on the supply-control role of production requirement β , it is assumed that increasing β above $\underline{\beta}$ does not have any effect on consumer preferences for the PDO product. (Lence et al.)

$$\frac{\partial U(X,\beta)}{\partial \beta} = 0 \text{ if } \beta \geq \underline{\beta}$$

So that if $\beta > \underline{\beta}$

$$p(X,\beta) = \frac{\partial U(X,\beta)}{\partial X} = p(X,\underline{\beta})$$

Farmers and processors

- Farmers
  - The cost of production is $c(q, \beta)$,
    - $c_q(q, \beta) > 0, c_{qq}(q, \beta) > 0$, $c_\beta > 0$ and $c_{q\beta} > 0$
    - $\beta \in [\underline{\beta}, +\infty]$
  - Profit: $\pi^f = wq - c(q, \beta)$
  - Price takers: $w = c_q(\frac{Q}{n}, \beta)$
- Processors
  - One unit of PDO products requires one unit of PDO input
  - The processing cost is assumed to be zero.
  - Profit: $\pi_i^p = (p(X) - w)\, x_i$

Game

- 1- the farmer group and the processor group jointly decide the PDO quality β. Two cases may occur:
  - Farmers and processors have the same incentive when choosing production standards.
  - They have different interests.
- 2- processors simultaneously decide how much to sell on the downstream market and buy the quantity of input according to their downstream production decision.
  The market of the raw material clears through the balance of supply and demand.

Perfect competition

- Market clearing condition

$$p(X) = w = c_q(\frac{X}{n}, \beta)$$

- Impact on quantity and price

$$\frac{dX}{d\beta} = \frac{c_{q\beta}}{p' - c_{qq}/n} < 0, \qquad \frac{dp(X)}{d\beta} = p'\frac{dX}{d\beta} > 0$$

- Quality choice
  - Processors earn zero profit
  - Farmers: $\frac{dn\pi^f}{d\beta} > 0$ iff

$$\eta = \frac{c_{q\beta}}{c_\beta/q} > 1 + \frac{\epsilon_d}{\epsilon_s}$$

  - Higher η: larger increase in marginal cost relative to the increase in the average cost. Depending on cahier des charges.

Cournot competition among processors

- Processors may have either oligopsony and/or oligopoly power
- Profit maximizing:

$$\max_{x_i} \pi_i^p = \left(p(x_i + X_{-i}) - c_q(\frac{x_i + X_{-i}}{n}, \beta) \right) x_i$$

- First order condition:

$$p(X) - c_q(\frac{X}{n}, \beta) + \frac{X}{m} \left(\underbrace{p'(X)}_{oligopoly} \underbrace{-\frac{c_{qq}(\frac{X}{n}, \beta)}{n}}_{oligopsony} \right) = 0$$

- Mark-up:

$$L \equiv \frac{p - w}{p} = \frac{1}{m}(\underbrace{\frac{1}{\epsilon_d}}_{oligopoly} + \underbrace{\frac{w}{p}\frac{1}{\epsilon_s}}_{oligopsony}) = \frac{\epsilon_s/\epsilon_d + 1}{m\epsilon_s + 1}$$

Choice of quality

- Impact on quantity: $\frac{dX}{d\beta} = \frac{c_{q\beta} + \frac{q}{m} c_{qq\beta}}{SOC} < 0$
  - β depends on cahier des charges:
    - shifts the level of marginal cost $c_{q\beta} = \frac{\partial w}{\partial \beta}$
    - may also change the slope of the marginal cost $c_{qq\beta}$
  - SOC depends on the competition pattern
- Impact on profit of processors: $\frac{dm\pi^p}{d\beta} = \underbrace{-Xc_{q\beta}}_{-} \underbrace{-\frac{m-1}{m}(p-w)\frac{dX}{d\beta}}_{+}$
- Impact on profit of farmers: $\frac{dn\pi^f}{d\beta} = \underbrace{-nc_\beta}_{-} + \underbrace{Xc_{q\beta}}_{+} + \underbrace{\frac{dX}{d\beta} q c_{qq}}_{-}$
- Divergent interest between farmers and processors, depending on
  - Competition: oligopoly and/or oligopsony
  - Form of $c(q, \beta)$

Oligopoly

- First order condition: : $p(X) - c_q + \frac{X}{m}p'(X) = 0$
- Impact on quantity: $|\frac{dX}{d\beta}|_{\text{oligopoly}} < |\frac{dX}{d\beta}|_{\text{Perfect competition}}$

$$\frac{dX}{d\beta} = \frac{c_{q\beta}}{p' - \frac{c_{qq}}{n} + \underbrace{\frac{1}{m}(p' + Xp'')}_{oligopoly}}$$

- Impact on the margin: if demand is not too convex ($p' + Xp'' < 0$)

$$\frac{d(p-w)}{d\beta} = \underbrace{-c_{q\beta}}_{\text{direct impact on } w} + \underbrace{(p' - \frac{c_{qq}}{n})\frac{dX}{d\beta}}_{\text{indirect impact on the margin}} < 0$$

- Impact on profit of processors: $\frac{dm\pi^p}{d\beta} < 0$

Oligopoly

- Impact on the profit of farmers: $\frac{dn\pi^f}{d\beta} = \underbrace{-nc_\beta}_{-} + \underbrace{Xc_{q\beta}}_{+} + \underbrace{\frac{dX}{d\beta} qc_{qq}}_{-}$
  - The first two effects depends only on cost function
  - the negative effect on quantity is smaller under oligopoly competition
  - $\frac{dn\pi^f}{d\beta} > 0$ iff $\eta > 1 + \frac{\frac{1}{\epsilon_s}(\epsilon_d - \frac{1}{m})}{1+\frac{1-V_d}{m}}$

  $\Longrightarrow$ It is more likely for farmers to choose a higher β under oligopoly competition than under perfect competition

- Conflict of interest:
  - Processors prefers the minimum quality.
  - Farmers tend to choose a more stringent quality requirement.
  - The equilibrium quality is decided through negotiation, depending on their relative bargaining power.

Oligopsony

- First order condition: $p(X) - c_q - \frac{X}{m}\frac{c_{qq}}{n} = 0$
- Impact on quantity:

$$\frac{dX}{d\beta} = \frac{c_{q\beta} + \overbrace{\frac{q}{m}c_{qq\beta}}}{p' - \frac{c_{qq}}{n} \underbrace{-\frac{1}{mn}(c_{qq} + qc_{qqq})}_{-}}$$

  The impact is larger if $\mu = \frac{c_{qq\beta}}{c_{q\beta}/q}$ is larger.

- Impact on the margin: $\frac{dp-w}{d\beta} > 0$ iff $\mu > \frac{1+V_s}{1+\frac{1}{\epsilon_d}(\epsilon_s+\frac{1}{m})}$
  - The larger μ and/or the larger ϵ_s compared to ϵ_d, the more likely that processors have a positive margin.

Oligopsony

- Impact on profit of processors:

$$\frac{dm\pi^p}{d\beta} = \underbrace{(p-w)\frac{dX}{d\beta}}_{-} \qquad \underbrace{+X\frac{dp-w}{d\beta}}_{\text{depending on } \mu,\ \epsilon_s \text{ and } \epsilon_d}$$

  $\frac{dm\pi^p}{d\beta} > 0$ iff $\mu > \frac{2+V_s}{\frac{1}{\epsilon_d}(\epsilon_s+\frac{1}{m})+1-\frac{1}{m}}$ which holds for a large μ, small m, large ϵ_s compared to ϵ_d and large V_s.

- Impact on profit of farmers: $\frac{dn\pi^f}{d\beta} = \underbrace{-nc_\beta}_{-} + \underbrace{Xc_{q\beta}}_{+} + \underbrace{\frac{dX}{d\beta}qc_{qq}}_{-}$
  - $\frac{dn\pi^f}{d\beta} > 0$ iff $\eta > 1 + \frac{\mu+m}{\frac{m\epsilon_s+1}{\epsilon_d}+1+V_s-\mu}$.
  - If μ is large so that the impact on X is large, it is less likely to have $\frac{dn\pi^f}{d\beta} > 0$, however it depends also on η.
- Conflict of interest may be reversed when μ is large
  - Farmers may prefer a lower quality standard than processors.

Conditions for a higher quality standard

	Perfect Competition	Oligopoly	Oligopsony
Processors	$\pi^p = 0$	$\beta^p = \underline{\beta}$	$\beta^p > \underline{\beta}$ iff $\mu > \frac{2+V_s}{\frac{1}{\epsilon_d}(\epsilon_s+\frac{1}{m})+1-\frac{1}{m}}$
Farmers $\beta^f > \underline{\beta}$ iff	$\eta > 1 + \frac{\epsilon_d}{\epsilon_s}$	$\eta > 1 + \frac{\frac{1}{\epsilon_s}(\epsilon_d - \frac{1}{m})}{1+\frac{1-V_d}{m}}$	$\eta > 1 + \frac{\mu+m}{\frac{m\epsilon_s+1}{\epsilon_d}+1+V_s-\mu}$

- For a given market structure, the choice of quality depends on how β affects the technology.

Different technologies

- Parallel shift of supply function: $c(q,\beta) = G(q) + F(\beta)q + H(\beta)$
  - $c_q = G'(q) + F(\beta)$, $\eta = \frac{c_{q\beta}}{c_\beta / q} \leq 1$, $\mu = \frac{c_{qq\beta}}{c_{q\beta}/q} = 0$.
  - In all cases of competition, $\beta^p = \beta^f = \underline{\beta}$

- Rotation of supply : $c(q,\beta) = F(\beta)q^\lambda$ (with $\lambda \geq 2$)
  - $c_q = q^{\lambda-1}\lambda F(\beta)$, $\eta = \lambda$, $\mu = \lambda - 1$, $V_s = \lambda - 2$
  - Depending on demand structure: if $\epsilon_d < 1$
    - $\beta^f > \underline{\beta}$ in all cases of competition
    - $\beta^p > \underline{\beta}$ in case of oligopsony.

An illustration: linear demand and supply function

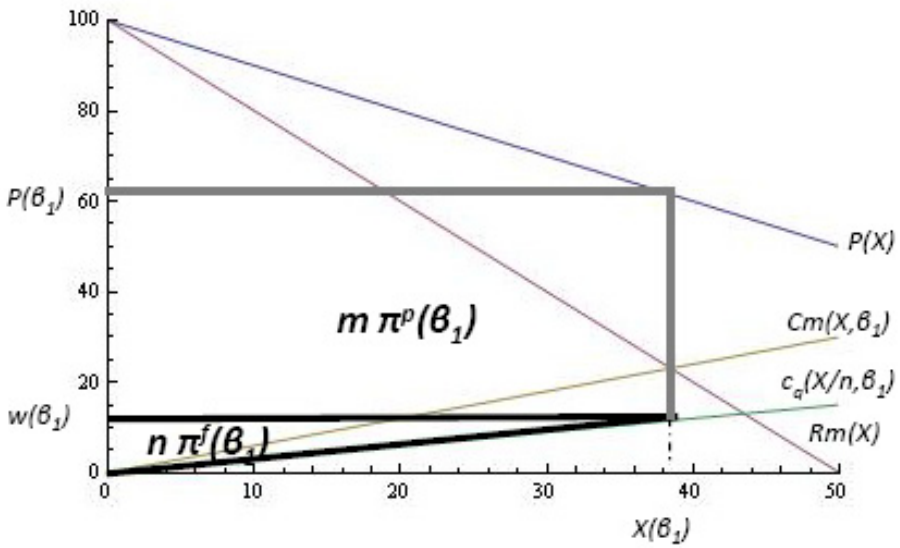
- Demand function: $p(X) = a - bX$
- Cost function: $c(q, \beta) = \frac{1}{2}\beta q^2$

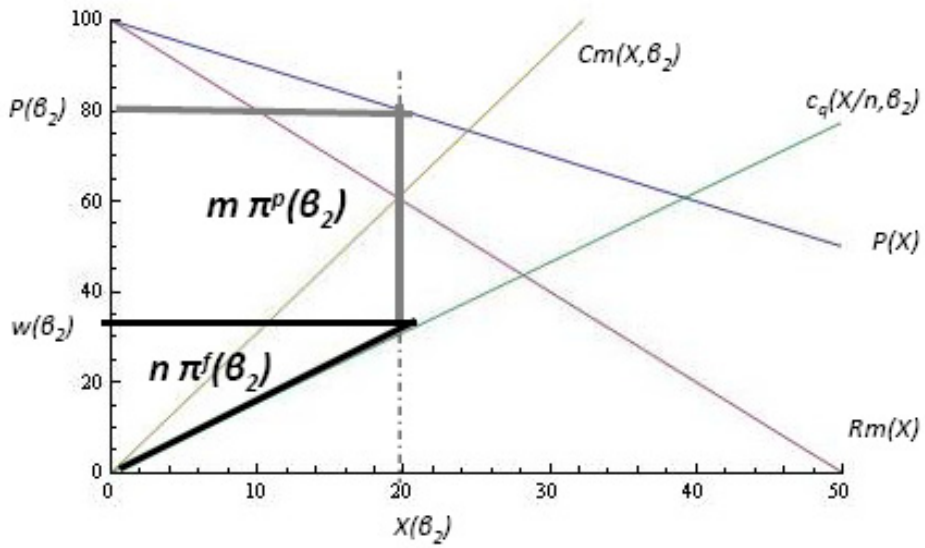
	Perfect Competition	Oligopoly	Oligopsony	both
Processors	$\pi^p = 0$	$\beta^p = \underline{\beta}$	$\beta^p = \frac{m}{1+m} bn$	$\beta^p = \underline{\beta}$
Farmers	$\beta^f = bn$	$\beta^f = \frac{1+m}{m} bn$	$\beta^f = \frac{m}{1+m} bn$	$\beta^f = bn$

A higher quality is preferred by farmers if

- the demand is less elastic (the larger b)
- the total supply is more elastic (the larger n)
- the degree of oligopoly competition is higher (the smaller m)
- the degree of oligopsony competition is lower (the larger m)

An illustration–with both oligopoly and oligopsony power





Concluding remarks

- PDO producers provide higher than minimum production requirements to control quantity, if
  - the quality requirement rotates the product supply upward, i.e. makes the production more diseconomy of scale.
  - the demand for PDO is inelastic
- Only in the case that processors have oligopsony power, can it be possible that they have incentive to choose a higher β.
- In other cases, farmers tend to choose a higher β than that would be chosen by processors.
- The requirements at the equilibrium depends on
  - relative bargaining power
  - political power of farmers/processors to influence public authority

Further work

- PDO cahier des charges: the supply-rotation effect.
- PDO processing technology.
- More specific vertical relationship between farmers and processing industry: contract, negotiation...
- The role of confining the geographical area.
- The role of certification costs.
- Competition between PDO and non PDO.
- Impact on demand.