

Reply on Comment to "Small Firms and the Merger Mania"

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ABSTRACT. Research on performance differences between small and large firms is booming. It emerges relatively separated from the mainstream Industrial Organization Literature. Inspired by Levy's comment on an earlier paper we try to bridge the gap between the two areas. Especially we screen non cooperative game theoretical models for predictions on performance differences. Most of them forecast higher profits for larger firms, but there exist also some models which predict the opposite for very specific circumstances.

"While it is easy to envision the reasons for integration, it is harder to articulate costs of increased size." Holmstrom and Tirole, 1989

1. Introduction

Levy (1993) has commented on our article in which we tried to bring together the literature on the size-profitability relationship and on the success of mergers (Aiginger and Tichy, 1991). He offers some additional hypotheses why larger size or mergers could be profitable referring to literature offered by Industrial Organization. In section 2 we will react on the comments and relate them to our article and to some empirical trends. In the following sections we will follow Levy's direction and investigate further implications for the profitability-size issue offered in the literature. We will especially investigate what the game theoretical strand of Industrial Organization predicts for the relationship between firm size, concentration and profits (and to some degree on the merger profitability issue).

2. Firm specific capital, life cycles and integration

One question industrial organization literature addresses with great intensity is why firms exist. Transaction cost, contractual reasons, firm specific capital are some of the explanations. Levy focusses on "firm specific capital" especially learning by doing, knowledge of a firm about employees capabilities and their efforts. This capital "may be employed . . . in different product lines or . . . areas". This clearly is an important potential for economies of scope. If it is empirically relevant diversified firms should have higher profits (in addition to eventual economies of scale for each product line).

Mergers, Levy continues, may "promote anti-competitive behavior". We will come to this point later. And mergers may also be efficient as "a way of quickly becoming established in another product line". This is a nice *potential* source of efficiency gains of mergers, which does not depend on cost reductions due to larger batch sizes. Whether it is empirically relevant has yet to be investigated. There is some scepticism about "too much diversification" of firms in the empirical literature lately.

Another argument that sounds very attractive, namely that "small firms in young industries" should be integrated, while larger firms in mature industries become less integrated. A quick check of Austrian data (manufacturing, 1988) provides some preliminary evidence. The value added-sales ratio is lower for basic goods (34.5%), than for engineering products (38.2%), the latter probably representing younger products, the earlier comprising mature products. It looks, however, as if larger firms had a higher degree of integration (39.0%) than smaller firms (33.2%). But this hypothesis is open for empirical investigation.

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Value added data and sales data are available for many countries and industries, and panel data could help to disentangle size and age as determinants of the degree of integration of firms.

3. Game theoretic implications

Game theory has become the state of the art for Industrial Organization. Transaction costs, asset specificity and many other concepts can now be modelled into games in which strategies, the timing of decisions, the knowledge of the players, and the horizon of the game are precisely defined. The present article investigates which influence on profits non cooperative game theory predicts for firm size and concentration.

3.1. Monopoly and competition

The prediction of these extreme models is clear cut as far as the spread between marginal costs and price is concerned. Prices equal marginal costs under competition and exceed them under monopoly. This does not extend to profitability as such. Short run profits can be positive or negative under competition as long as firms do not enter or exit and fixed costs have not been adjusted adequately. On the other hand, monopoly can go with negative profits in the short run too (due to fixed costs or strategic considerations). In the long run economic profits are zero under competition and positive under monopoly.

For the size profitability relation we can conjecture that a monopoly position will be easier to achieve or maintain for larger firms. Competition by definition implies rather small firms, leading to a clear prediction for the price-cost margin and long run profits. But much noise may happen since monopoly is not size, and due to the importance of the entry-exit process.

We have to keep in mind, however, that industrial organization focusses on the price-cost margin as performance criterium and on rather demanding equilibria concepts, while empirical data refer to accounting profits and may be dominated by disequilibria.

3.2. Static oligopoly, homogeneous case

Modern oligopoly theory offers three standard

models. In Cournot models firms simultaneously choose quantities, in Bertrand models prices. In their standard version both models are static and assume a homogeneous product and symmetric costs (over firms). In the third important model class two different types of firms play sequentially in the same market setting optimal quantities or prices after the other group has made a decision (Stackelberg or fringe models).

In Cournot models profits (more exactly the price-cost margin) of individual firms depend positively on the firm's market share and negatively on the market demand elasticity. Firms with larger market shares have higher profits. Larger market shares imply lower costs (at the margin).

In Bertrand models all firms have zero profits, if at least two identical firms are in the market (and if an equilibrium exists). The potential threat that any price chosen by one firm would later on prove to be slightly higher than that chosen independently by the competitor forces all firms to set price equal to marginal costs. Cost differences between firms allow positive profits for the low cost firms (and therefor for the aggregate too), while the high cost firm still equals price and marginal costs.

In Stackelberg models the dominant firm makes larger profit than the follower, the leader maximizes profits knowing that the follower will maximize his profits in the residual part of the market. In models with one group of firms with a price setting capacity and a competitive fringe the first group makes supernormal profits the second not. Usually the stories assume the leaders to be the larger firms. How leadership emerges is unexplained, and if free to choose, all firms would prefer to be leaders. Some empirical support that large firms are leaders and small firms are followers is presented by Geroski (1983) and Roberts (1983).

3.3. Concentration and profits

The size-profitability issue and the concentration-profitability issue are related. The first, however, focuses on differences between firms in a specific market, the second on differences across industries.

If all firms played Cournot games, market concentration indicators should be positively correlated with the price-cost margin. The result

comes exactly if all firms have identical costs, and the (inverse) market demand elasticity is held constant across markets. The actual number of firms in each market (and concentration in general) depends on the cost curve and the entry conditions (and — if we skip the assumption of identical elasticity across industries — on the market demand elasticity).

Size differences *within an industry* depend on cost asymmetries between firms (not on economies of scale). Differing degrees of cost asymmetries in industries are an additional source for differences in concentration across markets.

If all firms played standard Bertrand games, there would be no observable concentration — profit pattern. However, cost asymmetries, product heterogeneity, capacity constraints open possibilities of positive profits on the firm level and then also for industries. Profits are in the first case linked to (differences in) efficiency, this is the Demsetz approach. In the second case they are related to characteristics of demand (markets) other than the traditional number of suppliers (which dominate the SCP — paradigm). In the third case they depend on technological factors (capital intensity or continuous process requirements separating capacity and production decisions). All these arguments have in common that there may be profit differences which are not related to concentration and/or collusion.

If some industries compete in quantities and some in prices even a *negative* relation between size (concentration) and profits could emerge in a sample mixing Bertrand and Cournot industries. Profits are low in industries which are forced to compete by prices (it does not help that the number of players is low or that the largest ones have a very high market share). Positive profits emerge if firms compete in quantities (and/or the markets are heterogeneous), a large number of firms does not erode profits. Aiginger (1991) finds empirical support for this hypothesis.

3.4. Product heterogeneity

In differentiated product oligopoly models Bertrand equilibria offer some price setting power and therefor positive profits. However, Bertrand equilibria tend to be more competitive than Cournot equilibria (lower prices, higher outputs), and

Cournot strategies are dominant if firms are able to choose (Singh and Vives, 1984). The results partly depend on the nature of the strategic interactions (between the own profits and the actions of the competitor), on uncertainty and on the specific rationing rule (Vives, 1985; Klemperer and Meyer, 1985; Kreps and Scheinkman, 1983; Davidson and Deneckere, 1986). A further interesting result is that as the number of products increases (within both a Cournot or a Bertrand market) prices approach marginal costs (Vives, 1985).

3.5. Collusion

If there is explicit collusion firms can reach anything up to monopoly profits. Older industrial organization theory developed conditions facilitating collusion, like a small number of firms, price leadership, rule of thumb pricing, as well as factors limiting collusion (secret price cuts, cost asymmetries, legal restrictions, etc.). It is fair to mention, that the possibility of implicit collusion has been known for long, though the models of the kinked demand curve as well as conjectural variation sounded always somewhat ad hoc (and are indeed somewhat artificial since they want to model dynamics in a static framework).

Modern non cooperative game theory starts to model the feasibility of implicit collusion in *repeated games*. In this class of games one period games are repeated with no physical link between the periods. For *finite* repetitions the one period results remains valid (e.g. the Bertrand or Cournot results are replicated in all periods). For infinite replications (supergames) the result changes dramatically: if the discount of future profits is not extremely high ("sufficient patience"), any degree of collusion is sustainable. The mechanism in its simplest version is the following: the gain of secret price cutting is the one period monopoly profit (otherwise to be shared), the loss is the foregone (shared) profits for the infinite future (assuming that the other firms revert to marginal cost pricing forever). For the duopoly price model a discount factor of 0.5 is the critical value. More generally, for n firms the critical discount factor is $1-1/n$, so that (similar as in the old Bain story, but now implicitly) concentration facilitates tacit collusion. Of course information lags, infrequent transactions, and fluctuating demands reduce the power

of tacit collusion (all these factors can be considered as decreasing the importance of the future, the discount factor). And punishment is less harsh in other models e.g. for Cournot reversion. Three phase strategies (with a limited period of punishment, thereafter collusion again) can be modelled (Porter (1983), Green and Porter (1984)).¹ For an empirical study of the dependence of profits on factors predicted to be relevant in the supergame literature see Aiginger (1992).

A result which is not obvious without the explicit use of game theory is that it is sometime profitable to remain small. Gelman and Salop (1983) show that for price competition committing to remain small increases profits since it invokes less aggressive response. Rather general for strategic substitutes (which are rather typical in the case of second period quantity competition) aggressive strategies seem optimal, for strategic complements soft strategies (limiting price reactions).

What can we learn for the size — profitability relationship? The supergame result is usually interpreted that many collusive strategies are sustainable (embarrassment of riches). We could add that the probability of collusion is higher for markets in which the number of firms is small. The incentive to undercut is larger for small firms (if capacity is available), maybe detection is less easy too and the discount factor is lower. These factors could provide some rationale for higher profits of small firms in "out of equilibrium" situations. The scope for sustainable collusion is lower in markets with many small firms.

3.6. *Entry and profits*

The Cournot and the Bertrand results are developed as oligopoly models, modelling behavior for an exogenously given (small) number of firms. Some form of entry barrier must exist, to sustain supernormal profits. The older literature stresses size, technological advantage and price behavior of the incumbent firms. Contestable market literature focus on the question whether existing fixed costs are sunk or can be recovered in case of exit. Game theory models the relation between an incumbent and potential entrants as a dynamic game, in which reputation, signals and strategic decisions are important.

We cannot survey the richness of dynamic models on entry, entry deterrence or accommodation (see Gilbert, 1989). Instead we want to return to the fact — known for long — that in general the feasibility of supernormal profits depends on the existence of some form of entry barriers. What does this imply for the size profitability issue? Usually we would assume that the size of existing firms is itself an entry barrier, maybe technology, capital intensity, government regulation being other factors. All these factors combined would forecast, that entry barriers and supernormal profits existed in markets with large firms, but are not very probable in those where small firms dominate. Game theory offers the possibility that small firms can enter if they can commit themselves to remain small. This is a nice explanation for the coexistence of firms of different sizes in one market. Now firms do not (necessarily) differ in their cost curve but in history (commitments).

3.7. *Exit and firm size*

There is a growing literature on the order of exit of firms in declining industry, which may have some implications on profits and size. Ghemawat and Nalebuff (1985) show that (if firms are informed about their rivals costs, demand declines deterministically and continuously, reentry is not possible) the smaller firms survive longer. If it is feasible continuously to adjust capacity the larger firms reduce capacity first (until they have shrunk to the size of the smaller rivals, Ghemawat and Nalebuff, 1985).

More models can explain higher growth (slower decline) of smaller firms. The profitability consequence is less obvious, since the models employ demanding concepts of rationality (including subgame perfectness). In the final stage there is a monopoly with positive profits, which eventually erodes inducing the exit of the winner. Up to that stage there are profits or sometimes even strategic losses, which tend to be higher for the later winner. It could be that real world imperfections (policy interventions) delay the exit of the later loser, increasing the profit differences predicted by optimal behavior.

4. Economies of scale (and scope) and profit definition

4.1. *Economies of scale and scope*

Decreasing costs with the scale of operation (quantity or number of lines) sounds like a "traditional base" for considerations about size and profit. If there are economies of scale or scope then larger firms should be more profitable and markets more concentrated. The story however is not that easy under the conditions of unconstrained maximization.

If all firms have identical cost curves and economies of scale exist over the whole range there will be only one firm in the market. It may make considerable profits (though not by equalizing MC and MR). The same is true for an increase of average costs "too late" in relation to market size to comfort two firms (see the discussion of subadditivity). Both cases lead to policy considerations and questions of sustainability. If the models are relevant they predict large profits for concentrated industries but no profit differences within an industry (since there is only one firm).

Limit price models, contestable market literature and entry games address the question of sustainability of monopoly profits. All stress that profits are limited because of potential competition, with the extremum that prices may be reduced to marginal (or average) costs in absence of sunk cost (and rapid quantity adjustment).

This yields strong predictions that economies of scale may influence the number of firms in a market (together with entry and exit conditions) and to some degree their profitability. But it is hard to relate any differences between firms of different size to the shape of a single cost curve typical for an industry.

Firms of different size have to operate on different cost curves (not only different points of the curve) or face different demand conditions or face different strategic situations. We may assume that large firms have a technological advantage insofar that their cost curve is always lower than that of the smaller competitor. Then large firms have larger profits. That small firms may have lower cost curve seems impossible *ex ante*, since the large firms could always produce in small units (eventually after buying the small firm). Maybe a

large firm can get stuck with unexpected high cost, due to some kind of X-inefficiency or to slacks (Leibenstein, 1987; Frantz, 1988).

The empirical evidence is consistent with small firms producing in niches with low costs, while large firms produce with higher costs in large relatively standardized markets. Strictly speaking costs as well as demand differs and so different models have to be applied and almost everything can happen.

Economies of scope have similar consequences for the size profitability relation. If they existed — maybe in the variant of firm specific capital as proposed by Levy (1993), they imply profits of larger firms, since these are usually operating in several product lines. However if the same technology is available to all firms we must explain why firms differ in size (scope). If firms are different (by some exogenous constraint) the result is trivial. Maybe one game theoretic story should be added. Multimarket contact tends to soften price competition (since a price war between the firms is more severe, see Bernheim and Whinston, 1990).

4.2. *Limits of firm size*

Industrial Organization has intensively addressed the questions why firms existed. Technological reasons, contractual reasons, legal constraints (for cooperation between firms but not within firms), the impact of uncertainty and asset specificity is well understood. It is much harder to specify the factors limiting size, especially since one can always integrate firms, let them operate independently, and intervene only if there are specific advantages ("selective intervention" Williamson, 1975, 1985). "While it is easy to envision the reasons of integration, it is substantially harder to articulate costs of increased size" (Holmstrom and Tirole, 1989).

Exhaustion of returns to scale, increasing slacks in the organization, problems in monitoring firms' objectives are some lines in which limits of size can be argued. Milgrom (1988) offers the idea of "influence costs" meaning undesired employee's activities that are intended to change their superior's action to the benefit of the employee. Cremer (1986) and Kreps (1984) discuss the importance of reputation in supergame models.

Reputation may be hard to achieve in a firm with many employees, the individual benefits of shirking may be higher than the joint advantage of reputation.

There is a vast amount of literature explaining the greater flexibility of small firms in times of rapid change in demand and in technology. Profits may be shown to rise with shorter decision periods (Aiginger, 1987), then again large and small firms have different strategy spaces. Waterson (1990) presents a model in which some customers are easier to serve than others. This kind of product differentiation leads to the surprising result that market shares and profits are negatively related. The author admits that he deliberately tried to elaborate such a relation to explain the empirical facts in Clarke, Davies and Waterson (1984) and in Schmalensee (1987) that in some industries market shares and profits are negatively related. The same was found in Aiginger (1992) for manufacturing firms and Mooslechner and Schnitzer (1992) for banking.

4.3. *Profit concepts and price-cost margins*

Empirical studies refer to average profits and usually relates them to sales or to assets. Theory predicts marginal profits, price or (relative) price-cost margins. This is less a problem if costs are linear, but serious for a survey on the relation between size and profitability (where fixed costs, sunk costs, capacity constraints play an essential role).

The concepts of profits are different in theory and empirical research. Economic profits are the residual after deducting all costs, including opportunity costs and risk elements, correctly calculated depreciation, research outlays, advertising, human capital investment and goodwill. Many authors stress the difference between this concept and any measured (accounting) profits (see Adelman and Stangle, 1985; Fisher and McGowan, 1983; Schmalensee, 1989). Case by case calculations show that the accounting profits and economic profits can be very different. Empirical research sometimes comforts us by showing some correlation between available profit indicators.

5. The puzzle remains

There are many arguments why larger firms should be more profitable than smaller ones. But it is harder to "articulate costs of increased size" (Holmstrom and Tirole, 1989). With some modifications the arguments are repeated in the literature on mergers, on the effect of concentration, and on vertical integration. The empirical data do not show unambiguously superior performance of large firms and overwhelming success of mergers (Aiginger and Tichy, 1991).

Levy presented some argument offered by Industrial Organization literature, which again underlined the potential advantage of mergers and vertical integration. I skimmed modern non cooperative game theory for predictions on profitability by size (and concentration). Non cooperative game theory tells us that many things can happen. So at least the a priori presumption of a positive relation between concentration and profits became much weaker than in collusion founded (Bain) or efficiency oriented (Demsetz) older oligopoly theory. Larger profits of small firms may come from their ability to play quantity strategies, while larger firms dominate (homogeneous) markets where price competition erodes profits.

Larger profits of smaller firms may come from their ability to collude implicitly (let aside that they may collude explicitly since antitrust is less attentive). The profits for deviation from implicit collusion may be larger, but punishment could also be more severe (greater insolvency risk). Small firms may have advantages during the entry process since they may invoke less aggressive reactions of the incumbent, they may also be more flexible during the exit in declining industries. Cheating may be more difficult to detect, allowing higher profits in out of equilibrium situations.

Mergers may be unprofitable for the merging firms (in case of quantity competition and in absence of an endogenization of the merger decision). But that looks to be a theoretical nicety as compared to most other potential circumstances in which only profitable mergers are done. Still many important elements favor the profitability of larger firms. Stackelberg models, competitive fringe models, and entry accomodation strategies can explain the coexistence of large and small firms (a very important stylized fact of actual

markets). However they too usually predict higher profits for leaders or incumbents.

So the puzzle is not solved. But Industrial Organization yields a lot of testable hypotheses about the impact on profits by size (and concentration). And investigations on the performance of small firms should make use of them. Levy's comment induced me to see this potential much more clearly.

Note

¹ Supergame results in general suffer from the multiplicity of equilibria and sometimes also from the topsy turvy principle (anything that makes more competitive behavior feasible — like unlimited capacities — actually promotes collusion). Another problem is that deviations from collusion should not actually happen, at least in non stochastic models. (See Shapiro, 1989, p. 357ff.)

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