

Mergers and Divestitures in Markets with Heterogeneous Products

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Recent waves of corporate mergers have sparked new interest in economic analyses of the preconditions and consequences of increasing market concentration. Traditionally, microeconomic models analyzing the effects of mergers compare the outcome of a fixed number of mergers of some firms in the market with the status quo ante. This paper methodologically extends these approaches by treating all firms in the market as potentially merging or divesting firms. We then develop firms' "merger best response functions" and derive merger equilibria. Thus, we provide a possible explanation for the emergence of waves of mergers followed by divestitures.

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1. Introduction

The waves of corporate mergers during the nineties have sparked new interest in economic analyses of the preconditions and consequences of increasing market concentration. Traditionally, static microeconomic models are used to analyze the effects of market concentration and to determine policy interventions. This paper methodologically extends these classical approaches of structural modeling of potential effects of mergers. For this purpose, we also investigate long-term implications by analyzing entry and exit behavior.

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Conceptual starting points for this research are the traditional industrial-organization literature on mergers¹, as well as newer literature on mergers with product differentiation and trade². After investigating firms' initial incentive to divest, we calculate best responses and merger equilibria (including the possibility of fringe single-product firms) and identify both corner solutions as well as interior merger equilibria. We use the results obtained to explain the emergence of waves of mergers followed by waves of divestitures.

The remainder of the paper is organized as follows. Section 2 surveys previous theoretical and empirical work on mergers and acquisitions. A basic model of mergers with differentiated products and Cournot competition is presented in section 3. Sections 4 and 5 analyze incentives to merge or to divest when unit costs are constant. In section 6, the optimal merger size in a model of monopolistic competition with variable-cost synergies is derived. Section 7 discusses generalizations of the results. The last section summarizes the findings and concludes.

2. Previous Analyses of Mergers and Acquisitions

This section reviews first literature on different classes of theoretical results about mergers followed by a summary of some relevant empirical findings. A very well structured review of the theoretical literature in particular is also provided by Ulukut (2003).

2.1. Theoretical Modeling of Mergers

Traditional methods analyze horizontal mergers assuming that products in the relevant market are homogenous (Jacquemin/Slade, 1988). Thus, Salant/Switzer/Reynolds (1983), modeling mergers as an exogenous change in market structure starting from an initial Cournot equilibrium and doing comparative statics, show that most exogenous mergers are unprofitable for the merging firms, while outsiders not participating in the merger gain. This is the “**Merger Paradox**“. In the standard Cournot setting without cost-altering effects of mergers, profitable mergers would have to involve more than 80 percent of the market while outsiders would always gain more than insiders. This need not imply that one should abandon the Cournot concept in modeling mergers. If the merger decision is endogenized, then

¹ See, e.g., Jacquemin/Slade (1988), Salant/Switzer/Reynolds (1983), Perry/Porter (1985), Farrell/Shapiro (1990), Berry/Pakes (1993).

² See, e.g. Long/Vousden (1995), Falvey (1998, 2003), Horn/Levinsohn (2001), Ryan/Kendall (2001), Neary (2003), Tombak (2003).

mergers that are disadvantageous will not occur in equilibrium. Other authors such as Farrell/Shapiro (1990) find that mergers in a Cournot oligopoly not creating cost synergies will raise prices and decrease market share. On the other hand, in the presence of cost synergies, output-reducing mergers can improve welfare by closing down inefficient firms.

Allowing for **pair-wise mergers** significantly reduces the minimum share of the market necessary to participate in mergers in order to make them profitable. However, the outsider advantage from mergers remains. See Böckem (2002), Neus (2002).

Other authors, such as Kamien/Zang (1993) or Rothschild (1999), Tombak (2002), Böckem (2002), Ulukut (2003) study horizontal mergers between firms with **heterogeneous costs**. Different but fixed unit production costs lead here to two effects, one encouraging mergers while the other discourages them. Mergers between high and low-cost firms decrease average cost of the merging firms; this is a positive effect similar to cost synergies. Mergers with high-cost rivals tends to decrease market price, since the high-cost, high-price rival is removed from the market; this tends to make mergers of that kind less profitable. As a result, there is only a particular window of cost asymmetries where mergers of this kind are profitable. With both very high and very low cost asymmetries, mergers will not take place. In this context, note that a large part of the mergers and trade literature also operates with explicitly different costs or cost asymmetries due to trade costs.

Perry/Porter (1985) introduce strong **cost economies** due to a tangible asset available in fixed quantity that reduces marginal costs. Each firm has a fixed fraction of this asset. Depending on the degree of cost synergies, this significantly increases merger incentives. Due to cost reductions resulting from a merger, insiders now have an advantage over outsiders and may gain more than the latter.

In order to analyze **price competition** fully, some degree of **product differentiation** needs to be introduced. For this case, Deneckere/Davidson (1985) show that mergers are always profitable for insiders, even without resulting synergies, since prices act as strategic complements. However, outsiders still gain more by such mergers. Consequently, other literature such as McAfee/Simons/Williams (1992) or Lommerud/Sørgard (1997), Rothschild (2000), Rothschild et. al. (2000) explores different conditions such as locational differences and multi-product operations. Werden/Froeb (1994) show how such a model can be estimated and simulated combining logit demands with constant marginal costs.

For the purpose of estimating mergers empirically for the semiconductor industry, Gugler/Siebert (2003) introduce a model with **heterogeneous products and quantity competition**. Apparently, there is no other literature using this approach, even though many industries besides the semiconductor industry could be characterized by this kind of competition.

Zachau, (1987) introduces mergers into the standard model of price competition with **vertically differentiated products** (Gabszewicz/Thisse, 1979, 1980; Shaked/Sutton, 1982, 1983). He finds that both the merging and the outside firms always gain by a merger. Furthermore, mergers are sometimes more profitable for the merging firms than for the outside firms. However, when merger decisions are fully endogenous, the monopoly created by a merger of all firms is the unique stable industry structure in a very strong sense. For newer related literature on vertical product differentiation, see also Wauthy (1996), Greenstein/Ramey (1998), Johnson/Myatt (2003).

Mergers have also been analyzed extensively in the context of the **trade policy literature**. Markusen and others have been investigating the behavior of multi-national enterprises (**MNEs in general equilibrium**) for quite some time (e.g. Markusen/Maskus, 2001). Falvey (2003) investigates mergers in the presence of **tariffs in integrated markets**, while Horn/Levinsohn (2001) **analyze trade liberalization** and mergers. Neary (2003) investigates **comparative advantage as a motivation for cross-border mergers**. Mergers in order to **transfer technology in product-differentiated markets** with international trade are analyzed by Ryan/Kendall (2001).

Long/Vousden (1995) analyze the effects of tariff reductions on horizontal mergers in a **Cournot oligopoly in a two-country world**. It is shown that for mergers between two domestic firms and for cross-border mergers which supply both markets from a foreign plant, unilateral tariff reduction encourages mergers which concentrate market power at the expense of mergers which reduce cost, while bilateral tariff reductions have the opposite effect, encouraging mergers which significantly reduce cost. Cross-border mergers that continue to supply each market from a local plant are discouraged by both unilateral and bilateral tariff reduction.

Huck/Konrad (2003) examine the profitability of mergers in an international Cournot context with **strategic trade policy by governments**. Unlike previous literature (Dixit 1984, Horn/Levinsohn 2001, Rysman 2001), the authors consider endogenous mergers, where firms merge first, followed by governments deciding about strategic trade policy. A national merger

induces the respective government to raise trade subsidies, while the foreign country lowers them. This implies that firms involved in the national merger can benefit from a merger that would have been unprofitable under free trade; national mergers can harm firms in other countries; national mergers can increase national welfare while decreasing welfare in other countries. On the other hand, international or cross-border mergers are never profitable for the firms involved, they harm competitors in the acquiring firm's country, while benefiting competitors in the acquired firm's country. Partially in contrast to these results, e.g. Collie (2003) finds that a foreign merger always reduces domestic welfare and foreign welfare, if a domestic country follows an optimal trade policy. Furthermore, the optimal response of the domestic country to a domestic merger is to leave its tariff unchanged and increase its production subsidy. The effects of mergers under **free trade** have been analyzed, e.g., by Dixit (1984), Ordoover/Willig (1986).

2.2. Empirical Evidence on Mergers

For **summaries** of some empirical work and results, see e.g. Berry/Pakes (1993) and Gugler et. al. (2003). The latter, in particular, use a large panel data set in order to analyze the effects of mergers internationally and over time. For this purpose, merging firms' profits and sales before and after the merger are compared. The majority of mergers decrease profits and efficiency, while there are also mergers that increase profits through either increasing market power or efficiency. The results are similar across different countries and sectors, and also between domestic and cross-border mergers.

Effects of mergers on **market shares** have been investigated by Mueller (1985). Using panel data for the largest 1000 firms between 1950 and 1972, and controlling for non-relevant factors, the market shares of acquired firms are compared to those of non-acquired firms. The results indicate that acquired firms perform rather worse than non-acquired firms, which is interpreted as evidence against the hypothesis that mergers improve efficiency. The impact of mergers **market concentration** was analyzed by Pryor (2001). This study uses data from Thompson Financial Securities on enterprise size and on industrial concentration in the United States and some other countries for 1985-1999. Findings are that enterprise size and industrial concentration have both increased. Similar conclusions were drawn by White (1989), Golbe/White (1993).

Models analyzing competition and market concentration in **differentiated-product markets** with exogenous market size have been forwarded by e.g. Trajtenberg (1985), Bresnahan (1987), Anderson et. al. (1992). Analyses of mergers' effects on **prices and profits** are contained in e.g. Nevo (2000) and Ivaldi/Verboven (2000), whereas Berry et. al.(1995), Petrin (2000), and Nevo (2000) present the effects on substitution **behavior of consumers**.

Effects on **product variety** were investigated by Berry/Waldfoegel (2001) using a panel data set of 243 U.S. radio broadcast markets in 1993 and 1997. Since the Telecommunications Act of 1996 substantially relaxed ownership restrictions in these markets, increased concentration has reduced station entry while increasing variety. This may indicate that increased concentration has increased efficiency.

Studies investigating particular industries have been forwarded recently, e.g. by Gugler/Siebert (2003)³ for the **semiconductor industry**, by Park, et. al. (2001)⁴ for **railroad mergers**, and Berry/Waldfoegel (2001) for **radio broadcast markets**.

With the exception of **dynamic merger models**, this research does not take the long-term effects of mergers into account. This is relevant, since short-term effects may be different from long-term effects (see e.g. Berry/Pakes, 1993; Pakes/McGuire, 1994). One major aspect of long-term behavior to be taken into account here is entry and exit of firms adjusting to the new market structure resulting from mergers. Furthermore, the relevance of innovative activities and **product innovations** for merger behavior had already been noticed early on (Stigler, 1965). Consequently, this research will present a theoretical framework taking product differentiation caused by product innovation as well as market exit and entry into account.

3. A Basic Model of Mergers with Differentiated Products and Cournot Competition

For a model with differentiated products and Cournot oligopoly, we present the derivation of “merger best responses“ and the resulting endogenous merger formation - this is our new theoretical contribution.

³ Using a model with heterogeneous products and quantity competition, evidence is presented that research joint ventures represent viable alternatives to mergers. This is the only study known to us combining heterogeneous products with Cournot competition.

⁴ The results seem to imply that railroad mergers do not necessarily increase market power, as measured by the Lerner ratio. Earlier studies were conducted by MacDonald (1989 and 1989), Lemke/Babcock (1987).

3.1. Model Setup

There are n firms or plants (and their respective products) in a single (domestic) market. Firms may collude with other firms to form a merger. Otherwise each single-product firm is identical.

Costs depend on the number of single-product plants (or firms) m being part of an existing merger. Marginal production cost is denoted as v_m with $v_m' < 0$, $v_m'' \geq 0$. Fixed (“setup”) cost per single-product plant are ϕ_m with $\phi_m' > 0$, $\phi_m'' \geq 0$.

Utility is quadratic with potentially imperfect substitutability; resulting in linear demands.

Firms play a two-stage industry game

- 1) Firms choose number of products, i.e. merger size (and decide about entry)
- 2) Firms compete in quantities (Cournot)

Denote the consumption quantities of goods i and j as q_i and q_j , respectively. Let $\alpha > 0$, $\beta > 0$, $0 \leq \gamma \leq \beta$. Quasi-linear generalized quadratic utility function of a single consumer is then given by:

$$U = \alpha \sum_{i=1}^n c_i - 0.5\gamma \sum_{i=1}^n c_i \sum_{j=1}^n c_j - 0.5(\beta - \gamma) \sum_{i=1}^n c_i^2$$

For large n , we can approximate this relation by using integrals rather than sums:

$$U = \alpha \int_0^n c_i di - 0.5\gamma \int_0^n c_i di \int_0^n c_j dj - 0.5(\beta - \gamma) \int_0^n c_i^2 di$$

With L consumers (equal to aggregate labor supply), inverse demand functions per consumer will be:

$$p_i = \alpha - \beta \frac{q_i}{L} - \gamma \sum_{\substack{h=1 \\ h \neq i}}^n \frac{q_h}{L}, \quad i = 1, \dots, n$$

or

$$p_i = \alpha - \beta \frac{q_i}{L} - \gamma \int_0^n \frac{q_h}{L} dh, \quad i = 1, \dots, n$$

Let all firms/products belonging to a single merger of m firms be listed at the beginning of the list of firms. Profit functions per single product firm within an m -firm merger are then:

$$\Pi_i = (q_i((\alpha - \beta \frac{q_i}{L} - \gamma \sum_{\substack{h=1 \\ h \neq i}}^n \frac{q_h}{L}) - v_m) - \phi_m), i = 1, \dots, m$$

or

$$\Pi_i = (q_i((\alpha - \beta \frac{q_i}{L} - \gamma \int_0^n \frac{q_h}{L} dh) - v_m) - \phi_m), i = 1, \dots, m$$

Note that (m-1) of the other products actually belong to the same merger. Given that firms are identical, we can invoke symmetry within the merger. Let the number of firms in this merger now be denoted by m_1 and the quantity supplied by each firm as q_1 . Likewise, allow for another n_2 mergers with symmetric firms numbering m_2 each. Lastly, allow for a single-product firm fringe of $(n - m_1 - n_2 m_2)$ firms. We then have:

$$\Pi_1 = (q_1((\alpha - \beta \frac{q_1}{L} - \gamma(m_1 - 1) \frac{q_1}{L} - \gamma(n_2 m_2) \frac{q_2}{L} - \gamma \sum_{\substack{h=m_1+1 \\ n_2 m_2 + 1}}^n \frac{q_h}{L}) - v_m) - \phi_m)$$

or

$$\Pi_1 = (q_1((\alpha - \beta \frac{q_1}{L} - \gamma(m_1) \frac{q_1}{L} - \gamma(n_2 m_2) \frac{q_2}{L} - \gamma \int_{\substack{m_1+1 \\ n_2 m_2}}^n \frac{q_h}{L} dh) - v_m) - \phi_m)$$

Note that the inverse demand functions are then given by:

$$p_1 = \alpha - \beta \frac{q_1}{L} - \gamma(m_1 - 1) \frac{q_1}{L} - \gamma(n_2 m_2) \frac{q_2}{L} - \gamma \sum_{\substack{h=m_1+1 \\ n_2 m_2 + 1}}^n \frac{q_h}{L}$$

$$p_2 = \alpha - \beta \frac{q_2}{L} - \gamma(m_1) \frac{q_1}{L} - \gamma(n_2 m_2 - 1) \frac{q_2}{L} - \gamma \sum_{\substack{h=m_1+1 \\ n_2 m_2 + 1}}^n \frac{q_h}{L}$$

$$p_j = \alpha - \beta \frac{q_j}{L} - \gamma(m_1) \frac{q_1}{L} - \gamma(n_2 m_2) \frac{q_2}{L} - \gamma \sum_{\substack{h=m_1+1 \\ n_2 m_2 + 2}}^n \frac{q_h}{L}$$

or

$$p_k = \alpha - \beta \frac{q_k}{L} - \gamma(m_1) \frac{q_1}{L} - \gamma(n_2 m_2) \frac{q_2}{L} - \gamma \int_{\substack{m_1+1 \\ n_2 m_2}}^n \frac{q_h}{L} dh, k = 1, 2, j$$

where subscript 1 denotes merger 1, subscript 2 denotes each of the n_2 other mergers, and subscript j denotes each of the remaining single-product firms.

The model outlined above is quite flexible and can capture a number of different constellations presented already in the literature. With $m_2 = 1$, this is a single-merger model. With $\gamma = \beta$, this is a homogenous-good model. With $m_2 = 1$ and $\gamma = \beta$, this is similar to the PP model (Perry/Porter, 1985). With $m_2 = 1$, $\nu = \phi = 0$, and $\gamma = \beta$, this similar to the SSR model (Salant/Switzer/Reynolds, 1983). With $m_1 = m_2 = 2$, $\nu = \phi = 0$, and $\gamma = \beta$, this similar to the Pair-wise model (Böckem, 2002).

3.2. Cournot Competition

When analyzing Cournot competition in the presence of mergers, we need to include the possible interaction of one merger with a number of other mergers. Therefore, we present the best response for a single member of a particular merger indexed by 1. Since all merger members are identical, coordination leads to identical quantity choices for each. The same is true for any one of the other mergers and their best responses are indexed by 2. The representative Cournot quantity reaction function is then given by:

$$q_1^{rc} = \frac{L(m_1\alpha - \nu_{m_1})}{2m_1(\beta + m_1\gamma)} - \frac{(n - m_1)\gamma q_2}{2(\beta + m_1\gamma)}$$

Cournot equilibrium with symmetric merger size, i.e. $m_2 = m_1$ and $n_2 = (n - m_1)/m_1$ can then be characterized as follows:

$$q_1^c = \frac{L(\alpha - \nu_{m_1})}{2\beta + (n + m_1)\gamma}$$

$$p_1^c = \frac{(\alpha + \nu_{m_1})(\beta + m_1\gamma)}{2\beta + (n + m_1)\gamma}$$

$$\Pi_1^c = \frac{L(\alpha - \nu_{m_1})^2(\beta + m_1\gamma)}{(2\beta + (n + m_1)\gamma)^2} - \phi_{m_1}$$

This concludes the introduction into the general model and the following sections will present analyses of specific benchmark model variations.

4. Mergers or Divestitures in a Heterogeneous-Goods Demand System with constant Unit Costs

Before further analyzing merger equilibria, it is instructive to investigate what incentives a single firm within an n-firm oligopoly has with respect to a possible divestiture rather than joining a merger.

In the simplest possible setup with constant unit cost (i.e. constant marginal costs and no fixed costs), “divesting” for a single firm could be the decision to split up into a number j of additional independent firms rather than staying single or joining a merger. When this is done, the new divested entity owns $(j+1)$ independent firms and their profits and the market has increased to size $(n+j)$. If the firm hypothetically joined a merger of all n firms, then it would receive an n^{th} share of that markets monopoly profits.

As we know already, joining a monopoly merger is always a local maximizer. However, as a single firm, marginal profits from merging are negative since the (negative) market share effect dominates the (positive) market concentration effect. Since divesting into additional firms reverses direction, the signs of these effects are reversed and establishing additional firms marginally increases profits. Eventually, the (now negative) market concentration effect will dominate again, so that there is another local maximizer at some number j^* of divested additional firms. Below, we compare profits at these two local maximizers after calculating the optimizing number of divested firms.

An individual firm i 's profits in an n-firm market is given as:

$$\Pi_i^n = \frac{L(\alpha - \nu)^2 \beta}{(2\beta + (n-1)\gamma)^2} - \phi$$

If a single firm divests in to j additional firms, the sum of the resulting profits, the divestiture profits, are:

$$\Pi_j^n = (1+j)\Pi_i^{(n+j)} = \frac{(1+j)L(\alpha - \nu)^2 \beta}{(2\beta + (n+j-1)\gamma)^2} - \phi$$

Maximal divestiture profits are given by choosing the number of additional firms j such that:

$$j^* = (n-3) + 2\frac{\beta}{\gamma}$$

Hence optimal divestiture profits will be:

$$\Pi_{j^*}^n = \frac{L(\alpha - \nu)^2 \beta}{(2\beta + (n-2)\gamma)^2} - \phi$$

In contrast, profits gained from participating in a merger of all market firms would be given by:

$$\Pi_m^n = \frac{L(\alpha - \nu)^2}{4\beta + (n-1)\gamma} - \phi$$

For $\phi = 0$, the ratio of divestiture profits to merger participation profits is then:

$$\left(\frac{\Pi_{j^*}^n}{\Pi_m^n} \right) = \left(\frac{\beta}{\gamma} \right) \frac{(\beta + (n-1)\gamma)}{(2\beta + (n-2)\gamma)}$$

Note that for all $0 < \gamma \leq \beta$, this ratio will be greater than or equal to 1; it will be exactly equal to one for $\gamma = \beta$. Consequently, **for any heterogeneous-goods demand system with constant unit costs**, the following will hold:

- 1.) A single firm will ALWAYS be better off divesting than staying single, ceteris paribus.
- 2.) The **optimal number of divested firms is $(n-3) + 2\beta/\gamma$** .
- 3.) When choosing to divest into the optimal number of new firms, the owner of these new firms is (collectively) at least as well off as if he/she had participated in an n-firm (monopoly) merger!
- 4.) Given that firms always prefer divesting to a single monopoly-merger, they also always prefer divestiture to any (local) **symmetric merger equilibrium with (n/m_1) mergers merging m_1 firms each**.

5. Local Merger Equilibria with Perfect Substitutes and Constant Unit Costs

Given that firms always prefer divesting to a single monopoly-merger, they also always prefer divestiture to any local **symmetric merger equilibrium with (n/m_1) mergers merging m_1 firms each**. Nevertheless, **local symmetric merger equilibria may still exist!** This section shows that this is indeed the case and derives the necessary existence condition for the case of homogenous goods.

With homogenous goods, Cournot profits of single members of a particular merger of m_1 firms in the presence of n_2 other m_2 -firm mergers, are then given by:

$$\Pi_1^{hc} = \frac{L(\alpha - \nu)^2}{m_1 \beta (n - m_1 - n_2 m_2 + n_2 + 2)^2} - \phi$$

Marginal profits and second-order profit changes as merger size varies are:

$$\frac{\partial}{\partial m_1} \Pi_1^{hc} = \frac{2L(\alpha - \nu)^2}{m_1 \beta (n - m_1 - n_2 m_2 + n_2 + 2)^3} - \frac{L(\alpha - \nu)^2}{m_1 \beta (n - m_1 - n_2 m_2 + n_2 + 2)^2}$$

$$\frac{\partial^2}{\partial m_1^2} \Pi_1^{hc} = \frac{6L(\alpha - \nu)^2}{m_1 \beta (n - m_1 - n_2 m_2 + n_2 + 2)^4} - \frac{4L(\alpha - \nu)^2}{m_1^2 \beta (n - m_1 - n_2 m_2 + n_2 + 2)^3} + \frac{2L(\alpha - \nu)^2}{m_1^3 \beta (n - m_1 - n_2 m_2 + n_2 + 2)^2}$$

With symmetric merger sizes and no single-product firms left, i.e. $m_2 = m_1$ and $n_2 = (n - m_1)/m_1$, profits and marginal profits will be:

$$\Pi_1^{hc} = \frac{L(\alpha - \nu)^2 m_1}{\beta (n + m_1)^2} - \phi, \quad \frac{\partial}{\partial m_1} \Pi_1^{hc} = \frac{L(\alpha - \nu)^2 (2m_1^2 - m_1 - n)}{\beta (n + m_1)^3}$$

For any $\alpha > \nu \geq 0$, marginal profits are negative for small m_1 and positive for relatively large m_1 . In particular, marginal profits are positive when:

$$\frac{\partial}{\partial m_1} \Pi_1^{hc} > 0 \text{ for } m_1 > (\sqrt{8n+1} + 1)/4$$

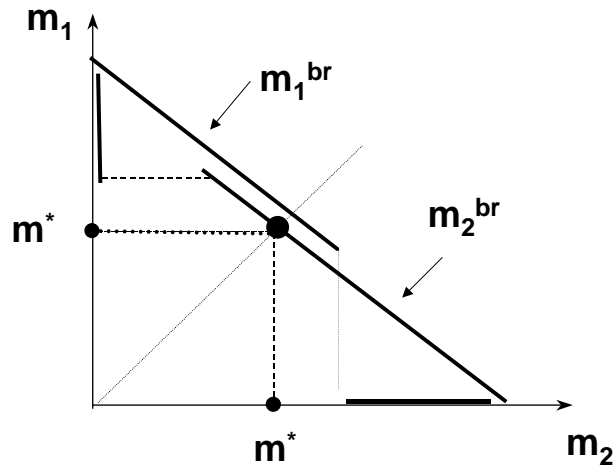
This implies three things. Firstly, once merger size is large enough, firms always have the (local) incentive to merge with as many firms as possible. Secondly, with the number of mergers endogenous, this implies merging to a monopoly conglomerate. Thirdly, symmetric merger equilibria with more than one mergers are only possible, if the (minimum) number of mergers is exogenously fixed.

Note further, that merger best responses will be to not merge for any merger size lower than $(\sqrt{8n+1} + 1)/4$, whereas it will be to merge all remaining firms for any larger merger size. (Graphically, merging with all remaining firms means that the best response merger choice has a slope of minus one for all mergers involved. Hence finding a symmetric equilibrium requires determining when this part of the best response crosses the 45-degree line.)

Taking the difference between single-firm profits with some merger size $m_1 = r = (n - n_2 m_2)$ and profits where $m_1 = 1$, we get:

$$\Pi_{1(r)}^{hc} - \Pi_{1(1)}^{hc} = \frac{L(\alpha - \nu)^2_1}{\beta (n_2 + 2)^2 (n - n_2 m_2)} - \frac{L(\alpha - \nu)^2_1}{\beta (n - n_2 m_2 + n_2 + 1)^2}$$

Figure: Symmetric Merger Equilibria without Cost Synergies



This is a function of the remaining number of mergers n_2 , while the total number of mergers is then $n_m = n_2 + 1$. Substitute $n_m - 1$ for n_2 , assume symmetry, i.e. $m_1 = m_2$, and solve the profit difference equal to zero for n_m .

$$\Pi_{1(r)}^{hc} - \Pi_{1(l)}^{hc} = \frac{L(\alpha - v)^2_1}{\beta(n_m + 1)^3(n/m_m)} - \frac{L(\alpha - v)^2_1}{\beta(n_m + (n/m_m)(n_m + 1))^2} = 0$$

This gives the following existence condition for a symmetric Nash-equilibrium in mergers:

$$n_m \leq \sqrt[3]{n}$$

Hence, for the **homogenous-good case, local symmetric merger equilibria exist whenever $2 \leq n_m \leq \sqrt[3]{n}$!**

6. Mergers and Divestitures under Monopolistic Competition

This section presents internal solutions with several symmetric mergers in a monopolistic market, where variable costs fall with merger size while fixed costs per single-product unit rise with merger size. Explicit analytical solutions for this model are available, because we set $\gamma = 0$ and therefore individual single-product inverse demand collapses to $p_i = \alpha - \beta q_i$. Therefore, this model can serve as a benchmark.

Mergers are always profitable in comparison to staying an outsider because of the resulting reduction of variable costs. Since the products exhibit zero-substitutability, individual merger choices are independent of the size of other mergers in the market, since own market demands are not affected. Likewise, outsiders' market shares are not affected so they cannot gain from any mergers among other firms.

Cournot quantity reaction functions and equilibrium quantities are identical since they do not depend on other mergers' size:

$$q_1^{rcm} = \frac{L(\alpha - v_{m_1})}{2\beta} = q_1^{cm} = \frac{L(\alpha - v_{m_1})}{2\beta}$$

Cournot equilibrium prices and profits are then:

$$p_1^{cm} = \frac{\alpha + v_{m_1}}{2}$$

$$\Pi_1^{cm} = \frac{L(\alpha - v_{m_1})^2}{4\beta} - \phi_{m_1}$$

Assuming $L=1$ and setting cost functions equal to $v_m = v/m$ and $\Phi_m = \Phi m^2$, the Cournot equilibrium then becomes:

$$q_1^{cm} = \frac{m_1\alpha - v}{2m_1\beta}, \quad p_1^{cm} = \frac{m_1\alpha + v}{2m_1}$$

$$\Pi_1^{cm} = \frac{(m_1\alpha - v)^2}{4\beta(m_1)^2} - \phi m_1$$

In order to find the optimal merger choice, we solve for the first-order condition and check the second-order condition:

$$\frac{\partial}{\partial m_1} \Pi_1^{cm} = \frac{\alpha(m_1\alpha - v)}{2\beta(m_1)^2} - \frac{(m_1\alpha - v)^2}{2\beta(m_1)^3} - \phi = 0$$

$$\frac{\partial^2}{\partial m_1^2} \Pi_1^{cm} = \frac{\alpha^2}{2\beta(m_1)^2} - \frac{2\alpha(m_1\alpha - v)}{\beta(m_1)^3} + \frac{3(m_1\alpha - v)^2}{2\beta(m_1)^4} \leq 0 \text{ for } \alpha \geq 1.5 v$$

The second-order condition is satisfied, given that market size is large relative to marginal costs. Then optimal merger size chosen by any merger will be given by the solution to the first-order condition in m_1 :

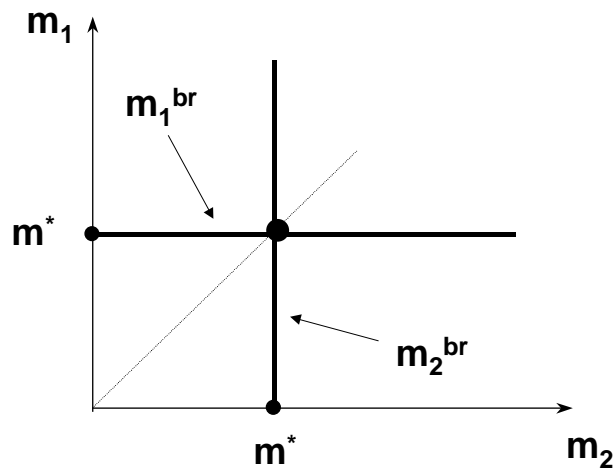
$$m_1^* = \frac{\alpha v}{2(6)^{1/3} \left(9\beta^2 v^2 \phi^2 + \sqrt{3} \sqrt{27\beta^4 v^4 \phi^4 - 2\alpha^3 \beta^3 v^3 \phi^3} \right)^{1/3}} + \frac{\left(9\beta^2 v^2 \phi^2 + \sqrt{3} \sqrt{27\beta^4 v^4 \phi^4 - 2\alpha^3 \beta^3 v^3 \phi^3} \right)^{1/3}}{2(6)^{2/3} \beta \phi}$$

When the parameter restriction for the second-order condition is satisfied, we also have:

$$\frac{\partial}{\partial \alpha} m_1^* > 0, \quad \frac{\partial}{\partial v} m_1^* > 0, \quad \frac{\partial}{\partial \phi} m_1^* < 0$$

In the model presented in this chapter, endogenous merger size: 1.) increases with market size (α); 2.) increases with variable costs (v), since that also increases economies of scope; 3.) decreases with fixed costs (Φ), since that also increases diseconomies of scope.

Figure: Symmetric Merger Equilibria without Cross-Price Effects



Hence, a merger wave followed by a divestiture wave can happen in each of the following three ways:

- A.) An increase in market size (α) where the ex-post realization is smaller than the ex-ante expected increase.
- B.) An increase in variable cost (v) where the ex-post realization is smaller than the ex-ante expected increase.

C.) A decrease in fixed cost (Φ) where the ex-post reduction is smaller than the ex-ante expected decrease.

7. A Generalization of Mergers and Divestitures for Heterogeneous-Products Oligopolies

For a generalization of the model variants presented above, recall that $0 < \gamma < \beta$ implies (partial) substitutability between products. With substitutability, we then have the following additional effects:

- i) A **positive concentration effect for both insiders and outsiders** – total number of firms falls.
- ii) A **negative market share effect for insiders only** – (w/o cost reductions) market share of each of the merger members falls.
- iii) **Reductions in variable costs counteract the market share effect.**
- iv) If (iii) for insiders is stronger than (i) for outsiders, merger participants will gain more than outsiders.
- v) If (iii) is stronger than (ii), then insiders will increase market shares and outsiders will lose.

A detailed analysis of this generalized model will be presented in future research.

8. Conclusions

In this section, we recapitulate our findings obtained so far; these results can be summarized as follows:

- 1.) There exists an internal multi-merger solution for some specifications of our model.
- 2.) This solution requires both strong economies of scope for small merger sizes (mergers reduce cost per single-product firm) and increasing diseconomies of scope for large merger sizes (then cost per firm must eventually increase).
- 3.) These conditions are sufficient to have mergers being more profitable than staying outside a merger as a single-product firm. However, in order to have a result where mergers reduce profits of outsiders, cost economies of scope must decrease variable costs sufficiently.
- 4.) This hold in principle no matter what the degree of substitutability between products: from monopolistic to homogenous products.

- 5.) However, the higher substitutability, the higher need to be both the scope economies (to make a merger profitable at all) and the scope diseconomies (to yield an internal solution) – internal here means more than just one merger!
- 6.) With zero-substitutability monopolistic competition, results will be totally driven by cost effects of mergers.
- 7.) With homogenous/heterogenous products, a monopoly merger (corner solution) is only guaranteed to develop – i.e. from two firms on, adding firms to the merger will always increase per firm profit – if some minimum level of cost synergies is present.

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