Diversification and Synergies: Effects on Profitability

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Abstract

The paper addresses the question of the effects of diversification strategies on firms' profitability. Empirical analyses do not seem to confirm the hypothesis that diversification is the optimal response to the presence of synergies and hence generates higher profits. It is shown that this might be either the effect of distortions due to the omission of some other factors which affect the efficiency of firms, or the result of selection bias. Diversified firms, in fact, may be the less efficient firms, just able to survive due to the synergies they achieve diversifying.

Keywords: diversification, synergies, profitability, distortions, efficiency of firms.

1. Introduction

A certain degree of diversification is a characteristic of nearly all firms. A fairly developed theoretical literature on reasons for diversification identifies them mainly in the search for synergies or for market power[2].

If this is the case we would expect a positive relationship between diversification and performance of firms. However econometric work does not in general confirm, or at least offers only weak support, to the hypothesis that diversified firms are more profitable[3]. Moreover, after a wave of intense diversification, often conglomerate, in the sixties and seventies, especially in the United States but also in Europe, in the eighties and nineties a large number of firms reversed that trend[4].

A debate on the reasons for this behaviour has developed and empirical analyses on the relative performance of diversified versus undiversified firms have followed.

In the literature, the reasons for firms' excessive diversification, leading to an observed negative relationship between diversification and (some measure of) performance are found in "disequilibrium" stories. They rely on some non profit maximising behaviour by owners or managers of firms: first, because of agency reasons linked to a divergence of objectives between managers and shareholders, the former being more interested in the firm's growth even through wasteful investments; secondly, due to an excessive faith of managers in their ability to

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2 See Montgomery (1994) for a recent survey.

3 See Rhoades (1973, 1974), Carter (1977), Wernerfelt an Montgomery (1988a, 1988b), Lang and Stulz (1995). Wernerfelt and Montgomery (1988a, 1988b) suggest that diversified firms might have lower average returns, as diversification is generated in their framework by the presence of excess capacity, and positive profits are the consequence of the ownership of a specific factor, whose efficiency is reduced when applied to other fields. However, in their context, the possibility of exploiting synergies is ignored.

4 See Bhagat, Shleifer, Vishny (1990), Kaplan, Weisbach (1992), Lang and Stulz (1995).

manage all kinds of business (the hybris hypothesis); or, finally, because the capital markets provided wrong signals and incentives to profit-maximising firms[5].

Here we offer a further explanation, based on equilibrium profit-maximising behaviour of firms in a very simple setting. This explanation appears to be consistent with some of the empirical findings of the past and the more recent empirical literature.

In the literature, the theoretical analysis of diversification is performed either in a perfectly contestable framework, where all firms diversify if there are economies of scope; or in a strategic framework, where firms diversify also in absence of synergies. The essential novelty of the present approach is to model entry decisions, taking firm characteristics as given. The self selection of firms in the light of intrinsic efficiency differences drives the main results.

We suggest that the results of empirical work (relating profitability to diversification) may be biased due to the omission of factors other than diversification which affect the efficiency of firms. It might then be the case that the performance of diversified (but relatively inefficient) firms is worse than the performance of specialised (but relatively efficient) firms: the advantages of the synergies might not be sufficient to offset the disadvantages of being inefficient. At first glance, it might seem that such effects were simply 'random', and that they would merely lead to 'noise' in the data. This, however, is not so. We identify conditions under which, in equilibrium, efficient specialised firms are not willing to diversify. In particular this is the case when it is "better" to be very good in one product only, rather than sufficiently good in all of them. Specialised firms may be very efficient in one line of production, but relatively inefficient in the others. At the same time, some highly inefficient firms may only be able to survive in the market due to the presence of synergies. Hence, the observation of higher average profits for the undiversified firms is not a sufficient argument against the theory that the diversification process was driven by synergies. Indeed, the usual *ad hoc*

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5 For a survey of these reasons see Montgomery (1994) and Markides (1996).

assumption that diversification and profitability should be correlated across industry groups does not have any robust theoretical basis.

These results are particularly interesting in the context of a very recent analysis on the wave of de-diversification that occurred in the United States in the 1980s. Lang and Stulz (1995) compare the performance of conglomerate firms with that of specialised firms in the 1980s. They use Tobin's q as a measure of performance and adopt a "chop-shop" approach for the comparison: the performance of a real conglomerate firm is compared to a weighted average of the performance of specialised firms in all the industries where the former is active. The authors find that conglomerates are consistently worse performers than specialised firms in the period considered. More interestingly, in the context of our results, they find some preliminary evidence that firms which diversify are poor performers relative to firms that do not. The theoretical result on the negative correlation of diversification with profitability holds for firms diversifying into industries that are not too closely related and relies on the fact that diversified firms might be the poorest performers. Hence the evidence of Lang and Stulz appears to be consistent with our explanation of a negative correlation.

2. The Basic Framework

We consider an economy with an infinite number of potential firms, endowed with a random efficiency parameter which affects their cost function and which they can learn after paying a fixed entry cost[6]. Once on the market they act as price-taking profit maximisers and face increasing marginal costs[7].

6 See, for example, Lippman, Rumelt (1982). They explain in this framework the presence of positive and heterogeneous rents across firms with price taking behaviour and free entry: firms enter the market if their expected profits are positive; entry occurs until the price is driven down to the point where expected profits are negative. The surviving firms will have positive profits on average, even if free entry is allowed.

7 Given that the Bertrand models of competition lead either to zero profits for the firms or to severe existence problems, any alternative specification should rely either on an entry-exit version of Cournot competition or on a product differentiation model with entry costs. However these specifications would create unnecessary technical difficulties for our

To keep matter simple and concentrate on the effects of synergies, the model we consider is static, and diversification is generated only by attempts to exploit synergies across markets[8].

The empirical and business literature underlines how, among the factors driving diversification and having a considerable impact on its success, the degree to which markets are 'related' is particularly relevant[9]. The concept of 'relatedness' is variously defined in this literature. A first set of factors includes technological elements, which amount to the possibility of sharing fixed costs between different products (economies of scope) [10]. These can be either fixed plant costs (whenever one product technology is sufficiently close to another), or other types of fixed costs, such as marketing costs (whenever marketing networks can be at least partially shared across series of products), distribution costs (products used by the same type of consumer will be probably distributed through the same channels, e.g. durable consumer goods, food products etc.), or the exploitation of a brand image[11].

A second set of factors playing an essential role in the diversification process, and having a considerable influence on its effects, is what we might label 'managerial ability': "relatedness to the parent company refers to the likelihood that an entrant launched by an established company inherits *skills* from the parent, which it tries to transfer to the entered market" and "new product introductions are more likely to succeed if they demand *skills* that *managers* already have" (Biggadike, 1979). The relatedness across markets arises from the familiarity with manufacturing methods used in the market to be entered, from expertise in serving a

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problem. We are in fact confident that our argument would carry through to these alternative models, since it only relies on some general statistical properties of the profit function.

8 Hence, we do not consider motives linked to agency problems or managers hybris which would lead to an even stronger negative relationship between diversification and performance nor other reasons such as the possibility of exploiting internal capital markets. See Stein (1995), Gertner, Sharfstein, Stein (1994).

9 See Biggadike (1979), Lamelin (1982).

10 See Panzar, Willig (1981), Teece (1980, 1982).

11 See Bianco (1995) for some examples and case studies.

certain type of customer, in differentiating products and in developing low cost distribution and customer serving systems. They are benefits that arise when a firm exploits its excess firm-specific assets in similar markets (Markides, 1996). Hence, the best strategy, when diversifying, is to enter businesses where the managerial skills can best be used (Peters and Waterman (1982)).

We shall represent these two elements in terms of the cost functions of firms as follows.

The 'managerial skills' hypothesis will be represented through the presence of a *positive correlation between costs* in two industries, so that if a firm has relatively high costs in one product, it is likely that costs will also be high in the second product. This could be taken to describe two markets which are 'related' because they have the same type of production structure: if a firm, active in both markets, has a 'good' manager, his ability will show equally in both and generate the same level of efficiency. Specifically, we shall consider a firm-specific efficiency effect, which can be modelled in terms of a random 'cost draw' (see below).

The economies of scope possibility will be represented by a *reduction in total cost* that any firm enjoys if it actively produces in both industries. Here, we are concerned with a feature of the production or distribution technology, *per se*, which all firms face equally.

This introduces in a very simplified way both industry characteristics (summarised by economies of scope or cost correlation across them) and firm specific factors (a 'cost draw') in the diversification decision.

We want to concentrate on the issue of how diversification arises and the relation between diversification and profitability. In what follows, we examine in turn each of the two types of model. The 'managerial skills' model is discussed in sections 3-5, while the 'economies of scope' model is examined in section 6. For simplicity we shall consider only two industries: firms will decide whether to enter neither industry, only one industry (specialised firms), or both industries (diversified firms).

3. The 'Managerial Skills' Model

We assume that the products produced by the various firms are homogeneous within each of the two markets considered and the demand for each product i is fixed and known:

$$Q_i = A - p_i \qquad i = 1,2.$$

Firms differ in their efficiency: for each of the two products the cost function for firm j is a simple quadratic function (so the marginal cost schedules of the firms are linear), and differs across firms by a vertical shift parameter

$$C_i^j = (q_i^j)^2 + c_i^j$$

where c_i^j is the realisation of a random variable $\tilde{c}_i^j$. $\tilde{c}_1^j$ and $\tilde{c}_2^j$ are i.i.d. with respect to j and have commonly known distribution functions. The realisation of c_i is observed by firm j only on paying a non-recoverable entry cost M>0[12];

The profit function, once in market i, is therefore

$$\pi_i^j = p_i q_i^j - ((q_i^j)^2 + c_i^j)$$

Firms behave as price-takers. Their profit maximising choice of output given the market price p_i is:

$$q_i^j = \begin{cases} \dfrac{p_i}{2} & \text{if } \dfrac{p_i^2}{4} > c_i^j \\ 0 & \text{otherwise.} \end{cases}$$

If n_i is the total number of firms active in market i, in equilibrium it must be the case that

$$S(p_i) = n_i \frac{p_i}{2} = A - p_i = D(p_i)$$

where $S(p_i)$ denotes total industry supply. Hence the equilibrium price is:

$$p_i = \frac{2A}{n_i + 2}$$

12 The entry cost M is the cost of setting up the firm, and it is the same whether one wants to be able to produce on market 1, market 2 or both markets.

We assume that firms are risk neutral: they enter the industry as long as the expected profits are larger than M.

An equilibrium is defined as a vector:

$$(n_T^*, p_1^*, n_1^*, p_2^*, n_2^*)$$

where: p_i^* is the market price, n_T^* is the number of firms entering the market (i.e., paying M and observing cost draws), n_i^* is the number of active firms on each market i (i.e., those with non negative profits).

We assume the following conditions:

Free Entry $\qquad E(\pi | p_1, p_2) = M$

Price Taking Behaviour $\qquad q_i^j(c_i^j, p_i) = \begin{cases} \dfrac{p_i}{2} & \text{if } \dfrac{p_i^2}{4} > c_i^j \\ 0 & \text{otherwise.} \end{cases}$

Condition 1 is the optimal entry decision rule, given market price. Condition 2 is the profit maximising output decision for price taking firms. We are thus assuming perfect competition in product markets, and condition 2 ensures that supply equals demand. Here we confine ourselves to symmetric equilibria $(p_1^* = p_2^*, n_1^* = n_2^*)$.

Within this basic model we want to consider two possible functional forms of the random variable c_i^j in order to study the effects of diversification on the performance of firms[13]. These will be used to represent the presence of cost correlation and economies of scope respectively.

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13 Differences in c_i^j are taken to summarize different levels of efficiency in an extremely simple way, without evaluating potential strategic interactions internal to the firm. For example, if we also assume perfect competition in the input markets, the rents from greater efficiency of one input would be appropriated by that input (the managers, if we are considering their efficiency) and we would not observe different efficiency levels for the firms themselves.

4. Correlated Costs: is it Possible that Specialised Firms Perform Better?

We shall first consider the case where cost draws are correlated. This may be interpreted as the effect of 'relatedness' or similarity of markets: if a firm is efficient (its costs are relatively low) in one market, it is likely that it will be similarly efficient in another with analogous characteristics.

Imagine for example that the efficiency of the firm is essentially determined by the manager's ability. If a firm is active in two markets, with a relatively similar structure (e.g. in terms of type of consumers, or in terms of the competitive structure, so that a strategy successful in one would probably also be successful in the other), then if the manager of the firm is 'good' in one, he will probably be 'good' in the other. Another source of 'relatedness' arise from input costs: if two industries use similar inputs, then a firm with access to low cost supplies will benefit in both markets.

We represent these possibilities by assuming a simple functional form for the firm specific element of cost c_i^j:

$$\tilde{c}_1 = (1-\rho)\tilde{v}_1 + \rho v_{12}$$
$$\tilde{c}_2 = (1-\rho)\tilde{v}_2 + \rho v_{12}$$

where $\tilde{v}_1, \tilde{v}_2, \tilde{v}_{12}$ are i.i.d. random variables. This allows us to describe the 'degree of relatedness' across markets in terms of the parameter ρ. If $\rho = 0$ the markets are completely unrelated, and $\tilde{c}_1 = \tilde{v}_1, \tilde{c}_2 = \tilde{v}_2$, i.e., the cost draws are independent. If $\rho = 1$ the cost draws are perfectly correlated, i.e., $\tilde{c}_1 = \tilde{v}_{12} = \tilde{c}_2$.

We might consider, for example, the cost of undertaking an advertising campaign. If the two markets are similar, a marketing manager who has organised a successful advertising campaign in one market will presumably be able to reproduce that success in the other. If the industries are not related, the success in one may be poorly correlated with success in another.

Now, as we noted in the introduction, it is often argued that diversified firms should have higher profits than undiversified firms, since the synergies they exploit should create higher profits. In this section, we present a simple example which is consistent with the absence of a relationship between diversification and profitability.

We assume:

$$\tilde{v}_1, \tilde{v}_2, \tilde{v}_{12} = \begin{cases} 0 & \text{with probability } 1/2 \\ 1 & \text{with probability } 1/2 \end{cases}$$

$\tilde{v}_1, \tilde{v}_2$ are associated with the share of fixed costs which is independent in the two markets (which we shall define the "market specific cost draw"), while $\tilde{v}_{12}$ is associated with the share of costs which affects both markets together (the "common cost draw"). The random variable $\tilde{c} = (\tilde{c}_1, \tilde{c}_2)$ will thus be distributed as:

$\tilde{c}_1$	$\tilde{c}_2$	probability
0	0	1/8
ρ	ρ	1/8
0	$1-\rho$	1/8
ρ	1	1/8
$1-\rho$	0	1/8
1	ρ	1/8
$1-\rho$	$1-\rho$	1/8
1	1	1/8

It is easy in this case to solve explicitly for the equilibrium outcome $(n_T^*, p_1^*, n_1^*, p_2^*, n_2^*)$. We simplify by confining attention to symmetric equilibria, that is $p_1^* = p_2^* = p^*$, and $n_1^* = n_2^* = n^*$. Hence our equilibrium is a triple (n_T^*, n^*, p^*) where $n_T^* = \alpha n^*$ $(\alpha \geq 1)$. In order to solve the equilibrium conditions $E(\pi|p)$=M and $D = S$, we first compute $E(\pi|p)$. Given the distribution of the cost pairs, we have:

$$E(\pi|p)=\begin{cases}\frac{1}{8}p^2 & \text{if } \frac{p^2}{4}\le min(\rho,1-\rho)\\ \frac{p^2}{4}-\frac{1}{2}min(\rho,1-\rho) & \text{if } min(\rho,1-\rho)<\frac{p^2}{4}\le max(\rho,1-\rho)\\ \frac{3}{8}p^2-\frac{1}{2} & \text{if } max(\rho,1-\rho)<\frac{p^2}{4}<1\end{cases}$$

To obtain the expression we proceed as follows. In the first interval ($\frac{p^2}{4}\le \min(\rho,1-\rho)$), observe that only firms with cost draws $(c_1,c_2)=(0,0),(0,\rho)$ or (ρ,o) are active in at least one market and would earn $p^2/4$ in each. Firms with all the other possible cost draws earn, in this price interval, zero profits. Taking the expectation over the eight possible combinations leads to the above expression.

In the second interval (assuming we are in the case $\rho<1-\rho$, i.e., $\rho<1/2$[14]) firms active in both industries are those with cost draws $(c_1,c_2)=(0,0)$ or (ρ,ρ). In each market the former have profits $p^2/4$, the latter $p^2/4-\rho$. Firms active in one market only are those with cost draws $(c_1,c_2)=(0,1),(1,0),(\rho,0)$ or $(0,\rho)$. In the first two cases they have profits equal to $p^2/4$, in the second two, $p^2/4-\rho$. In all the other cases firms would earn zero profits. A straightforward computation of expected profits leads to the above expression.

Expected profits in the third zone are computed in a similar way[15]. Now, $E(\pi|p)$ is monotonically increasing in p. As long as $E(\pi|p)>M$, firms enter the market. Entry reduces market price, thus decreasing expected profits of entering firms, until $E(\pi|p)=M$ (as stated in condition 1 above). We can now solve for the equilibrium (n_T^*,n^*,p^*) in terms of the exogenous parameters M and ρ by substituting for $E(\pi|p)$ in the equilibrium conditions. There are four different cases depending on the values of M and ρ (here the two cases $\rho<1/2$ and $\rho>1/2$ have been split).

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14 The case $\rho>1/2$ is treated in the same way.

15 Details of the computations will be found in Appendix 1.

(i): $M \le \min(\frac{\rho}{2}, \frac{1-\rho}{2})$

$$n^* = \frac{A - 2\sqrt{2M}}{\sqrt{2M}} \qquad p^* = 2\sqrt{2M} \qquad n_T^* = 8n^*$$

(ii): $\frac{\rho}{2} < M \le 1 - \frac{3}{2}\rho$ and $\rho < 1-\rho$

$$n^* = \frac{2A}{\sqrt{4M+2\rho}} - 2 \qquad p^* = \sqrt{4M+2\rho} \qquad n_T^* = 2n^*$$

(iii): $\frac{1-\rho}{2} < M \le \frac{3}{2}\rho - \frac{1}{2}$ and $1 - \rho < \rho$

$$n^* = \frac{2A}{\sqrt{4M+2(1-\rho)}} - 2 \qquad p^* = \sqrt{4M+2(1-\rho)} \qquad n_T^* = 2n^*$$

(iv): $\max(\frac{3}{2}\rho - \frac{1}{2}, 1 - \frac{3}{2}\rho) \le M < 1$

$$n^* = \frac{A}{\sqrt{\frac{2}{3}M + \frac{1}{3}}} - 2 \qquad p^* = 2\sqrt{\frac{2}{3}(M + \frac{1}{2})} \qquad n_T^* = \frac{4}{3}n^*$$

To illustrate the derivation of these results, we outline the calculations for case (i). The two equilibrium conditions, $E(\pi|p) = M$ and $S = D$, can be now solved explicitly:

$$\begin{cases} E(\pi|p) = \frac{1}{8}p^2 = M \\ p = \frac{2A}{n^* + 2} \end{cases}$$

Solving for p^* and n^* leads to the above expressions. n_T^* is determined by computing the fraction of firms which will not produce. We can also substitute the value of p in terms of the exogenous parameter M into the condition $(p^2/4) \le \min(\rho, 1-\rho)$.

We now turn to the performance of firms, by considering the profits of active firms, conditional on being diversified or non diversified.

Specifically, we compare expected profits conditional on being active in both markets, $E(\pi | c_1 \le p_1^2/4, c_2 \le p_2^2/4)$, with expected profits conditional on being active in one market only, $E(\pi | c_i \le p_i^2/4, c_j > p_j^2/4)$[16]. In what follows we shall simply denote the former by $E(\pi | 1\&2)$, and the latter by $E(\pi | i)$.

In order to make an appropriate comparison, we should either compare the total profits of a diversified firm with the sum of the profits of two specialised firms (active in different industries), each of size equal to the corresponding product line of the diversified firm, or compare the ratio (total profits/total sales revenue) of a diversified and a specialised firm. However, in our model the size of each product line, both for specialised and diversified firms, is always $p/2$. It is therefore irrelevant whether we compare profits per industry, profits/sales ratios or the sum of the profits of each product line. In what follows we compare the first variable.

To ease exposition, all derivations have been placed in Appendix 1. Here we merely state the results. We again distinguish several cases, depending on the parameters of the model.

(i) $\min(\rho, 1-\rho) > \dfrac{p_i^2}{4}$

This case corresponds to a situation in which the observed equilibrium price is so low that only very efficient firms are active. Here, both specialised and diversified firms have the same expected profits, $E(\pi_1 | 1\&2) = \dfrac{p_i^2}{4} = E(\pi_1 | 1)$. This case arises

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16 p_i are the respective equilibrium prices.

when the entry cost M is very low ($M < \rho/2, (1-\rho)/2$). This drives the equilibrium price down and allows only the most efficient firms to survive.

(ii) $1-\rho > \frac{p_i^2}{4} > \rho$

This case corresponds to a higher level of equilibrium price than case (i), with a very low correlation factor. Only firms with a low market specific cost draw ($\nu_i = 0$) are able to survive (as their total costs will be at most ρ), and this creates a 'symmetry' between diversified and non diversified firms, such that $E(\pi_1|1\&2) = E(\pi_1|1)$.

(iii) $\rho > \frac{p_i^2}{4} > 1-\rho$

This case differs from the previous one only in the presence of a high correlation factor. In this case all firms will be active in both markets. Only firms with a 'good' common cost draw ($\nu_{12} = 0$) will be able to survive, as $\nu_{12} = 1$ would imply $c_1, c_2 \geq \rho > p$, but having a 'low' common cost draw and high correlation implies being able to survive in both markets (as costs on each market will be smaller than $1-\rho < p$).

(iv) $1 > \frac{p_i^2}{4} > \max(\rho, 1-\rho)$

We turn now to the most interesting case: the observed equilibrium price is high enough that many firms, with different cost draws, will enter. In this case the price is sufficiently high to allow all the firms, except those with cost draw = 1, to survive on the market. We have:

$$E(\pi|1\&2) = \frac{p_i^2}{4} + \frac{1}{5}\rho - \frac{2}{5}$$

$$E(\pi_1|1) = \frac{p_i^2}{4} - \rho$$

so that:

$$E(\pi|1\&2) > E(\pi_1|1) \qquad \text{if} \quad \rho > 1/3$$
$$E(\pi|1\&2) < E(\pi_1|1) \qquad \text{if} \quad \rho < 1/3$$

This is the most interesting case for our purposes: if the price is sufficiently high, (which will be the case, whenever M is large enough, i.e., $M > 1 - 3/2\rho$) diversified firms are more profitable only if the cost correlation is high enough. When it falls below 1/3, i.e. when markets are not very 'close', *diversified firms are less efficient on average than specialised firms.*

An intuitive interpretation of the results is as follows. When we observe that a firm is specialised, this raises the probability that its common cost draw[17] is 'bad' (if it were good the firm would have entered both markets). However, the fact that the firm is active in one market implies that the market specific share of the cost must have been relatively good. Accordingly, diversified firms must have a good common cost draw: this allows them to enter the market even if the market specific cost component is high.

If the correlation between the two industries is high, this synergy generates better average performance for diversified firms. However, if the industries do not have too much in common, the "good management" effect does not have a substantial effect on costs and profitability and diversified firms are less profitable than specialised ones.

Notice that it is not diversification *per se* which negatively affects firms' performance. Rather, being diversified is simply correlated with relative inefficiency.

The discreteness in our example makes it somewhat difficult to characterise the necessary conditions for the result. We therefore turn now to a continuous distribution function, by reference to which we give a complete characterisation of

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17 We shall imagine, in the following, that the common cost draws depend on managerial skills, so that if $\tilde{v}_{12} = 0$ we say the firm 'has a good management', and if $\tilde{v}_{12} = 1$ then 'it has a bad management'.

the properties of the cost functions and the correlation factors which generate the outcome.

5. A General Characterisation

The result in the above example, that diversified firms may be less profitable, relies on a particular relation between the parameters M and ρ. First, the correlation ρ must be relatively low, so that efficiency is mainly affected by the firm specific element in the cost draw. Second, the distribution function of that cost element must be 'very steep' at some point (in fact, at the point corresponding to the equilibrium market price). This last characteristic will favour the entry of a large number of relatively inefficient diversified firms (i.e. those with a high firm specific cost element) since they can exploit a lower value of the common cost element, which 'just' compensates for the high realisation of the firm specific cost element.

In this section we show that, if the distribution of the firm specific cost factor has sufficient mass at some point, equilibrium configurations exist where a large number of diversified firms with high market specific cost draws enter the market.

This effect dominates the positive influence of the synergies when these are not too strong, i.e., when the correlation factor is sufficiently small.

In the remainder of this section we show that these two features are in fact necessary and sufficient to make diversified firms less profitable than single product firms.

Consider the random variables $\tilde{v}_1, \tilde{v}_2, \tilde{v}_{12}$, with continuous density functions f_1, f_2, f_{12} (resp. distribution functions F_1, F_2, F_{12}) and support $[0,1]$[18], and define as before:

$$\tilde{c}_1 = (1-\rho)\tilde{v}_1 + \rho v_{12}$$
$$\tilde{c}_2 = (1-\rho)\tilde{v}_2 + \rho v_{12}$$

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[18] The result would go through with any support.

Proposition: There exists a $\bar{p}$ and an equilibrium price $\bar{p}$, such that for all $\rho<\bar{p}$:

$E(\tilde{c}_1|\tilde{c}_1 < \hat{p},\tilde{c}_2 < \hat{p}) > E(\tilde{c}_1|\tilde{c}_1 < \hat{p},\tilde{c}_2 > \hat{p})$[19] (where $\hat{p} = \frac{\bar{p}^2}{2}$), if and only if there exists $x \in [0,1]$ such that the following condition is satisfied:

$$\left[\int_0^x f_1(v_1)dv_1\right]^2 < f_1(x)\left[\int_0^x (x-v_1)f_1(v_1)dv_1\right]$$

Proof: see Appendix 2.

Intuitively, the condition requires that the density of the market specific cost component is sharply peaked at some point. This is satisfied, for example, in the case of a continuous distribution on $[0,1]$ with $f(v) \to \infty$ as $v \to 1$. It is not satisfied, for example, by uniform distributions.

It may be helpful to note here that this proposition is couched in terms of the equilibrium market price $\bar{p}$, and not in terms of M. It is easy to show, however that $\bar{p}$ is a 'possible' equilibrium price, depending on the value of the entry cost M. To see this, notice that $E(\pi|p)$ is a continuous increasing function of the equilibrium price:

$$E(\pi|p) = \int_0^{\frac{p^2}{4}} (\frac{p^2}{4} - c_1)f(c_1)dc_1 + \int_0^{\frac{p^2}{4}} (\frac{p^2}{4} - c_2)f(c_2)dc_2$$

$$\frac{\partial E(\pi|p)}{\partial p} = \int_0^{\frac{p^2}{4}} \frac{1}{2}pf(c_1)dc_1 + \int_0^{\frac{p^2}{4}} \frac{1}{2}pf(c_2)dc_2$$

and p is a continuous decreasing function of n (the number of active firms):

19 Here we are comparing the expected cost in industry 1 for diversified firms with the expected cost for firms specialized in industry 1. The same applies for the expected cost in industry 2.

$$\frac{\partial p}{\partial n} = -\frac{2A}{(n+2)^2} < 0$$

The entry of firms on the market will therefore generate a reduction in expected profits. At equilibrium,

$$E\left[\pi(p(n))\right] = M$$

so that it is possible to solve for equilibrium values of n and p:

$$n^* = n^*(M) \qquad n^{*\prime} < 0$$

$$p^* = p^*(M) \qquad p^{*\prime} > 0$$

It is therefore always possible to find a value of the entry sunk costs that generates an equilibrium price $\overline{p}$.

6. The "Economies of Scope" Model

We turn now to the possibility that diversification is driven by economies of scope. This implies that if a firm produces two 'related' goods, the total cost of producing them jointly is lower than the sum of the costs of producing them separately. This possibility is usually attributed to the presence of shared inputs, which are imperfectly divisible (so that manufacturing a subset of the output leaves excess capacity), or of human or physical capital which is a public input[20].

If economies of scope exist, we would intuitively expect (and in fact this is the common presumption in the literature) that diversified firms, being those which benefit from this possibility, perform better on average. We shall see below that this might not be so. We shall illustrate this possibility by means of a simple example in the spirit of section 4.

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20 See Panzar and Willig (1981), Teece (1980, 1982), Montgomery (1995).

The assumptions are identical to those of the first model, except for the determination of the fixed element in the cost function. Assume that the total fixed cost for firm j is given by:

$\tilde{c}^{j} = \tilde{v}_i$ if it is only active in industry i

$\tilde{c}^{j} = \tilde{v}_1 + \tilde{v}_2 - s$ if it is active in both industries

where s represents the proportion of the fixed costs which can be 'shared' between the two products and where v_1, v_2 are discrete i.i.d. random variables

$$\tilde{v}_i = \begin{cases} 1 & \text{with probab. } 1/3 \\ 2 & \text{with probab. } 1/3 \\ 3 & \text{with probab. } 1/3 \end{cases}$$

(with $s \leq 1$) so that the random variable c will be distributed as:

v_1	v_2	$c = v_1 + v_2 - s$	probability
1	1	$2-s$	1/9
1	2	$3-s$	1/9
1	3	$4-s$	1/9
2	1	$3-s$	1/9
2	2	$4-s$	1/9
2	3	$5-s$	1/9
3	1	$4-s$	1/9
3	2	$5-s$	1/9
3	3	$6-s$	1/9

When there are economies of scope, the entry decisions for the two markets are not independent (as was instead the case with correlated costs). The 'entry criterion' for a firm will involve a comparison of the profits that can be achieved by entering only one market with those that can be achieved by entering both markets.

A firm will enter only one market if the expected profits in that market are positive but smaller than those that could be earned entering two industries and thereby benefiting from the economies of scope.

We shall again have several cases depending on the value of the equilibrium price[21] (see Appendix 1 for the derivation of results).

(a) $\frac{p^2}{4} > 3 - s$

This corresponds to the case of a high market equilibrium price. This allows all firms entering the market to diversify. I.e., prices are so high that even the less efficient firms can survive in both markets.

(b) $3 - s > \frac{p^2}{4} > 2$

In this case the equilibrium price is slightly lower than in case (a). Diversified firms have an average cost per industry equal to (3-s)/2, while undiversified firms have on average cost equal to 3/2.

This means that diversified firms are more profitable. This case holds if the equilibrium price is high, and relatively inefficient firms can enter the market. Diversified firms will then enjoy the advantage of the economies of scope.

(c) $2 > \frac{p^2}{4} > 2 - s$

If the price is lower than in the previous cases, specialised firms need to be very efficient in order to survive (specialised firms will be those with a very good cost draw in one market and a very bad cost draw in the other, so that the cost reduction generated by the economies of scope are not sufficient to compensate for the losses in the market where they are less efficient), while those entering both markets can exploit the economies of scope. However these economies only allow the firms to

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21 We shall simply assume here that the number of firms is given exogenously and this determines equilibrium prices.

survive in the markets and do not compensate for the relative inefficiency with respect to undiversified firms. Diversified firms have an average cost in each industry equal to (3-s)/2, while specialised have costs equal to 1. In this interval, *specialised firms are more profitable.*

(d) $2-\frac{s}{2}>\frac{p^2}{4}>2-s$

In this case an equilibrium price lower than in the previous cases eliminates some of the inefficient diversified firms. Diversified firms have average costs per industry equal to (8-3s)/6 while specialised firms have, on average, costs equal to 1. Diversified firms are more profitable if s > 2/3, i.e., if economies of scope are 'important'. If the economies of scope are sufficiently high, this will induce a higher average profitability for the diversified firms.

(e) $2-s>\frac{p^2}{4}>1$

This is the extreme case of (d): if the price is extremely low, only highly efficient firms manage to survive, whether they diversify or not. Diversified firms however enjoy a cost reduction.
Diversified firms have an average cost in each industry equal to 1-s/2. Hence they are more profitable than specialised firms, whose average costs equals 1.

(f) $1>\frac{p^2}{4}>1-\frac{s}{2}$

In this case the equilibrium price is even lower than in case (e). Only diversified firms (the most efficient ones) enter.

Here, the result that diversified firms are not more profitable than specialised firms is driven by the possibility, for those entering both markets, of achieving a cost reduction through economies of scope which allows even relatively inefficient firms to survive. Undiversified firms on the other hand are those with a very high efficiency level in one industry, and a very poor one in the other, so that the cost reduction does not compensate for the difference in costs.

7. Conclusions

Empirical studies that find a negative relationship between diversification and profitability do not necessarily imply that diversification has a negative impact on profitability.

We have shown that such econometric results may be explained either in terms of a bias in the estimation of the relationship, due to the omission of variables affecting efficiency, or in terms of selection bias: diversified firms may be very inefficient and able to survive only due to the exploitation of synergies.

More generally, it is not surprising that no very clear or consistent result emerges from the econometric literature which compared average profits of diversified firms with those of specialized ones. In spite of the commonly adduced arguments as to why a positive relationship should be expected here, an examination of some simple models suggests that there is no robust theoretical basis for any such relationship.

This result is instead consistent with some of the recent findings on the performance of firms which diversifed in the 70s and on those which remained specialized.

Appendix 1: Comparison between profits of specialized and diversified firms

(i) Cost correlation

Entry patterns for each price range:

	Cost combinations					Price ranges			
	v_1	v_2	v_{12}	c_1	c_2	$\rho, 1-\rho > \hat{p}$	$1-\rho > \hat{p} > \rho$	$\rho > \hat{p} > 1-\rho$	$\hat{p} > \rho, 1-\rho$
1)	0	0	0	0	0	1&2	1&2	1&2	1&2
2)	0	0	1	ρ	ρ	-	1&2	-	1&2
3)	0	1	0	0	$1-\rho$	1	1	1&2	1&2
4)	0	1	1	ρ	1	-	1	-	1
5)	1	0	0	$1-\rho$	0	2	2	1&2	1&2
6)	1	0	1	1	ρ	-	2	-	2
7)	1	1	0	$1-\rho$	$1-\rho$	-	-	1&2	1&2
8)	1	1	1	1	1	-	-	-	-

The symbol (-) means that firms with the indicated cost combinations do not enter any market; 1&2 that they enter both markets etc.

<u>An example of comparison between profits: the parameter range</u> $\frac{p^2}{4} > \rho, 1-\rho$

(a) We first look at specialised firms: these will be firms with the cost combinations 4) and 6), i.e.:

- firms with $v_1 = 0, v_2 = 1, v_{12} = 1$ (they enter only industry 1)
- firms with $v_1 = 1, v_2 = 0, v_{12} = 1$ (they enter only industry 2)

These firms have a "bad" common cost draw $v_{12} = 1$, and a "good" cost draw in one industry only. Average costs per industry, $E(c_1|1) = E(c_2|2)$, are ρ.

(b) We now look at diversified firms. These are firms with cost draws as in 1), 2), 3), 5), 7), i.e.:

- firms with $v_1 = 0, v_2 = 0, v_{12} = 0$
- firms with $v_1 = 0, v_2 = 0, v_{12} = 1$
- firms with $v_1 = 0, v_2 = 1, v_{12} = 0$
- firms with $v_1 = 1, v_2 = 0, v_{12} = 0$
- firms with $v_1 = 1, v_2 = 1, v_{12} = 0$

These firms have on average a "good" common cost draw (except in one case, 2), where firms have very good values of both independent cost draws), which allows entry even with high market specific draws. Average costs per industry are $E(c_1|1+2) = E(c_2|1+2) = (2-\rho)/5$.

(c) The comparison is then between $E(\pi|1\ or\ 2) = \frac{p^2}{4} - \rho$ and $\frac{E(\pi|1+2)}{2} = \frac{p^2}{4} - \frac{2-\rho}{5}$.

(ii) Economies of scope

When there are economies of scope, the entry decisions for the two markets are not independent: the "entry criterion" involves a comparison of profits that can be achieved by entering only one market with those that can be achieved by entering both.

(1) Firms enter only industry 1 if:

$$\frac{p^2}{4} - v_1 > 0$$

and

$$p_1 - v_1 > \frac{p_1^2}{4} + \frac{p_2^2}{4} - (v_1 + v_2 - s)$$

i.e., if profits in industry 1 are positive and higher than those that can be achieved by entering both markets.

(2) Firms enter only industry 2 if the equivalent condition holds, with the subscript interchanged.

(3) Firms enter both industries if:

$$\frac{p_1^2}{4} + \frac{p_2^2}{4} - (v_1 + v_2 - s) > 0 \qquad \frac{p_1^2}{4} + \frac{p_2^2}{4} - (v_1 + v_2 - s) > \max\left(\frac{p_1^2}{4} - v_1, \frac{p_2^2}{4} - v_2\right)$$

i.e., if profits are positive and higher than those that can be achieved by entering one market only.

<u>A profit comparison: the case</u> $3 - s > \frac{p^2}{4} > 2$:

	v_1	v_2	c
1	1	1	2-s
2	1	2	3-s
3	1	3	4-s
4	2	1	3-s
5	2	2	4-s
6	2	3	5-s
7	3	1	4-s
8	3	2	5-s
9	3	3	6-s

We first identify firms which pass the "enter both" criterion: these are firms in groups 1), 2), 4), 5). Their costs are (2-s), (3-s), (3-s) and (4-s). Average costs per industry are (3-s)/2.

Firms in groups 3) and 6) pass the "enter only industry 1" criterion. Their costs are 1, 2 (on average 3/2).

Firms in groups 7) and 8) pass the "enter only industry 2" criterion. Their average costs are 3/2. The comparison is therefore between $E(\pi|1 \text{ or } 2) = \frac{p^2}{4} - \frac{3}{2}$ and $E(\pi|1 + 2) = \frac{p^2}{4} - \frac{3-s}{2}$.

Appendix 2

Proof of proposition 1.

The proof proceeds in three steps:

(i) We first show that for $c_1 = (1-\rho)\tilde{v}_1 + \rho\tilde{v}_1$, $E(\tilde{c}_1 | \tilde{c}_1 < \hat{p}, \tilde{v}_{12} = w)$ is a decreasing function of w under the assumption of the proposition. I.e., the lower is the realisation of the common part of the costs, the higher is the expected value of the cost $\tilde{c}_1$.

Observe that:

$$E(\tilde{c}_1 | \tilde{c}_1 < \hat{p}, \tilde{v}_{12} = w) =$$

$$= (1-\rho)E(\tilde{v}_1 | \tilde{v}_1 < \frac{\hat{p}-\rho w}{1-\rho}) + \rho w =$$

$$= (1-\rho)\frac{\int_0^{\frac{\hat{p}-\rho w}{1-\rho}} v_1 f_1(v_1)dv_1}{\int_0^{\frac{\hat{p}-\rho w}{1-\rho}} f_1(v_1)dv_1} + \rho w$$

Differentiating with respect to w gives:

$$\frac{1}{\rho}\frac{\partial E}{\partial w} = \frac{1}{\left[\int_0^{\frac{\hat{p}-\rho w}{1-\rho}} f_1(v_1)dv_1\right]^2} \cdot \left[-\frac{\frac{\hat{p}-\rho w}{1-\rho}}{1-\rho} f_1(\frac{\hat{p}-\rho w}{1-\rho}) \int_0^{\frac{\hat{p}-\rho w}{1-\rho}} f_1(v_1)dv_1 + f_1(\frac{\hat{p}-\rho w}{1-\rho}) \int_0^{\frac{\hat{p}-\rho w}{1-\rho}} v_1 f_1(v_1)dv_1\right] + 1$$

For $\hat{p} = x$ the assumption, by continuity, implies that, for every $w \in [0,1]$, if ρ is chosen small enough

$$\frac{\partial E}{\partial w} < 0$$

On the other hand if the assumption is not satisfied, it is always the case that

$$\frac{\partial E}{\partial w} > 0$$

(ii) we now integrate over the common cost factor. Here we use the fact that:

$$Pr(\tilde{v}_{12} < w | (1-\rho)\tilde{v}_2 + \rho\tilde{v}_{12} < \hat{p}) \geq Pr(\tilde{v}_{12} < w | (1-\rho)\tilde{v}_2 + \rho\tilde{v}_{12} > \hat{p}) \quad \forall w \in [0,1]$$

This can be established by showing that, for independent x and y,

$$Pr((\tilde{x} < x) | \tilde{x} + \tilde{y} < z) \geq Pr((\tilde{x} < x) | \tilde{x} + \tilde{y} > z)$$

which, by standard properties of conditional probabilities, is equivalent to

$$\frac{Pr(\tilde{x} < x, \tilde{x} + \tilde{y} < z)}{Pr(\tilde{x} + \tilde{y} < z)} \geq \frac{Pr(\tilde{x} < x, \tilde{x} + \tilde{y} > z)}{Pr(\tilde{x} + \tilde{y} > z)}$$

This inequality holds if

$$Pr(\tilde{x} < x, \tilde{x} + \tilde{y} < z) \geq Pr(\tilde{x} < x) Pr(\tilde{x} + \tilde{y} < z)$$

which holds trivially for $z < x$. If $x < z$ we rewrite the last inequality as

$$\int_0^x F_y(z-t) f_x(t) dt \geq \int_0^x f_x(t) dt \cdot \int_0^z F_y(z-t) f_x(t) dt$$

that is

$$E(F_y(z - \tilde{x}) | \tilde{x} < x) \geq E(F_y(z - \tilde{x}) | \tilde{x} < z) Pr(\tilde{x} < z)$$

which is obviously true.

(iii) We can now proceed to the comparison of the two expectations:

$$E(\tilde{c}_l | div.) - E(\tilde{c}_l | undiv.) =$$

$$= E(\tilde{c}_l | \tilde{c}_l < \hat{p}, \tilde{c}_2 < \hat{p}) - E(\tilde{c}_l | \tilde{c}_l < \hat{p}, \tilde{c}_2 > \hat{p}) =$$

$$= \int_0^1 E(\tilde{c}_l | \tilde{c}_l < \hat{p}, \tilde{v}_{12} = w) [f(w | \tilde{c}_2 < \hat{p}) - f(w | \tilde{c}_2 > \hat{p})] dw =$$

$$= 0 - \int_0^1 \frac{\partial}{\partial w}(\tilde{c}_1 | \tilde{c}_1 < \hat{p}, \tilde{v}_{12} = w)\left[F(w|\tilde{c}_2 < \hat{p}) - F(w|\tilde{c}_2 > \hat{p})\right]dw > 0$$

as:

(i) implies $\frac{\partial E}{\partial w} < 0$ and

(ii) implies $\left[F(w|\tilde{c}_2 < \hat{p}) - F(w|\tilde{c}_2 > \hat{p})\right] > 0 \quad \forall w$

Since a violation of the assumption implies $\partial E / \partial w > 0$, we also obtain the necessary part of the proposition.

q.e.d.

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