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del Servizio Studi

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The purpose of the «Temi di discussione» series is to promote the circulation of working papers prepared within the Bank of Italy or presented in Bank seminars by outside economists with the aim of stimulating comments and suggestions.

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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.

1 Introduction[1]

Theoretical analysis suggests that diversification is the optimal response to the presence of synergies, which allow reductions in total costs, or to the possibility of achieving higher market power, for example through multimarket contact (see Scott,1982,1989). The business literature suggests that diversified firms perform better if they expand into related markets, where they can exploit common skills. This in principle should lead to an increase in average profits.

This paper is motivated by the results of econometric work, which in general do not confirm (or at least give only a very weak support to) the hypothesis that diversified firms are more profitable (see Rhoades, 1973, 1974; Carter,1977).

Should this lead to the rejection of the theories mentioned above?

We shall develop a very simple idea, which accounts for the inconsistencies between theory and empirical observation.

On the one side, the results of empirical work (which relates profitability to diversification) may be biased due to the omission of additional factors, different form 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 specialized (but relatively efficient) firms: the advantages of the synergies are not sufficient to offset the disadvantages of being inefficient.

1 I should like to thank John Sutton for constant help and suggestions, Juergen Dennert for many useful discussions, and a referee for extremely valuable comments.
The present paper was written while I was a Ph.D. student at the London School of Economics.

We shall identify the conditions under which this is in fact an equilibrium configuration, where efficient specialized firms are not willing to diversify: this is the case if specialized firms are those particularly efficient in one line of production, but highly inefficient in the others[2].
On the other side, empirical results might be explained in terms of selection bias: some highly inefficient firms may be able to survive on the market only 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.

The paper is organized as follows. In the second section the basic framework for the analysis of the performance of diversified firms is introduced. The third describes the model used. In section 4 we introduce a very simple example which shows that there are cases where specialized firms earn on average higher profits, even if diversification is a profit maximizing strategy given the presence of synergies across markets. Section 5 gives a full characterization of the result. In section 6 the case of 'economies of scope' driven diversification is studied, and again an example is presented showing that the presumption that diversified firms are on average more profitable is not confirmed. Section 7 concludes.

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2 I.e., it is "better" to be very good in one product only, rather than sufficiently good in all of them.

2 The Basic Framework

Before analyzing differences in profitability, we need a framework which generates positive excess returns in the first place. Since we do not intend to focus on the issue of how the excess profits arise, we adopt a straightforward specification. We consider an economy with an infinite number of potential firms, endowed with a random efficiency parameter which affects their cost function: they can learn it after paying a fixed entry cost (see Lippman, Rumelt (1982)[3]); once on the market they act as price-taking profit maximisers and face increasing marginal costs. 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[4]. These specifications would however create unnecessary technical difficulties for our 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.

The model we consider is therefore static and with uncertainty. Diversification in this framework will be only generated by the aim of exploiting synergies across markets.

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3 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 on average positive profits, even if free entry is allowed.

4 Since we deal with 'supply driven' diversification, we do not consider any argument relying on collusive behaviour.

From the empirical and business literature, it emerges that, among the factors driving diversification and having a considerable impact on its success, the degree to which markets (considered as objective of the expansion program) are "close" is particularly relevant.
The concept of relatedness takes, in this literature, various forms. These can be explained basically in terms of two sets of factors: the first includes technological elements, which amount to the possibility of sharing fixed costs between different products (economies of scope): 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.
The second factor playing an essential role in the diversification process, and having a considerable influence on its effects, is what we might label a 'managerial ability' element: "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" (E.R.Biggadike,1979). The relatedness across markets arise then from the familiarity with manufacturing methods used in the market to be entered, from expertise in serving a certain type of customer, in differentiating products, in developing low cost distribution and customer serving systems. Hence, the best strategy, when diversifying, is to enter

businesses where the managerial skills can be used at best (see Peters,Waterman(1982)).
We shall represent these two elements in terms of the cost functions of firms:

(i) the '<u>managerial skills</u>' hypothesis will be represented through the presence of <u>correlation</u> between costs in two industries, so that if a firm has relatively high costs in one production line, it is likely that also in the second production line they will be high. This could be taken to describe two markets which are 'related' because they have the same type of structure: if a firm, active in both markets, has a 'good' manager, his ability will equally show in both, and generate the same level of efficiency;

(ii) the <u>economies of scope</u> possibility will be represented by a <u>reduction in total cost</u> that the firm enjoys if it is active in both industries.

This introduces in a very simplified way both industry characteristics (summarized by economies of scope or cost correlation across them) and firm characteristic (cost draw) in the diversification decision.
We want to concentrate on the issue of how could diversification be generated and its consequences in terms of profitability.
We shall consider only two industries: firms will decide whether to enter none of them, one only (specialized firms), or both (diversified firms), depending on the expected profits in each industry.

3 The Model

We assume that:

- The product is homogeneous in each of the two markets considered.
- 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:

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

  where c_i^j is the realization of a random variable $\tilde{c}_i^j$. $\tilde{c}_1^j$ and $\tilde{c}_2^j$ are i.i.d. with respect to i and have commonly known distribution functions. Their realization can be discovered by firm i only paying a non recoverable entry cost M>0;
- The profit function, once on market i, is therefore:

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

- Firms behave as price-taker; their profit maximizing choice of output given the market price p_i is:

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

- If n_i is the total number of firms active on market i, in equilibrium it must be:

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

  where $S(p_i)$ is the aggregate supply. Hence the equilibrium price is:

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

- Firms are risk neutral: they enter the industry as long as the expected profits $E(\pi) = E(\pi_1) + E(\pi_2)$ are larger than M. The condition $E(\pi) = M$ will therefore determine the equilibrium number of active firms and the corresponding equilibrium price.

In the model firms observe n_1, n_2, p_1, p_2, but not c_1, c_2, and decide whether to pay the sunk entry cost M. Their expected profits from entry are:

$$E(\pi) = \int_0^{\frac{p_1^2}{4}} \left(\frac{p_1^2}{4} - c_1 \right) f(c_1) dc_1 + \int_0^{\frac{p_2^2}{4}} \left(\frac{p_2^2}{4} - c_2 \right) f(c_2) dc_2$$

with:

$$\frac{\partial E(\pi)}{\partial p_i} > 0$$

p_i is a continuous decreasing function of n_i (the number of active firms in market i):

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

The entry of new firms on the market will therefore generate a reduction both in the price and in expected profits; in equilibrium it must be:

$$\int_0^{\frac{p_1^2(n_1)}{4}} \left(\frac{p_1^2(n_1)}{4} - c_1 \right) f(c_1) dc_1 + \int_0^{\frac{p_2^2(n_2)}{4}} \left(\frac{p_2^2(n_2)}{4} - c_2 \right) f(c_2) dc_2 = M$$

We can solve for equilibrium values of n's and therefore of p's. In principle the solution is indeterminate, as we have one equation in two variables (n_1, n_2) ; we shall consider here only the symmetric solution: $n_1 = n_2 = n, p_1 = p_2 = p$. [5]
The equilibrium condition becomes:

$$\int_0^{\frac{p^2}{4}} \left(\frac{p^2}{4} - c_1\right) f(c_1) dc_1 + \int_0^{\frac{p^2}{4}} \left(\frac{p^2}{4} - c_2\right) f(c_2) dc_2 = M$$

with:

$$p = \frac{2A}{n-2}$$

In equilibrium:

$$n^* = n(M) \qquad n' < 0$$

$$p^* = p(M) \qquad p' > 0$$

i.e., the equilibrium number of firms is inversely related to the value of the entry costs, and the equilibrium price increases in M.

Within this basic model we want to consider two possible functional forms of the random variable $\tilde{c}_i^j$ in order to study the effects of diversification on the performance of firms; these will be used to represent respectively the presence of cost correlation and economies of scope.

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5 There is obviously here an existence problem in so far as n can only take integer values. A precise formulation would require a continuum of firms. Here we will simply ignore the integer problem.
The symmetric solution $n_1 = n_2$ would also emerge endogenously as the unique equilibrium in a formulation with a continuum of firms.

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

We shall first analyze the possibility that costs are correlated. This may be interpreted as the effect of 'relatedness' or similarity across markets: if a firm is efficient (its costs are relatively low) on one market, it is likely that it will be similarly efficient on another with analogous characteristics.
Imagine for example that the efficiency of the firm is essentially determined by the managers' 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 on one would probably also be successful on the other), then if the manager of the firm is 'good' on one, he will be probably 'good' also on the other. Another source of 'relatedness' may relate to variable input costs: if two industries use similar inputs (milk, yoghurt), then if a firm is able to obtain favourable conditions on them, this will equally affect both production lines.

We shall represent these possibilities by assuming a very simple functional form of the costs $\tilde{c}_i^j$:

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

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

where $\tilde{v}_1, \tilde{v}_2, \tilde{v}_{12}$ are random variables. This allows to describe the 'degree of relatedness' across markets in terms of the parameter ρ . If $\rho = 0$ the markets are completely unrelated (say, the experience of a manager in one of them is completely irrelevant in the other). This implies, in term of the cost

function, that: $\tilde{c}_1 = \tilde{v}_1, \tilde{c}_2 = \tilde{v}_2$,i.e., the fixed costs of the firm for each market are completely independent. If $\rho = 1$, the markets have identical characteristics (at least those which influence the fixed cost c), and $\tilde{c}_1 = \tilde{v}_{12} = \tilde{c}_2$.
If markets are strongly related $(\rho \sim 1)$, then if the firm is very efficient in one market (which here implies that v_1 and v_{12} have very 'low' values), it is likely that also on the second market it will be highly efficient as a large share of the costs have the same characteristics. In the present context this translates into the fact that c_1, c_2 are essentially determined by the (common) value of v_{12} , as the weight of v_1, v_2 $(1-\rho)$ is very low.
We could think of c as representing, for example, the cost of an advertising campaign. If the two markets are very close with respect to the type of customer served and the marketing strategies, a marketing manager who has organized a very efficient advertising campaign on one market (v_{12} low), will presumably be able to reproduce the success on the other. The 'weight' of the costs of the campaign not common to the two markets is very low, so that even if the firm is not very efficient in managing those, the global level of efficiency will be high. Viceversa if the industries are not related.

It is often argued that we should observe diversified firms to fare better than undiversified, since they should have on average a "better" management or other common skills, and these synergies should create higher profits. This intuition however does not account for the ambiguity and non robustness of the empirical results[6].

We shall develop, in this section, a simple example which suggests an explanation for the results.

Let us assume:

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

$\tilde{v}_1, \tilde{v}_2$ are associated with the share of fixed costs which is independent in the two markets, while $\tilde{v}_{12}$ is associated with the share of costs which moves together. The random variable $\tilde{c} = \tilde{c}_1, \tilde{c}_2$ will thus be distributed as:

$\tilde{c}_1$	$\tilde{c}_2$	prob.
0	0	1/8
ρ	ρ	1/8
0	1-ρ	1/8
ρ	1	1/8
1-ρ	0	1/8
1	ρ	1/8
1-ρ	1-ρ	1/8
1	1	1/8

6 Montgomery and Wernerfelt (1988) 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.

It is easy in this case to solve explicitly for the equilibrium number of firms n^* and the equilibrium price p^* on the market, as functions of the sunk entry cost M. Given the distribution of the cost pairs, we have:

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

$E(\pi)$ is monotonically increasing in the equilibrium price; as long as $E(\pi)>M$, firms will enter the market; this reduces the equilibrium price as:

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

and the expected profits. Entry occurs until $E(\pi)=M$. The equilibrium values of n and p are defined by the condition S(p)=D(p) and by the no entry condition, as functions of the non recoverable entry cost M:

$$n^* = \frac{A+2\sqrt{2M}}{\sqrt{2M}} \qquad p^* = 2\sqrt{2M} \qquad \text{for } M < \frac{\rho}{2}, \frac{1-\rho}{2}$$

$$n^* = \frac{2A}{\sqrt{4M+2\rho}} + 2 \qquad p^* = \sqrt{4M+2\rho} \qquad \text{for } \frac{\rho}{2} < M < 1 - \frac{3}{2}\rho, \rho < 1-\rho$$

$$n^* = \frac{2A}{\sqrt{4M+2(1-\rho)}} + 2 \qquad p^* = \sqrt{4M+2(1-\rho)} \qquad \text{for } \frac{1-\rho}{2} < M < \frac{3}{2}\rho - \frac{1}{2}, 1-\rho < \rho$$

$$n^* = \frac{A}{\sqrt{\frac{2}{3}M + \frac{1}{3}}} + 2 \qquad p^* = 2\sqrt{\frac{2}{3}\left(M + \frac{1}{2}\right)} \qquad \text{for } 1 - \frac{3}{2}\rho < M < 1$$

with:

$$\frac{\partial n^*}{\partial M} < 0 \quad \text{and} \quad \frac{\partial p^*}{\partial M} > 0.$$

Now in order to study the performance of firms, we shall consider the profits of active firms, i.e., the profits conditional on being already active on the market.
We want to compare here the expected profits of a diversified firm, i.e, the expected profits conditional on being active in both markets, $E(\pi \mid c_1 \le p_1^2/4, c_2 \le p_2^2/4)$ (here for simplicity $E(\pi \mid 1+2)$), with those of a specialized firm, i.e., the expected profits conditional on having only one of the cost draws lower than $p_i^2/4$, $E(\pi \mid c_i \le p_i^2/4, c_j > p_j^2/4)$ (here for semplicity $E(\pi \mid i)$)[7].
In order to have a meaningful comparison, we should match total profits of a diversified firm with the sum of the profits of two specialized firms (active in different industries), each of size equal to the corresponding product line of the diversified firm. However, given the complete symmetry of the

7 p_i are the respective equilibrium prices.

model (the size of each product line, both for specialized and diversified, is always p/2) it is sufficient to compare expected profits per industry.

We have to distinguish several cases (see the Appendix for the derivation):

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

In this case:

$$E(\pi_1 \mid 1+2) = \frac{p_i^2}{4} = E(\pi_1 \mid 1)$$

When the observed equilibrium price is so low that only very efficient firms are active, both specialized and diversified have the same expected profits. This occurs 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.

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

In this case:

$$E(\pi_1 \mid 1+2) = E(\pi_1 \mid 1)$$

The same occurs when the correlation factor is very low and the equilibrium price is smaller than $1-\rho$ but larger than ρ: then only firms with a low independent cost draw $(\upsilon_i = 0)$ are able to survive (as their total costs will be at most ρ), and this creates the 'symmetry' between diversified and non diversified.

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

With high correlation and a relatively low observed equilibrium price, all firms will be active in both markets. Only firms with a 'good' common cost draw ($v_{12}=0$) will be able to survive (as $v_{12}=1$ 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).

<u>case (iv)</u> $1 > \frac{p_i^2}{4} > \rho, 1-\rho$

We turn now to the interesting case: the observed equilibrium price is high enough that many firms, with different cost draws, had the possibility to 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:

$$E(\pi_1 \mid 1+2) = \frac{p_i^2}{4} + \frac{1}{5}\rho - \frac{2}{5}$$

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

so that:

$$E(\pi_1 \mid 1+2) > E(\pi_1 \mid 1) \qquad \text{if} \quad \rho > 1/3$$

$$E(\pi_1 \mid 1+2) < E(\pi_1 \mid 1) \qquad \text{if} \quad \rho < 1/3$$

This is actually 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 correlation factor is high enough. When it reduces below 1/3, i.e. when markets are not very 'close', diversified firms are less efficient than specialized firms.

What is the rationale behind this example? Observing a specialized firm raises the relative probability that the common cost draw[8] 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 independent share of the cost must have been relatively good. Accordingly, diversified firms must have in general a good common cost draw: this allows them to enter the market even if the independent cost component is high.

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

Notice that it is not diversification by itself which negatively affects firms' performance. Being diversified is simply correlated with a relative inefficiency.

The discreteness in our example makes it somewhat difficult to characterize the necessary conditions for the result. Therefore we shall now give a complete characterization of

8 We shall imagine, in the following, that the cost draws which 'move together' depend on managerial skills , so that a $\tilde{v}_{12} = 0$ is interpreted as 'having a good management', and a $\tilde{v}_{12} = 1$ as 'having a bad management'.

the properties of the cost functions and the correlation factors in the case of continuous distributions, which generate the phenomenon described.

5 A General Characterization

The result relies on two underlying parameters. First, the correlation must be relatively low, so that efficiency is mainly affected by the uncommon factor. Second, the distribution function of the uncommon cost factor must be at some point (corresponding to the equilibrium price on the market) very steep. This last characteristic will enable, on average, a large number of relatively inefficient (i.e., with a large uncommon cost factor) diversified firms on the market, since they can exploit a lower value of the common cost factor, which 'just' compensates the high realization of the other. If the distribution of the uncommon cost factor has a sufficient mass at some point, equilibrium configurations exist where a large number of diversified firms with high independent cost draws enter the market.

However, 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 shall show that these two features are in fact necessary and sufficient to produce the above result.

To fix ideas, 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 $[0,1]$[9], and define again:

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

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

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

$$E(\tilde{c}_1 \mid \tilde{c}_1 < \hat{p}, \tilde{c}_2 < \hat{p}) > E(\tilde{c}_1 \mid \tilde{c}_1 < \hat{p}, \tilde{c}_2 > \hat{p})$$[10]

(where $\hat{p} = \frac{\bar{p}^2}{2}$)

if and only if there exists $x \in [0,1]$ such that:

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

According to our intuition, the condition stated in the Proposition roughly requires that the density of the uncommon cost has in some point a very large value. This is fulfilled, for example, in the case of distributions with $f(1) = \infty$. It is not fulfilled by uniform distributions.

<u>Proof</u>:
see Appendix.

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9 The result would go through with any support .

10 We are comparing here 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.

As before, we can show that $\overline{p}$ is a 'possible' equilibrium price, depending on the value of the entry cost M.
$E(\pi)$ is in fact a continuous increasing function of the equilibrium price:

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

$$\frac{\partial E(\pi)}{\partial p}=\int_0^{\frac{p^2}{4}}\frac{1}{2}pf(c_1)dc_1+\int_0^{\frac{p^2}{4}}\frac{1}{2}pf(c_2)dc_2>0$$

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

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

The entry of firms on the market will therefore generate a reduction in expected profits; in equilibrium:

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

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 Economies of Scope: Diversified Firms are not always more Profitable

We turn now to the possibility that the main reason for diversification is the presence of 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 mainly explained by 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[11].

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, on average perform better. We shall see how, as for the case of correlated costs, this might not occur.

We shall only develop, for this case, a simple example, in the spirit of section 4.

The assumptions are identical to those of the previous case, except for the definition of the fixed costs; again we introduce the possibility of economies of scope in a very simple fashion and assume that the total fixed costs for firm j are given by:

$c^j = v_i$ if it is only active in industry i

$c^j = v_1 + v_2 - s$ if it is active in both.

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11 See Panzar, Willig (1981).

s represents the proportion of the fixed costs which can be 'shared' between the two production lines.
v_1, v_2 are discrete random variables:

$$v_1, v_2 = \begin{cases} 1 & \text{with pr. } 1/3 \\ 2 & \text{with pr. } 1/3 \\ 3 & \text{with pr. } 1/3 \end{cases}$$

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

v_1	v_2	$c = v_1 + v_2 - s$	prob.
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 on the two markets are not independent (as it was the case with correlated costs); the 'entry criterion' for a firm will involve a comparison of the profits achievable entering only one market with those achievable entering both markets.
A firm will enter only one market if the expected profits on that market are positive but smaller than those that could be earned entering two industries and benefiting from the economies of scope.

We shall have again several cases depending on the value of the equilibrium price[12] (see the Appendix for the derivation of results).

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

All firms entering the market diversify; i.e., prices are so high that even the less efficient firms can survive in both markets.

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

Diversified firms have average costs per industry equal to (3-s)/2, while undiversified firms have on average costs equal to 3/2.

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

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

Diversified firms have average cost per industry equal to (3-s)/2, while specialized have costs equal to 1. In this interval, specialized firms are more profitable. If the price is lower, specialized firms need to be very efficient in order to survive (specialized firms will be those with a very good cost draw in one market and a very bad on the other, so that the cost reduction generated by the economies of scope are

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

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: these however only allow the firms to survive on the markets but do not compensate for the relative inefficiency with respect to undiversified firms.

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

Diversified firms have average costs per industry equal to (8-3s)/6 while specialized have on average costs equal to 1: <u>diversified firms are more profitable if s > 2/3</u>, i.e., if economies of scope are 'important'.
The reason for this is that a reduction in the equilibrium price eliminates some of the inefficient diversified firms. If the economies of scope are sufficiently high, this will induce a higher average profitability of the diversified.

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

<u>Diversified firms</u> have average cost per industry equal to 1-s/2 and will then be <u>more profitable</u> than specialized firms, with average costs equal to 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.

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

Only diversified firm (the most efficient ones) will enter.

Here, the result that diversified firms are not more profitable than specialized firms is driven by the possibility for those entering both markets to achieve a cost reduction through the economies of scope; this 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 huge 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 diversification. We have shown that 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 just be able to survive due to the exploitation of synergies.

Appendix 1

(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	-	-	-	-

- means that firms with the indicated cost combinations do not enter any market; 1+2 that they enter both markets etc.

An example of comparison between profits. The range $\frac{p^2}{4}>\rho, 1-\rho$

(a) We first identify specialized 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)

They 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 then identify 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 $v_1 = 1, v_2 = 1, v_{12} = 0$

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

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

(ii) Economies of scope

When there are economies of scope, the entry decisions on the two markets are not independent: the "entry criterium" involves a comparison of profits achievable entering only one market with those achievable entering both.

(1) Firms enter only industry 1 if:

$$\frac{p_1^2}{4} - v_1 > 0$$

and:

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

i.e., if profits on industry 1 are positive and higher than those achievable entering both markets.

(2) Firms enter only industry 2 if the same is true, with

industry 2 replacing industry 1.

(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 achievable entering one market only.

<u>An example of profit comparison. The case $3-s>\frac{p^2}{4}>2$:</u>

	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" criterium: these are firms in groups 1),2),4),5). Their costs are (2-s), (3-s), (3-s), (4-s); average costs <u>per industry</u> are (3-s)/2; Firms in groups 3),6) pass the "enter only industry 1" criterium; their costs are 1, 2: on average 3/2; Firms in groups 7),8) pass the "enter only industry 2" criterium; their average costs are 3/2. The comparison is therefore between $E(\pi\mid 1 \text{ or } 2)=\frac{p^2}{4}-\frac{3}{2}$ and $E(\pi\mid 1+2)=\frac{p^2}{4}-\frac{3-s}{2}$.

Appendix 2

The proof proceeds in three steps:

(i) We first show that for $c_1 = (1-\rho)\tilde{v}_1 + \rho\tilde{v}_{12}$

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

is a decreasing function of w under the assumption of the proposition. I.e., the lower is the realization of the common part of the costs, the higher is the expected value of the cost $\tilde{c}_1$.

Observe that:

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

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

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

Derivation with respect to w gives:

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

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 have then to integrate over the common cost factor; here we need:

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

We can prove this showing that, for independent x and y:

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

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

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

The above inequality implies:

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

this obviously holds when $z < x$, while when $x < z$, it implies:

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

i.e.:

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

which is obviously true.

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

$$E(\tilde{c}_1 \mid div.) - E(\tilde{c}_1 \mid undiv.) =$$

$$= E(\tilde{c}_1 \mid \tilde{c}_1 < \hat{p}, \tilde{c}_2 < \hat{p}) - E(\tilde{c}_1 \mid \tilde{c}_1 < \hat{p}, \tilde{c}_2 > \hat{p}) =$$

$$= \int_0^1 E(\tilde{c}_1 \mid \tilde{c}_1 < \hat{p}, \tilde{v}_{12} = w)[f(w \mid \tilde{c}_2 < \hat{p}) - f(w \mid \tilde{c}_2 > \hat{p})]dw =$$

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

as:

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

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

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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