Open Innovation in the food and drink industry

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Outline

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Introduction

The Food and Drink Industry

- One of Europe's most important and dynamic industrial sectors
- Made up of about 287 000 companies, and provides jobs for more than 4.25 million people
- The employment represents about 15% of the total manufacturing sector
- Total manufacturing turnover in 2011 was 1.017 bn for the EU-27, and contributed 1.9% to EU gross value added
- Characterized by fragmentation
- In 2010, European Commission placed the innovation as a major point of the Europe 2020 strategy, and announced the Innovation Union.
- R&D - one of the main tools important for innovation, productivity growth and the competitiveness of all industry sectors (EU Commission, 2009) .
- Food industry is not specially innovative compared to other industry branches, low research intence sector

The Theory of Open Innovation

Open Innovation - Definition

"Open Innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively." (Chesbrough, 2006).

OI involve outside-in and inside-out flows of technologies and ideas (defined as 'technology acquisition' and 'technology exploitation') (Lichtenthaler, 2008)

The Theory of Open Innovation

Open innovation leads to

- Opening up boundaries of the companies
- Flow of the valuable knowledge from outside
- Creation of opportunities for cooperative innovation processes with partners, customers, suppliers, academia, etc.
- Exploitation of ideas and Intellectual Property (IP) in order to bring it faster to the market than competitors can.
- Gaining strategic flexibility in the strategic process (Gasmann, Enkel, 2004).

The Theory of Open Innovation

Three significant processes in OI

1. *Outside-in process*
   - Integration of suppliers, customers, external knowledge sourcing
   - Can increase company innovativeness
   - Importance of networks, and/or crowdsourcing/mass customization
2. *Inside-out process*
   - Bringing ideas to the market, by:
     - Selling IPRs,
     - Multiplying technology by transferring ideas to the outside environment
     - *Charges for licences*
3. *Coupled process*
   - Co-creation with (basically) complementary partners through alliances, cooperation, and joint ventures – give and take are essential for success
   - Combination of inside-out and outside-in process (Enkel, Gassmann, Chesbrough, 2009)

The Theory of Open Innovation

- *Open innovation – primarily*:
  - large multinational companies, high-tech, fast growing
  - Information and communication technology sector/pharmaceutical industry
  - Examples: Linux, Mozilla Firefox, Microsoft, Oracle, Intel, Genentech

- *Drivers of opening up (food industry):*
  - A growing number of chain actors,
  - Contradictory requirements of chain actors,
  - Heterogeneous needs/new trends in consumers' demand,
  - Mass customization market
  - Legislators (Sakar, Costa, 2008; Bilgliardi, Galati, 2013).

Research objectives and questions

- *Problem statement:*
  - Open innovation approach works well for the high-tech industry, but we want to know if it will perform well for the low-tech industry.
- *Research objectives:*
  - Find out whether OI is an optimal strategy for the F&D industry
  - To assess whether R&D pooling will work better than patents and IPRs for the F&D industry

Methodology

The model is based on three different models:

1. *Endogenizing know-how flows through the nature of R&D investments (Cassiman et al., 2000)*

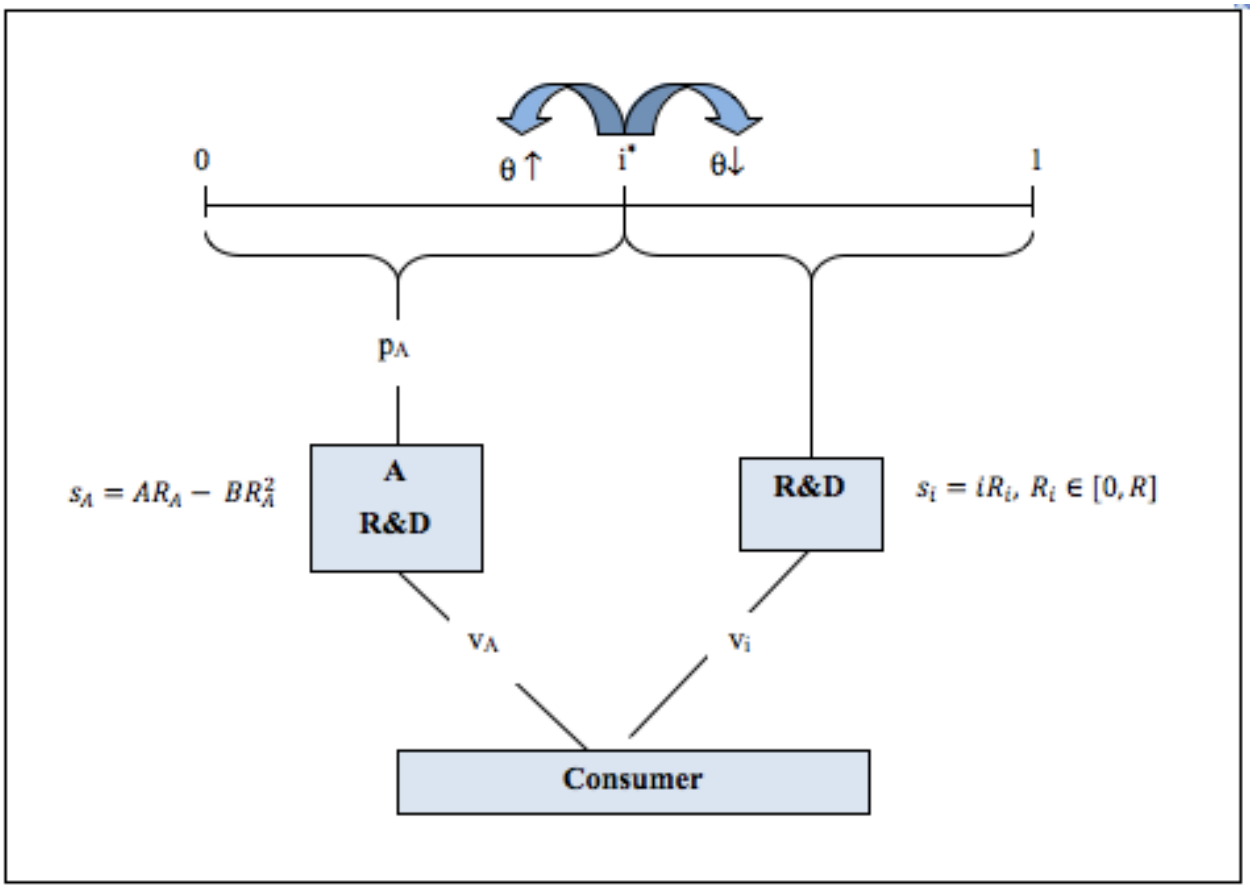
2. *Cooperative and Noncooperative duopoly with spillovers (D'Aspremont & Jacquemin, 1988)*

3. *Stable R&D Cooperation Between Asymmetric Partners (Kesteloot &Veugelers,1995)*

Description of the Model

- *Model's assumptions:*
  1) Small firms – linear and heterogenous returns to R&D (up to capacity sealing, where it hit the funding constraint); same funding constraint: they can invest a maximum *R* in R&D
  2) The big firm - concave returns to R&D.
  3) Duality in the size of the companies exists, only if there are capital market imperfections.
  4) No spillover effect included
- Each firm produce 1 unit of output and all of them need to be active to serve the market.
- There is one big firm (A) and many small firms (i), where $i \in [0,1]$.
- *Three different games:*
  1) Noncooperative game
  2) Big firm acts as a capital market for the small firms
  3) Cooperation via pooling R&D

Description of the Model



Description of the Model

- A consumer who buys a unit of product from a big firm of quality s_A at a price v_A obtains a utility of:

$$\boldsymbol{U = \theta s_A - v_A}$$

- A consumer who buys a unit of product form a small firm (i) of a quality s_{i-} at a price v_i obtains a utility of:

$$\boldsymbol{U = \theta s_i - v_i}$$

- Demand for each product is perfect arbitrage equation for all the quality of all the products:

$$\boldsymbol{\theta s_A - v_A = \theta s_i - v_i \geq 0}$$

Description of the Model

Noncooperative game

- Firms act noncooperatively in both output and R&D investments.

- Profit and quality functions for A and i:

$$\pi_A = (v_A - p_A)i^* - R_A$$

$$s_A = AR_A - BR_A^2$$

$$\pi_i = \begin{cases} v_i - R_i, & if\ i \geq i^* \\ p_A, & if\ i \leq i^* \end{cases}$$

$$s_i = iR_i,\ R_i \in [0, R]$$

Description of the Model

Noncooperative game (cont.)

- Best response for i
  - All firms' with better returns to R&D face the following problem:

$$\forall i \geq i^* \textit{ is such that}: R_i^* = argmax\ \theta(s_i - s_A) + v_A - R_i$$

  - We can have 2 possible outcomes:

$$1.\ if\ \theta i \geq 1\ then\ R_i^* = R\ so\ s_i = iR\ and\ v_i = \theta(iR - s_A) + v_A$$
$$2.\ if\ \theta i \leq 1\ then\ R_i^* = 0 \quad so\ if\ p_A > 0\ then\ i \leq i^*$$

  - Hence we know that:

$$\forall\, i < \frac{1}{\theta},\ R_i = 0\ and\ \pi_i = p_A$$

  - Therefore it must be the case that :

$$i^* \geq \frac{1}{\theta}$$

  - By Bertrand competition:

$$\pi_{i^*} = 0$$

$$p_A^* = 0$$

Description of the Model

Noncooperative game (cont.)

- Best response for A

$$\boldsymbol{R_A, p_A, v_A = argmax(v_A - p_A)i^* - R_A}$$

  - The profit function has to be maximized with respect to p_A, R_A and v_A.
  - p_A:

$$\text{Since } p_A = 0 \Leftrightarrow R_A, p_A, v_A = (v_A - 0)i^* - R_A$$

  - Including arbitrage eq.:

$$\boldsymbol{\pi_A^* = \left(v_i - \theta i R_i + \theta A R_A - \theta B R_A^2\right)i^* - R_A}$$

  - R_A :

$$\boldsymbol{R_A^* = \frac{A}{2B} - \frac{1}{2B\theta}}$$

  - And s_A:

$$\boldsymbol{s_A = \frac{A^2}{4B} - \frac{1}{4B\theta^2}}$$

Description of the Model

Noncooperative game (cont.)

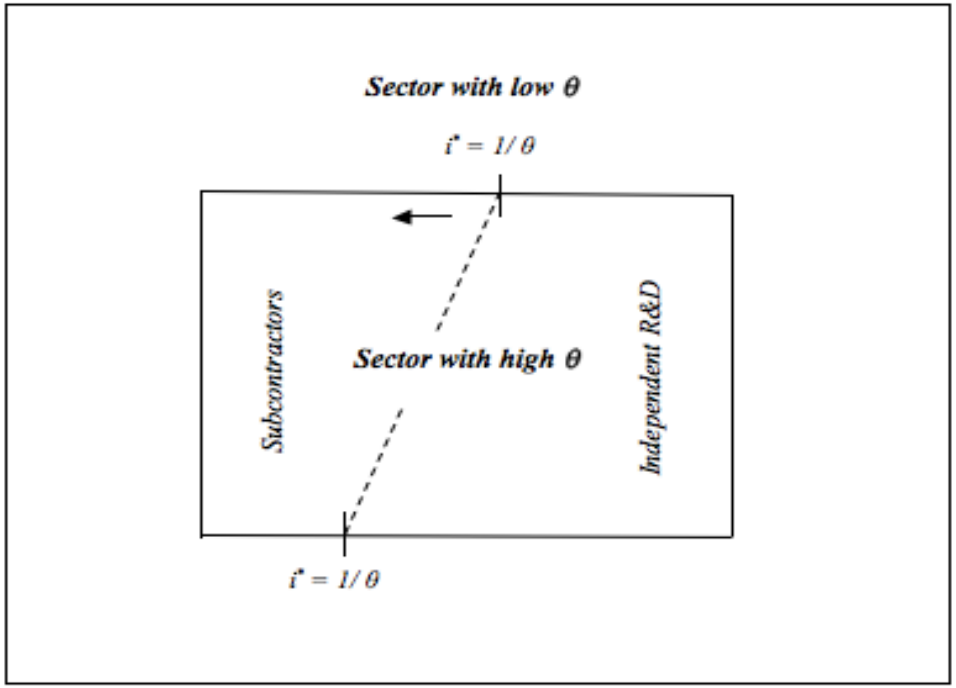
- v_A

$$v_A = argmax\ \pi_A^*$$

$$\theta s_A - v_A = \frac{\theta A^2}{4B} - \frac{1}{4B\theta} - v_A = 0$$

- Finally:

$$i^* = \frac{1}{\theta}$$



Description of the Model

Big firm acts as a capital market

- If a big firm (A) can work as a capital market for the small firm (i) then the Open Innovation will be the optimal and spontaneous equilibrium.
- It will always occur, because big firm have incentives to integrate with each of the small firm, which have higher marginal returns to R&D than the big firm itself.
- Small firms will not maintain linear returns to R&D, there will be a noticeable increase.
- For this reason and by relaxing the funding constraint there will be equalization between marginal returns to R&D across all small firms and a big firm.
- Not completely satisfactory.

Description of the Model

R&D pooling (outside-in OI)

- In this set the big firm picks up a subset of the best small firms and they pool R&D, which means that the value of the returns to R&D will be equal to the average of the pool

- The big firm A is cooperating with the firms that are in the fraction (1- i°) to pool R&D in a way that :

$$A_{new} = i_{new} = \frac{Ai^* + \left(1 - i^\circ\right)\frac{1 + i^\circ}{2}}{i^* + 1 - i^\circ}$$

- This value needs to be ≥ 1 because otherwise the small firm that has the highest investment in R&D (=1) will drop out

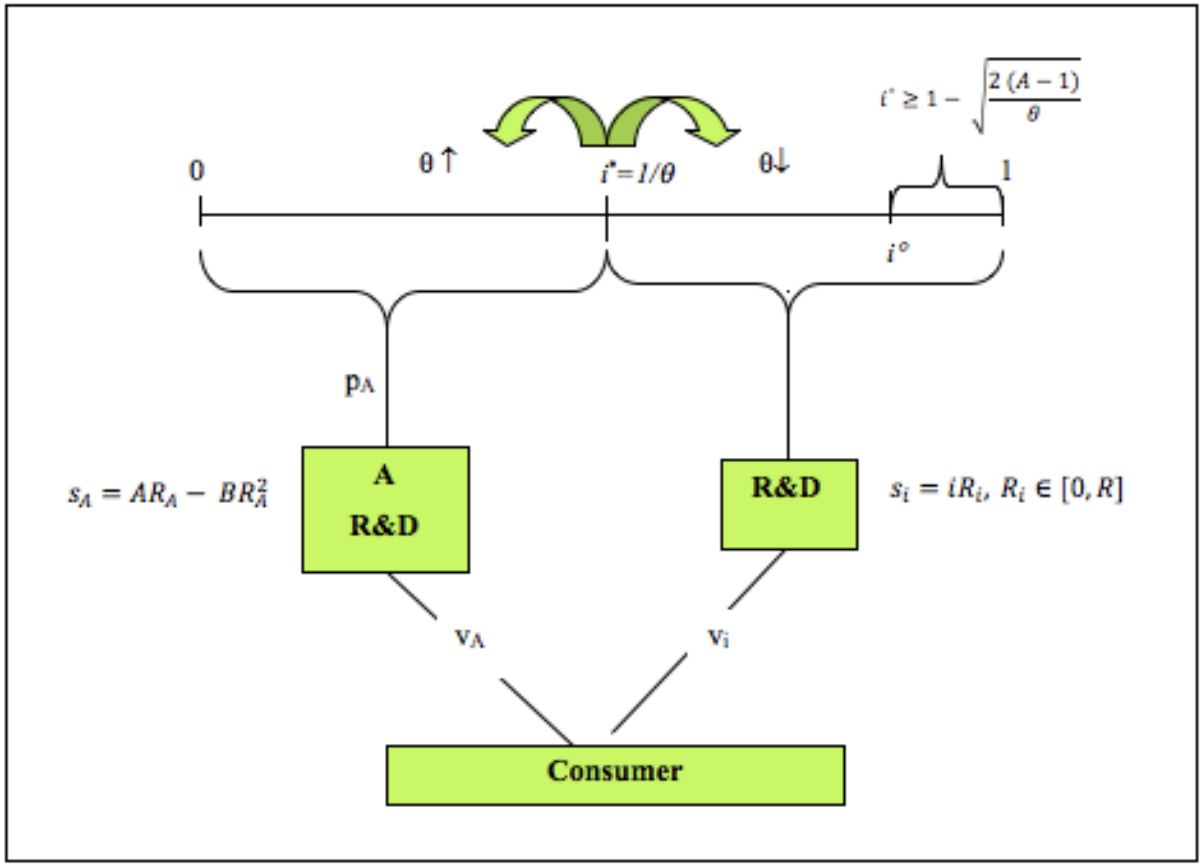
$$A_{new} = i_{new} = \frac{A\frac{1}{\theta} + \left(1 - i^\circ\right)\frac{1 + i^\circ}{2}}{\frac{1}{\theta} + 1 - i^\circ} \geq 1$$

- The result :

$$i^\circ \geq 1 - \sqrt{\frac{2\,(A - 1)}{\theta}}$$

- Positive gain for the sector

R&D pooling


$i^* \geq 1 - \sqrt{\frac{2(A-1)}{\theta}}$
0
θ↑
$i^* = 1/\theta$
θ↓
1
i^o
p_A
$s_A = AR_A - BR_A^2$
A
R&D
R&D
$s_i = iR_i,\ R_i \in [0, R]$
v_A
v_i
Consumer

Examples in F&D

- Procter and Gamble (P&G), one of the first firms to engage in OI, was able to increase the prosperity of its products by 50% and the efficiency of R&D by 60%.
- Calgene => design a new genetically modified tomato for the fresh market => built up a network of connections between consumers, suppliers, farmers, seed companies, and packers.
- Cargill ⇧ no. of products when it started to use a web-based application that collects ideas from internal and external sources.
- Mars uses knowledge and/or technologies from external sources by cooperating with consumers, big enterprises and SMEs, research institutes and Universities and many more.

Results

- Noncooperative situation market equilibrium i^* is equal to $1/\theta$,
- If the firms that have ⇧ returns to research than i^* = better off; can do maximum R&D and invest profit maximizing capital to perform R&D.
- If the firms that have ⇩ returns to research than i^* are not able to invest in R&D => subcontracting by the big firm to achieve profits.
- Firms which have high θ, belong to the high-tech industry, and its customers are willing to pay more for the added-value goods,
- Firms with low θ, belong to low-tech industry, (F&D) => no WTP
- In the sectors with low θ, the pool of products is larger, thus there is no incentives for high quality products.

Results

- In the case of a big firm acting as a capital market for the small firms, Open innovation will be an optimal and spontaneous equilibrium. Not completely clear if it is feasible for the big firm.

- When the cooperation occurs via pooling R&D, the big firm wants to cooperate only with the best small firms (with the highest marginal returns to R&D), thus the interval of the firms that cooperate is small.

Discussion

- The F&D (low-tech) = not correctly evaluated & measured.
- Use of Open Innovation => R&D pooling (increase profits and/or maintain competitive advantage).
- The high-tech - formalized and organized frameworks for the OI strategy, using patents or IPRs, and it is what differentiates it from the low-tech industries.
- Leiponen and Byma (2009) => the European patent system is insufficient for the SMEs, and the institutions need to be modified or created from the beginning.

Recommendations

- EU "*Patents encourage companies to make the necessary investment for innovation, and provide the incentive for the individuals and companies to devote resources to research and development*"
- The EU's current R&D policy needs to be improved.
- F&D firms need to:
  - cooperate with pharmaceutical, biotechnology, packaging, services, ICT and other supply chain players.
  - engage in collaboration with the international food companies, research institutes and Universities (i.e. Food Valley in the Netherlands).
- Encourage SMEs to search for new opportunities from outside their own environment.
- Change of objectives (cost minimizing) & start using different sources of knowledge.

Thank you for your attention!