Oligopolistic Competition, Technology Innovation, and Multiproduct Firms

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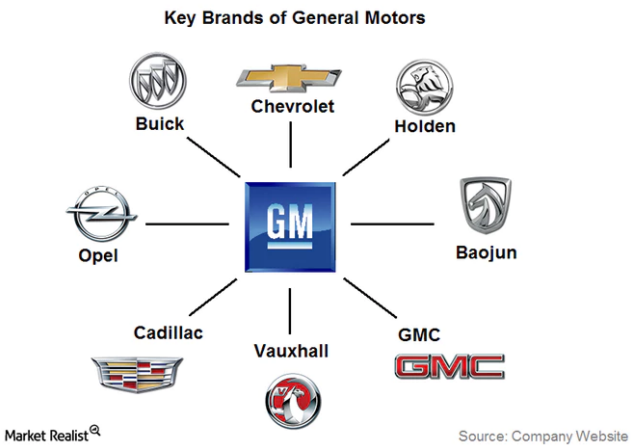
NEtwork media Management & Optimization

Backgrounds

- Market structure in many industries is:
  - Oligopolistic competition
  - With multi-product firms

- Oligopolistic automobile market
  - GM, Ford, and Crysler
- Ready-to-eat breakfast cereal
  - Kellogg, General Mills, Gneral Foods, and Quaker Oats



Limited theoretical backgrounds

- Two major contributions:
  - Endogenous product proliferation decision
  - Endogenous entry decision

- Existing literatures have some limitations:
  - Brander and Eaton (1984), exogenous product line size and the number of firms
  - Raubitscheck (1987), independent brand manager
  - Champsaur and Rochet (1989), analysis on a continuum
  - Anderson and de Palma (1992), shown only the existence of a Nash equilibrium
  - Baye et al. (1996), quantity competition

Major assumptions and concerns

- The compound *constant elasticity of substitution* (CES) model
  - Under the CES model, all existing products compete with one another and are equally good substitutes for one another.
  - *Compound* allows the firm-level heterogeneiuty.
- Endogenous product proliferation and firm entry decisions
- Firm products are identical, while the elasticity of inter-firm substitution may differ.

- In a symmetric equilibrium, it analyzes:
  - Product price
  - Number of products
  - Impact of the elasticity of substitution (across a firm's own products and across different firms)
  - Product quality decision

Model (demand side)

- Consumer utility maximization

$$\max_{x_{ij}} V(x_{11},\ldots,x_N) = \left(\sum_{i=1}^{m} \left[\left(\sum_{j=1}^{n_i} x_{ij}^{\rho} \right)^{\frac{1}{\rho}} \right]^{\alpha} \right)^{\frac{1}{\alpha}}$$

$$\text{s.t.} \sum_{i=1}^{m} \sum_{j=1}^{n_i} p_{ij} x_{ij} \le Y,$$

m, number of firms; n_i, number of firm i's products; x_{ij} and p_{ij}, consumption and price of firm i's product j; α and ρ, are the substitution parameters; Y, consumer budget.

  - where price index is $q_i = \left[\sum_{j=1}^{n_i} p_{ij}^{1-\delta} \right]^{\frac{1}{1-\delta}}$ and $q = \left[\sum_{i=1}^{m} q_i^{1-\theta} \right]^{\frac{1}{1-\theta}}$.

- The demand function is:

$$x_{ij} = \frac{1}{p_{ij}^{\delta} q_i^{1-\delta}} \frac{q_i}{q_i^{\theta} q^{1-\theta}} Y \text{ (when } n_i = 1 \text{ and } m = 1,\ x_{ij} = \frac{Y}{p_{ij}})$$

Model (supply side and game)

- Payoff function

$$\pi_i = \sum_{k=1}^{n_i} (x_{ik}(p_{ik} - c) - f)$$

- Game
  - Players: competing m firms
  - Strategies: price $\boldsymbol{p}_i$ and proliferation level n_i
  - Payoffs: net profit $\boldsymbol{\pi}_i$

  - Two stage game, proliferation level-first and price second

Major findings (2nd stage, price decision)

- **Proposition 1**. *In a symmetric equilibrium, an increase in the level of a firm's proliferation raises the firm's own prices and reduces other firms' prices.*
  - Or:

$$\frac{\partial p_i}{\partial n_i} > 0 \text{ and } \frac{\partial p_j}{\partial n_i} < 0$$

- Interpretation
  - The increase of the proliferation level raises the market power.
  - The increase of the market power elevates the product price.
  - The increase of the product price increases the markup.
  - The increase of the markup decreases the competitor's product price.

Major findings (1st stage, proliferation decision)

- **Proposition 2**. *The number of products produced by each firm increases as the marginal proliferation cost f decreases. (…)*
  - In a sense that:

$$n = \frac{1}{f}\left[\frac{Y}{(m-1)\theta + 1} - k\right]$$

- Interpretation
  - Intuitive in a sense that the higher cost burdens firms.

- However, unknown influence of the proliferation cost increase on the product price.
  - As assumed symmetric firms, $n_i = n$ and $p_i = p$.

Other findings

- **Proposition 3**. (elasticity of substitution)
  - *The more the substitution is elastic across a firm's own products, the smaller* n_i and the larger m.
  - *The more the substitution is elastic across the different firms, the larger* n_i and the smaller m.

- Proposition 4. (quality improvement, single product with multiple characteristics)
  - $x(i)$ denotes the product of firm i
  - $x(ij)$ denotes the j-th characteristic
  - The simplification $x(ij) = x$ provides $n(i)$ to denote the quality level

Conclusions

- Studied a competition of the symmetric multiproduct firms
  - Used the compound CES model
  - Symmetric implies each product in the market and the firms' strategies are identical

- Addressed that
  - An increase in the level of a firm's proliferation raises the firm's own prices and reduces other firms' prices.
  - The number of products produced by each firm increases as the marginal proliferation cost f decreases.