INDUSTRIAL STRUCTURE AND ECONOMIC GROWTH

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Abstract: *Large and small firms each have their relative virtues. The virtues of small enterprises seem to have been larger during the last two decades as the share of large firms of economic activity in manufacturing industries declined in many OECD-countries. It is also clear that the speed of this industrial transformation process has not been constant across countries and industries. This study investigates the consequence of lagging behind in this restructuring process in manufacturing. We develop a new, evolutionary model linking performance and firm size distribution. The mechanisms governing this link are ease of entry of new firms and ease of change of incumbent firms. As a prelude to our formal model the relative virtues of large as well as small firms are dealt with in a new and descriptive way. A sample of 13 manufacturing industries in 12 European countries has been constructed to empirically investigate the relationship between industrial structure and economic growth. It is found that, on average, the employment share of large firms in 1990 has had a negative effect on growth of value added in the subsequent five-year period. This provides some support for specific policies introduced during the 1980s in European countries stimulating small enterprises.*

1 Introduction

Several economists have claimed that economic activity moved away from large firms to small firms in the 1970s and 1980s. With this shift also the locus of economic activity moved away from larger, incumbent firms to smaller, predominantly young firms. Acs and Audretsch (1993) and Carlsson (1992) provide an overview of empirical evidence concerning manufacturing industries in countries in varying stages of economic development. Carlsson mentions two explanations for this shift. The first deals with fundamental changes occurring in the world economy from the 1970s onwards. These changes relate to the intensification of global competition, the increase in the degree of uncertainty and the growth in market fragmentation. The second deals with changes in the character of technological progress. He shows that flexible automation has various effects resulting in a shift from large to smaller firms.[1] Piore and Sabel (1984) also argue that increased market instability resulted in the demise of mass production and promoted flexible specialisation. The change in the path of technological development led to the occurence of important diseconomies of scale.

This shift away from large firms is documented predominantly for manufacturing industries but it is not completely confined to this sector. Brock and Evans (1989) show that this trend has been economy-wide at least for the United States. They suggest four more explanations for this shift: the increase of labour supply; changes in consumer tastes; relaxation of (entry) regulations and the intensity of the creative destruction process.

[1] Meredith (1987) argues that small firms are just as well, or better, equipped to implement technological advances like CAD/CAM. Small business owners often can more clearly see the benefits and problems of their automation decisions as they are very selective in where they invest their capital and because they are close to the operational level.

Loveman and Sengenberger (1991) stress the influence of two trends of industrial restructuring: that of decentralization and vertical disintegration of large companies and that of the formation of new business communities. They also mention the role of public and private policies promoting the small business sector.[2]

The question whether this change of the size class structure of industries has influenced their economic performance is underresearched. Here we are concerned with one of the most important questions in economics: why do industries grow? The link between industrial organization and economic growth has always been the subject of considerable debate. Traditionally, the prevalent assumption was that giant companies are at the heart of the process of innovation and creation of welfare. This assumption is generally referred to as the Schumpeterian hypothesis. Recently, the debate centers around the question whether the process of decentralization and deconcentration, which virtually every industrialized country has experienced in the last two decades, has had positive welfare implications. Audretsch (1995) calls this shift in orientation of our social-economic thinking 'the new learning'.

The question of the link between the shift in the industrial structure and subsequent growth can be answered in two ways. First, by investigating the many consequences of the shift in the locus of economic activity. For instance, one may study whether this shift has been favourable for the process of innovation and rejuvenation of industries. See Acs and Audretsch (1990), Audretsch (1995) and Cohen and Klepper (1996). Alternatively, one may zoom in on the discussion of the relation between the role of small firms and competition and industry dynamics. See Audretsch (1993,1995) and You (1995). Moreover, the role of small firms in the job creation process, usually treated as a controversial topic despite countless studies showing that small firms are a major engine in this process, may be dealt with. Davis et al. (1996) and Carree and Klomp (1996) provide a recent discussion. Lastly, the role of small firms as a vehicle for entrepreneurship may be the focal point of our attention.[3] Baumol (1990) amply deals with the role of entrepreneurial activities and their consequence for prosperity throughout history. Acs (1992) has been one of the first to bring it all together in a short descriptive manner and to survey some consequences of the shift of economic activity from large to smaller businesses. His claims are that small firms play an important role in the economy serving as agents of change by their entrepreneurial activity, being the source of considerable innovative activity, stimulating industry evolution and creating an important share of the newly generated jobs.[4] The evaluation of the various consequences of this shift is difficult but necessary to establish whether it is desirable and to be promoted by economic policy. It is difficult because none of these consequences is, in fact, independent from the other three and because the evaluation offers something of a series of tradeoffs. See Audretsch and Thurik (1997). For instance, small businesses may contribute to higher growth because of their contribution to the selection process due to their variety. On the other hand, however, their lower level of stability, inherent to the selection process, leads to welfare losses. Or, while employment levels may rise as firm

[2]De Koning en Snijders (1992) provide a survey of the various public policies in countries of the European Union which have been introduced during the 1980s.

[3]Entrepreneurship is not necessarily confined to small firms. Large enterprises seek to promote entrepreneurship by creating largely independent business units. Burgelman (1994) discusses possibilities for large firm entrepreneurship.

[4]More recent contributions by Zoltan Acs (and others) on the relationship between small firms and economic growth include Acs (1996a,1996b) and Acs et al. (1997).

size declines, the lower average wages small firms pay may at least offset the welfare effect induced by the employment growth.

A second way to answer the question is to circumvent the intermediary variables between the shift and growth like technological change, entrepreneurship, competitiveness and job generation. The focus is on a direct link between the shift and performance measures like growth or productivity. Some preliminary empirical results of the relation between changes in the firm size distribution and economic growth are presented in Thurik (1995,1996). The analysis shows a positive effect of an increase in the economy-wide share of small firms on growth in GDP. The interpretation of this result is somewhat difficult because it is not clear whether changes in the economy-wide share of small firms result mainly from changes in the sectoral composition or from downscaling in the specific industries. Moreover, the papers lack a theoretical component. Schmitz (1989) presents an endogenous growth model which relates entrepreneurial activity and economic growth. He shows that an increase of the proportion of entrepreneurs in the working force leads to an increase in long-run economic growth. His model also implies that the equilibrium fraction of entrepreneurs is lower than the social optimal level, providing a rationale for policies stimulating entrepreneurial activity. The size class structure of an industry and the proportion of entrepreneurs in its working force are strongly related. This paper lacks an empirical backup.[5]

The present paper follows the second way. It investigates the link between smallness and growth bypassing the analysis of all the intermediary variables. It presents a new model linking performance and firm size distribution. The two mechanisms governing this link are ease of entry of new firms and ease of change of incumbent firms. Empirical tests are provided using a sample of 13 manufacturing industries in 12 European countries for the period 1990-95. By dealing with data at a relatively low industry level the disturbing influence of changes in sectoral composition is eliminated. As a prelude to our formal model the relative virtues of large as well as small firms are dealt with in a new and descriptive way.

The contents of this paper is as follows. A list of effects which stimulate the presence of either small or large firms are discussed in Section 2. The empirical analyses in this paper are preceded in Section 3 by a tentative model of the effect of different market settings on industry structure and performance. The model is a pure selection model, in which entrepreneurs are assumed not to learn or innovate. Despite the simplicity of the model assumptions the predicted relationship between the number of entrepreneurs and economic performance is far from simple. It depends upon the particular group of market participants. Section 4 discusses the data set of large firm presence in European manufacturing. Empirical results of the effect of the degree of large firm presence on growth of value added are provided in Section 5. Section 6 provides some concluding remarks on the role of smallness in promoting economic growth in modern manufacturing industries.

2 Effects stimulating largeness and smallness

[5] Recent studies on the relation between industry structure and performance are Nickell (1996) and Nickell et al. (1997) who present evidence that competition, as measured by increased number of competitors, has a positive effect on the rate of total factor productivity growth. Hay and Liu (1997) claim that firms have a higher incentive to improve their efficiency in competitive environments and provide empirical evidence for UK manufacturing industries.

As long as there has been economics there has been a debate about the causes and consequences of firm size, about the meaning of average firm size and about differences in firm sizes, say, about the firm size distribution. See Audretsch (1993). Clearly, this has not been a conspicuous debate, but it has been a continuous one. Until some fifteen years ago its outcome was more or less unanimous: small firms would either disappear or be allowed to lead a marginal life. There have been isolated dissidents: Schumpeter accentuated the role of smallness in economic restructuring and Schumacher had the nerve to talk about the beauty of smallness in the darkest of the Galbraith times. See Schumacher (1973). In his pioneering empirical study Birch claimed to have discovered that most new jobs emanated from small firms. See Birch (1981). This finding contradicted the prevailing body of knowledge and intuition of that time. Mainstream economists, however, kept thinking that small firms would lead a fading life. It was not readily apparent how Birch's finding had to be reconciled with the empirical evidence displaying a level of concentration of economic activity which had been increasing for decades. Moreover, there are some theoretically powerful and empirically often corroborated mechanisms supporting the shift away from new and small firms and towards large and incumbent ones.

First, there is the effect of *scale*, usually interpreted as the fall of average costs with increasing volume of output. This mechanism occurs in many business functions from productive to administrative and on different levels of aggregation: in business units, in establishments and in enterprises. The sources of scale economies are well-known. One is that fixed set-up or threshold costs do not vary with the level of output. For instance, the costs of setting up a scientific gathering are fixed to a large extent. The costs of the organisation and the preparation of the presentations and the presentations themselves become more effective if the number of attendants to the meeting increases.

Second, there is the effect of *scope*, usually observed as the fall of average costs of a product if the number of different products increases. See Teece (1980) and Nooteboom (1993). Its sources can range from the use of indivisible resources (the room where a scientific meeting is held can be used for various purposes), to complementarity (presentations at scientific meetings can also be used as material for prospective articles in journals) and interaction (discussion during and between the presentations).

Third, there is the effect of *experience*, defined as the decline of average costs with increasing production volume accumulated over time. The best documented examples of unit costs falling over time as a result of past experience are those of the Liberty freighters and B-29 bombers during WW. II. See Scherer and Ross (1990), Lucas (1993) and Irwin and Klenow (1994).

It is clear that these three cost effects are detrimental to the survival of small firms. Small firms may try to compensate for these cost disadvantages by creating networks or other interfirm relations. From Williamson's contribution to the economic sciences we know that the organisers of productive output can choose between two so-called governance structures: that of integration of input within the hierarchy of the firm and that of purchase of input on the market. See Williamson (1975). The advantage of the latter structure lies in the economy of scale resulting from specialisation. For example, the consultant gains from specialisation doing similar consultancy work for many firms for which it does not pay to employ a specialist for solving similar problems occurring only with intervals. The disadvantage lies in the occurrence of transaction costs. Three stages of a transaction define three different sources of costs. The stage of contact involves search and marketing costs: search costs for the firm to be consulted and marketing costs for the firm supplying consultancy inputs. The stage of contract involves information, negotiation and definition costs. The stage of control involves costs of monitoring, discussion, feedback, redesign, arbitration, etc. In a recent article Nooteboom (1993) argues that smaller firms face higher transaction costs per unit of transaction than large ones.[6] First, there are threshold costs in all three stages of the transaction. The relative contribution of these threshold costs disappears the larger the transaction becomes. Second, small firms suffer more from the cost of acquiring and processing information. They are more sensitive to uncertainty, discontinuity, opportunism and specificity. So, the fourth effect, the effect of *organisation* defined as using outside production for one's inputs instead of inside production, boils down to the occurrence of more scale effects and to the appearance of transaction effects which are both damaging to the level of unit costs of small production kernels.

So far, the four effects would suggest an ever decreasing share of small firms, which was the case until the 1970s (Chandler (1990)). Other effects are needed to explain the existence and success of small firms.

The first effect is the *transportation* effect. Production and organisation costs discussed above are only part of the total cost structure. There is also the cost of delivering output to customers or bringing customers to the place where service is provided. See Scherer and Ross (1990). Many studies predict and report significant scale economies on the level of establishments in the retail industry. See Nooteboom (1987a). Still there is a considerable number of small retail stores. Prospective customers value their transportation costs when looking for supplies. This is why a geographic dispersion of demand goes together with a geographic dispersion of supply. And then smallness, at least at the establishment, plant, or in the retail case, store level has a chance.

The second effect is that of the *market size*. Small markets require small firms. Markets exist where scale economies have no meaning because they cannot be obtained. For example, it is easy to check that all participants of some scientific gathering wear a different shirt. Variety is a significant customer requirement. The market for a singular piece of apparel is small when compared to the entire textiles market. There is no apparent bonus for large firms in markets which are fragmented in size.

The third effect is that of *adjustment*. There is a trade-off between efficiency-production costs given some output level - and adjustability - the cost of adjusting a certain level of output. Large firms can produce at lower unit costs than small firms can. But small firms can adjust their output level at lower costs than large firms, because they are either more labour intensive or use different equipment.[7] It is the story of the two transportation firms: one firm using large lorries, thriving in a market with a persisting high demand for shipment, the other firm using small ones, thriving in a turbulent market with a varying demand for lorries. It is the story of many firms in the post-mass-consumption age: they produce exactly what the customer wants. They pay little attention to questions whether anyone else wants the product, whether the firm has made the product before or whether there will be follow-up demand for the product. See The Economist (Mar. 5 1994). It is also the story of the firms in the so-called industrial districts, competing and

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[6] Jovanovic (1993) notes that recent advances in information technology have made market-based coordination cheaper relative to internal coordination partially causing the recent decline in the average size of firms.

[7] Mills and Schumann (1985) and Fiegenbaum and Karnani (1991) provide empirical evidence for small firms to benefit from variability of the environment. Camacho (1991) develops a theoretical model in which adaption costs rise with the size of the firm leading to optimal firm size to be negatively related to such variability.

co-operating at the same time. There is no apparent bonus for large firms in markets which are fragmented in time.

The fourth effect is that of *effectiveness*. The essence of this effect is that different goods and services have different meanings for different people. A shirt that fits the average attendant of a scientific meeting is not the same good as a shirt tailored to fit a specific individual and bought for showing off at a specific occasion. A shirt factory can make shirts of the first type cheaper than a tailor can. But one receives more effective units of shirt from a tailor. At least the one who is sensitive to the satisfaction of knowing the uniqueness of his shirt or the gains of showing it off to others, will experience the effectiveness of a unique shirt. The rationale being that the existence of both the factory and the tailor in the shirt market can only be explained if output is measured in terms of effective units of shirts instead of just shirts. This not only explains the co-existence of clothing giants and tailors, but also that of supermarket chains and speciality stores, of the McDonald chain and three star restaurants.

Furthermore, there is the effect of *control*. Nooteboom (1987b) claims that this is the least documented of all effects. The discussion of what defines a small firm is probably as everlasting as the discussion of where small firms stem from. A challenging definition of a small firm is that of a firm where one person or a small group of persons is in control, or which bears the personal stamp of one person. Though ineffective and imprecise, this definition at least stimulates the investigation of behavioural advantages like entrepreneurial energy, motivated and effective labour due to the mutual proximity of customers, suppliers, production floor, management and ownership, etc. Entrepreneurial and organisational energy may flourish and be well controlled and guided in a small environment. The best evidence of this entrepreneurial energy is that many entrepreneurs convince themselves to work below the minimum wage and convince their employees to work below market prices, i.e. at a price lower than what a large firm would offer for a similar job. See Brown and Medoff (1989), Evans and Leighton (1989) and Oosterbeek and Van Praag (1995). This wage differential which continues to surprise many labour economists is partly explained by the higher levels of control, commitment, motivation, perseverance and energy, if these levels would prevail in small units. We think they do and that is why the effect of control can be presented as fifth effect. It is straightforward that the effect of control is not futile in an environment where the effect of adjustment (and hence flexibility and manoeuvrability) plays a role. They reinforce each other in their struggle to outperform the advantages of scale.

A final effect we mention is that of *culture*. It is safe for any researcher in the social sciences to point at culture as a factor influencing any phenomenon demanding explanation. But since William Baumol's essay showed us that entrepreneurship cannot only be productive as well as unproductive, but even be destructive, we would better start thinking of ways to grab the essence of Baumol's culture for using it as an effect reinforcing or demolishing other effects like control, adjustment or effectiveness. See Baumol (1990). Baumol's basic hypothesis is that, while the supply of entrepreneurship varies across societies, its productive contribution varies even more. The reason is that the societal perspective determines to what degree entrepreneurial activities are used for productive achievements such as innovation or unproductive ventures such as rent seeking or organised crime. Murphy et al. (1991) provide some empirical evidence showing that countries with a relatively high number of graduates from law schools, educated mainly to redistribute income, grow slower, ceteris paribus, than countries which have a relatively high number of graduates in technical disciplines. The effect of culture may be beneficial to large or to small firms.

Like the effects stimulating largeness, those stimulating smallness are not independent in their influence. The effects of market size and adjustment are mutually reinforcing when explaining smallness in many markets of producer goods and services. The supplier producing a specific car part this year is likely to produce a different but evenly specific part next year. This supplier operates in a market which is fragmented both in size and time. The effects of market size, adjustment and effectiveness are mutually reinforcing when explaining smallness in many markets of consumer goods and services. The small firm producing a unique shirt this year is likely to produce a different unique shirt next year, particularly if the shirt has a high fashion value. This market is fragmented in size, in time and in taste.

3 Competitive selection with differing rates of entry and adjustment

In the previous section we have discussed possible reasons for small firms outperforming large firms or vice versa. The variety of reasons does not allow for a model incorporating all elements. However, we think that recent developments in evolutionary economics may contribute to our understanding of the relation between the structure and performance of industries. More specifically, in this section we investigate two factors at the industry level which may strongly influence both the firm size distribution of firms and the performance of industries. These are the ease of entry and the ease of change of incumbent firms.

Evolutionary economists consider both structure and performance as endogenous and are usually interested in long term effects of market settings. They stress the importance of competitive selection (Jovanovic (1982)). Entry and exit which have barely any short effect on market structure in the short term may radicaly alter the market settings in a somewhat longer term. Eliasson (1995) shows that lack of entry may affect economic performance in a non-negligible extent only after a period of about 25 years. In this section we use a simple model to highlight the effects of lack of entry and lack of mobility in industries which progress through a process of competitive selection. It will be made clear that these effects depend on the precise group of market participants.

Consider a population of N persons who choose between being an entrepreneur and being an employee. Each person has an 'entrepreneurial ability' e_i which can be used in combination with L_i employees earning a wage w to produce an output of $e_i L_i^{\beta}$ with $0<\beta<1$[8].Taking the price of the good to be unity total profit will be $\pi_i = e_i L_i^{\beta} - wL_i$. From the first order condition it is easy to find that the optimal level of labour input and profit are equal to

$$L_i^* = \left(\frac{\beta e_i}{w}\right)^{\frac{1}{1-\beta}} \qquad \pi_i^* = (1-\beta)\, e_i \left(\frac{\beta e_i}{w}\right)^{\frac{\beta}{1-\beta}}$$

Entrepreneurs exit the industry in case the optimal level of profit is below the wage level w. These entrepreneurs have no long term prospect of their venture being profitable. That is, firms remain incumbent if

[8]Some other models in which heterogeneous ability is an essential feature are Lucas (1978), Gifford (1993) and Klepper (1996).

$$e_i > \frac{w}{\beta^{\beta}(1-\beta)^{1-\beta}}$$

The extent of entry and mobility are built into the model by having each period every person receiving a constant probability *p* of (re-)entering the industry.[9] The amount of labour entrepreneurs use is assumed to adjust gradually to the optimal level:

$$L_{it} = L_{i,t-1} + \lambda\,(L^{*}_{it} - L_{i,t-1})$$

The equilibrium wage level is derived from the condition that the demand and supply of labour are identical. Let *M* be the total number of entrepreneurs and Θ the set of entrepreneurs, then we have:

$$N - M = \sum_{i\in\Theta} L_{it} \;\Rightarrow\; N - M = (1-\lambda)\sum_{i\in\Theta} L_{i,t-1} + \lambda \sum_{i\in\Theta} L^{*}_{it} \;\Rightarrow\; w = \beta\left(\frac{\lambda \sum_{i\in\Theta} e_i^{\frac{1}{1-\beta}}}{N - M - (1-\lambda)\sum_{i\in\Theta} L_{i,t-1}}\right)^{1-\beta}$$

Competitive selection proceeds through entry, exit and mobility of firms. The intensity of the competitive selection process in this model depends on the probability of entry, *p*, and the adjustment rate, λ. We use some simple simulations to show the effect of this intensity on the market performance, measured by total market output. We first introduce the market settings which are identical across the scenarios and then we discuss the specific assumptions about the particular group of market participants. The abilities are assumed to be distributed as a linear combination of two independent lognormally distributed variables X_1 and X_2 with the same mean and variance. The weighting factor is α_t . That is, $e_{it} = \alpha_t x_{1i} + (1-\alpha_t) x_{2i}$ where x_{1i} and x_{2i} are the realizations of X_1 and X_2 for person *i*. Note that the mean of the abilities is independent of α_t while the variance is at a minimum when $\alpha_t = 0.5$ and at a maximum when α_t is either zero or one. The variables X_1 and X_2 stand for two 'underlying' abilities which combine into the entrepreneurial ability necessary to be successful in the industry. Gifford (1993) also distinguishes between two kinds of ability: ability to *innovate* (also used in Klepper (1996)) and ability to *manage* (also used in Lucas (1978)).

In the rest of this section we will discuss some scenarios. In each scenario the mean and variance of the lognormal distribution are $e^{-0.5}$ and $(e^{0.25}-1)/e$. In the first period there is a probability of 0.1 for each person to be one of the initial entrepreneurs. The value of β is taken as 0.8. Changing the value of β over time would certainly have an impact on the firm-size distribution. However, in this model we concentrate on selection instead of on changes in production technologies or organizational forms. The number of persons *N* is fixed at 10,000.

[9] See Carree (1997) for scenarios in which the probabilities of persons entering the industry depend on their ability as *p* times the ratio of e_i over the mean of the abilities in the population. That is, entrepreneurs are assumed aware to some extent of their own chances of success in the market.

The scenarios

We will show three scenarios which are derived by choosing between two alternative assumptions. The first choice is between:

(a) Nobody enters or leaves the population.

(b) Each period 200 persons (2%) are removed from the sample and 200 new ones are added. The ordering in which this is executed is determined before the simulation.

We first choose between having the same group of market participants throughout the entire simulation period or having this group 'refreshed' each period as some retire while others start their working career. The first option is viable only when the firm 'inherits' the ability of the founder. Successive entrepreneurs leading the firm are then assumed to be influenced strongly by their predecessors. See also Cohen and Klepper (1992b) and Klepper (1996) who suggest that R&D-related capabilities are *firm specific*. The second choice is between:

(c) The weighting factor α_t is 0.75 and constant in time.

(d) The weighting factor α_t starts at 0.5, increases with constant steps to 0.9 fifty periods later, then decreases again with the same steps to 0.1 one hundred periods later, etc.

Taking a constant α_t implies that entrepreneurial ability is also constant over time. Changes in the production process or market environment may shift the relevant abilities over time. In the second option α_t changes with 0.008 each period. It implies that the importance of X_1 and X_2 and therefore the set of individuals with the highest abilities also changes over time. The second alternative in both the first and second choice creates continuous incentives for *displacement* and *replacement*. Entrepreneurs who retire are replaced and entrepreneurs whose abilities decrease below a certain level due to a changing weighting factor are displaced. Table 1 shows the three scenarios for the adjustment rate equal to 0.15 and 0.05 and the probability of entry equal to 0.03 and 0.01.

Table 1: *Simulation results for three scenarios*

Scenario	λ	*p*	Number of entrepreneurs				Output index			
			t=10	t=25	t=100	t=300	t=10	t=25	t=100	t=300
(a)(c)	0.15	0.03	701	810	816	802	117	130	143	144
	0.15	0.01	429	494	567	624	111	119	138	145
	0.05	0.03	702	808	799	778	112	125	143	144
	0.05	0.01	409	479	544	611	109	117	137	145
(b)(c)	0.15	0.03	623	736	816	678	120	126	126	133
	0.15	0.01	387	445	489	388	110	112	111	115
	0.05	0.03	623	775	919	728	116	124	125	131
	0.05	0.01	393	465	556	405	108	111	110	113
(a)(d)	0.15	0.03	807	846	845	835	120	140	140	140
	0.15	0.01	523	539	586	557	115	129	133	137
	0.05	0.03	785	825	817	820	115	135	137	137
	0.05	0.01	487	536	579	556	112	126	131	135

Note: The total number of market participants is 10,000. The output index is 100 in the first year.

The following conclusions can be drawn from these simulations. First, in case of an unstable environment, i.e. changing population and abilities, the performance is considerably better when the rate of mobility and entry are higher. This is a consequence of the constant need of selecting the most able entrepreneurs. In a stable environment the rate of entry may turn out to be inefficiently high after the selection process has done most of its work and the best entrepreneurs run the firms. The extent to which the number of entrepreneurs and economic performance are positively related depends therefore on the stability of the business environment. This is in line with the findings of Mills and Schumann (1985) and Das et al. (1993) who conclude that small firm presence is positively related to fluctuations in demand.

Second, a higher number of firms need not be positively correlated with market performance. The number of firms for the low mobility scenarios is higher than that for high mobility scenarios in case the population changes from period to period. The reverse is the case when the population does not alter over time. In case of a changing population the optimal market structure is also constantly changing. An inefficiently large number of small firms survive in that market setting due to more able entrepreneurs not being capable of quick responses to a changing optimal firm size.

The conclusions show that there is not a simple relation between the number of firms and economic performance. However, it is likely that in a period of creative destruction a positive relation between these variables can be found. To test for this we simulate a period of creative destruction by abruptly changing the value of α_t from 0.75 to 0.25 in period 301 for two scenarios. The results can be found in Table 2.

Table 2: *Simulation results for a period of creative destruction*

Scenario	λ	*p*	Number of entrepreneurs t=300 t=305 t=310 t=325	Output Index t=300 t=305 t=310 t=325
(a)(c)	0.15	0.03	802 647 678 798	100 84 88 93
	0.15	0.01	624 407 434 478	100 84 86 89
	0.05	0.03	778 634 670 789	100 80 83 90
	0.05	0.01	611 400 423 466	100 80 83 87

Note: The total number of market participants is 10,000. The output index is 100 in the first year.

The simulation results show that a fast recovery in the number of firms after the shake-out due to a sudden change in abilities is beneficial for the recovery process. This process can be seen to have been almost twice as fast in the case of λ=0.15 and *p*=0.03 when compared to that of λ=0.05 and *p*=0.01.

The simulations results which we have discussed above show that the qualitative assumptions about the ‘pool’ of market participants may affect the evolution of market structure and performance considerably. It makes clear that an increase in the number of firms may be due to higher mobility barriers or to a too high level of entry and therefore possibly be negatively correlated with performance. It may of course be the reverse case: an increase in the number of firms may be due to lower mobility barriers or an increase of the rate of entry to more efficient levels. The question which case is relevant in which industry and which period remains an empirical one. The presented model of competitive selection is only tentative. Alternative analyses, also considering the role of technological learning, can be found in Eliasson (1984), Winter (1984) and Dosi et al. (1995).

4 Large firm presence in European manufacturing

The most impressive and also the most cited example of changes in the size class distribution of firms is that of the 500 largest American firms, the so-called Fortune 500. Their employment share dropped from 20 per cent in 1970 to somewhat more than 10 per cent now. Yearly summaries of the firm-size distribution of (potential) EU-members at the two-digit level for the entire business sector are published by Eurostat. In this study we will use data from the Third Edition of this summary, entitled *Enterprises in Europe*.[10]

The share of small firms in most manufacturing industries has increased since the 1970s. This may have been the result of, for example, downsizing of large firms, entry of new firms using advanced technologies and introducing new products and of flexible specialization of small firms. The speed and intensity of these developments have not been equal across industries and across countries as demonstrated in OECD (1994). Prominent examples of downsizing are IBM which has been reported to have its workforce reduced from about 400,000 employees in 1987 to about 200,000 employees in 1995 and General Motors which cut employment from about 800,000 in 1979 to about 450,000 in the early 1990s (The Economist (Dec. 21 1996)).

Smaller firms gaining market share can be positively related to economic performance in two ways. First, a decrease in market concentration may lead to more competition and hence an improved performance. Second, the increase in the market share of small firms may point at a fast and intensive process of introducing new products and technologies.[11] It may be interpreted as a measure of industry flexibility which is likely to be positively related to economic performance.

In the next section we investigate the effect of differences in the size class structure of firms on the growth of industrial value added. This will be done for a sample of 13 manufacturing industries in 12 European countries for a recent period (1990-1995). A related analysis was pursued in Carree and Thurik (1998). In that paper the dependent variable is the growth of industrial output and both the number of manufacturing industries and the number of countries is one larger while the periode is one year shorter, i.e. 1990-1994. The share of large firms is calculated from Eurostat (1994). Not all data of industries and countries in this Eurostat report are used. Some countries are not incorporated because they provide establishment data instead of enterprise data. We also do not take industries into consideration where the total number of employees is below 10,000. Finally, Eurostat sometimes does not provide employment data due to reasons of confidentiality. We define the share of large firms as the employment share of enterprises with 100 or more employees, LFP (Large Firm Presence) for short. For this variable there is a total of 126 observations. Growth in total value added from 1990 to 1993, 1994 and to 1995 is measured by the ratio of total real value added of the industry in 1993, 1994 and 1995 with base year 1990. The source for the indices is OECD StanBase (1996). We note that the Purchasing Power Parities used in this database to adjust the nominal figures are neither

[10] The efforts of Eurostat are currently being supplemented by the European Network of SME Research (ENSR), a cooperation of 16 European institutes. This organisation publishes a yearly report of the structure and the developments of the small business sectors in the countries of the European Union. See EIM (1996).

[11] Prusa and Schmitz (191) provide evidence for the PC software industry that new small firms are an important source of innovation.

industry-specific nor do they reflect relative producer prices. Additionally, some of the data points are estimated by the OECD Secretariat.

Data are available for 12 countries: Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, Norway, Portugal, Spain, Sweden and the United Kingdom. All data on large firm presence refer to the year 1990 except for Italy (1989). The five countries with total employment in the industries incorporated above one million persons are Germany (6.5 million), United Kingdom (4.1 million), Italy (3.8 million), France (3.7 million) and Spain (2.3 million). Total employment in the 126 industries equals 23.9 million persons. The fourth column of Table 3 shows how these are distributed over the 13 two-digit level manufacturing industries. The next two columns of the table show the average value added indices in 1995 (1990=1) and the average large firm presence, LFP. The right hand column shows the correlation between LFP and the value added indices in 1995. The non-weighted average of these correlations is -0.25. On average large firm presence and growth of value added appear to be negatively related, but the differences across industries are large. The correlations range from -0.80 to +0.16. In the rest of this paper we focus on the average effect of LFP on growth of production. The large range in correlations indicates that the effect may differ quite strongly from one specific industry to another.

Table 3: *Summary statistics for the 13 industries*

Sector	Description	N	Empl	VA95	LFP	Corr
21/22	Basic metals	8	907	1.037	0.870	-0.40
24	Non-metallic mineral products	9	1056	0.998	0.566	-0.40
25/26	Chemicals	11	1975	1.120	0.812	+0.16
31	Metal articles	9	2972	0.987	0.391	-0.80
34	Electrical engineering	11	3011	1.226	0.752	+0.02
35	Motor vehicles	6	1807	1.023	0.903	-0.52
37	Instrument engineering	7	492	1.129	0.542	-0.20
41/42	Food, drink and tobacco	12	3114	1.046	0.576	+0.13
43	Textiles	9	1388	0.919	0.604	-0.77
45	Footwear and clothing	10	1853	0.860	0.371	-0.48
46	Wood and wooden products	12	1698	1.010	0.286	-0.10
47	Paper, publishing and printing	12	2419	1.058	0.561	-0.02
48	Rubber and plastics	10	1245	1.109	0.569	-0.38
	Total / Average	126	23937	1.040	0.600	-0.25

Note: *N* is the number of countries for which the value added and large firm presence data are available. *Empl* stands for the total number of employees (in 1,000s). *VA95* is the value added index in 1995 (1990=1). *LFP* is the share of firms with 100 or more employees in total employment. *Corr* is the correlation coefficient between VA95 and LFP for the specific industry.

5 Empirical Results

To test for the effect of the share of large firms on growth of value added we consider the following equations:

$VA_{ijt} = a_i + b_1 LFP_{ij} + h_{1ijt} \quad ,t = 1993,1994,1995$

$VA_{ijt} = a_i + b_1 LFP_{ij} + b_2 LFP_{ij} * Y_{ij} + h_{2ijt} \quad ,t = 1993,1994,1995$

where *i* refers to industry and *j* to country. The variable VA_{ijt} is the value added index of industry *i* in country *j* and year *t* (1990=1). The variables a_i are industry dummies. The variable Y_{ij} is a proportional GDP per capita index (for 1990) ranging from 0.57 for Portugal to 1 for Germany. This variable is taken as a proxy for the stage of economic development. The variables h_{1ij} and h_{2ij} are residuals assumed to be i.i.d. It is necessary to incorporate industry dummies because a certain level of large firm presence considered relatively high in one industry may be considered relatively low in another.

The effect of industrial structure on economic progress may depend upon the stage of economic development of a country, as we test by incorporating *LFP*Y*. First, the introduction of new products and production techniques is especially important for the group of highly developed countries. Small innovative firms may play an even more important role in these countries than in countries which lag behind in terms of economic development. Second, the stage of ousting of inefficient (craft) firms may not have been completed in industries of less developed countries. A large share of small firms in these countries may still have a mom-and-pop character. Economic progress is not promoted to a considerable extent by these non-innovative firms. Third, the success of small firm networks is highly dependent upon the quality of regional infrastructure. Countries which are highly developed in economic terms generally have a well developed infrastructure.

Choosing a specific period over which to evaluate economic growth is crucial. If the period is too long then the size class structure of the industry may change considerably during the period of observation. If the period is too short then the effect of the size class structure may be overshadowed by the business cycle influence on industry output. We consider three periods, 1990-93, 1990-94 and 1990-95. In 1993 most European manufacturing industries experienced a period of recession. The average value added index in our sample in that year was 4% below that in 1990. The years 1994 and 1995 disclosed a strong recovery for most industries and the average value added index rose to 4% higher than that in 1990. Summary statistics for the variables can be found in Table 4.

In this section we determine the estimates of b_1 and b_2 by performing least squares regressions on the equations presented above in deviation of the industry-specific average of each variable:

(1) $VA_{ijt} - \overline{VA_{it}} = b_1 (LFP_{ij} - \overline{LFP_i}) + e_{1ijt}$

(2) $VA_{ijt} - \overline{VA_{it}} = b_1 (LFP_{ij} - \overline{LFP_i}) + b_2 (LFP_{ij} * Y_{ij} - \overline{(LFP * Y)}_i) + e_{2ijt}$

Table 4: *Summary statistics for dependent and independent variables*

Variable	Description	Mean	Stdev	Max	Min
VA93	Value added index 1993	0.955	0.096	1.230	0.624
VA94	Value added index 1994	1.005	0.116	1.591	0.677
VA95	Value added index 1995	1.042	0.166	2.106	0.581
LFP	Large firm presence	0.586	0.218	0.971	0.073
LFP*Y	LFP times GDP per cap. index	0.509	0.214	0.971	0.048

Note: The mean, standard deviation (Stdev), maximum (Max) and minimum (Min) are computed on basis of 126 observations of available country-industry pairs.

In Table 5 we present least squares estimation results of equations (1) and (2). We have considered four different least squares techniques. The first is ordinary least squares (OLS). The results of this technique suggested one particularly strong outlier, viz. the electrical engineering industry in Sweden (NACE 34). The second technique, therefore, is OLS without this one observation. A more general way to deal with (possible) outliers was suggested by Rousseeuw (1984). His robust regression procedure is programmed in PROGRESS.[12] The robust regression is a two-step procedure of Least Median Squares (LMS) followed by Reweighted Least Squares (RLS). This procedure proposed by Rousseeuw to cope with (multivariate) outliers is the third technique. The fourth least squares technique is to weight each observation by employment (WLS). This implies that countries and/or industries with a large number of employees have a stronger impact on the regression results. The interpretation of the coefficients in the table is straightforward. For example, the ordinary least squares results in the third column of Table 5 imply that an increase in LFP by 0.1 leads to a decrease in growth of value added by one per cent for the 1990-93 period, one and a half per cent for the 1990-94 period and two and a quarter per cent for the 1990-95 period.

We first discuss the estimation results of equation (1). The estimated value of b_1 is negative as expected and in most cases it is significantly different from zero at the 5%-significance level. The two exceptions are the estimates using the reweighted and weighted least squares techniques for 1993. For each of the four techniques the effect of large firm presence on the value added index becomes stronger when going from the period 1990-93 to the period 1990-95. That is, industries not only appear to have been more affected by the recession in case large firms had a larger employment share, they also tend to have recovered slower from this recession.

The results of equation (2) are somewhat less straightforward to interpret. Multicollinearity is caused by incorporating both *LFP* and *LFP*Y* into the regression equation. The GDP per capita variable *Y* has only limited spread across countries causing the two variables to be highly correlated. The OLS results show clearly the multicollinearity problem. Whereas the estimate of b_1 is significant in equation (1), both the estimates of b_1 and b_2 are insignificantly different from zero in equation (2). The reweighted and weighted least squares techniques both have a positive value for b_1 and a negative value for b_2.

[12] A description of the PROGRESS program can be found in Rousseeuw and Leroy (1987). See also Wagner (1994) for an application of the procedure.

These results clearly suggest that less developed countries may have benefitted from relatively high large firm presence during the early 1990s, while the reverse has been the case for the more highly developed countries. This corresponds to the results presented in Carree and Thurik (1998) who find that the two countries in the data set with lowest GDP per capita, viz. Portugal and Spain, have a different effect, on average, of large firm presence on growth of production than the other European countries. If we consider the RLS- and WLS-results for the 1990-95 period, the critical point of economic development is around 0.6. That is, European countries with GDP per capita above 60% of the highest GDP per capita (i.e. that of Germany) have tended to benefit, on average, from a higher presence of small firms in manufacturing industries in the early 1990s. It is not unlikely that many firms in the less developed Portuguese and Spanish manufacturing sectors have a sub-optimal scale. Small firm presence may only have a positive effect on economic growth in a certain stage of organizational and technological development in which scale economies have become less important. Spain and Portugal which joined the European Union only recently, may not reached this stage yet.

We note that the precise reason for the relationship between large firm presence (industry structure) and change of value added (economic growth) is left somewhat unclear. An increase in the share of small firms may, for example, be due to the entry of new small firms, to downsizing of large firms, or to spin-offs. This entails some research questions which we will leave unanswered in the present paper. Despite the general conclusion of a positive effect, on average, of small firm presence in European two-digit manufacturing industries on growth of value added, there are some issues to be resolved in future research. First, the effect appears to differ across industries (see Table 3) and to depend upon the stage of economic development of countries (and, as a result, industries in these countries). Second, the empirical results presented are based upon data on a level of aggregation which is still relatively high. Research on a lower aggregation level is to be recommended. However, these and other research topics are highly dependent upon the increasing supply of rich and broad data sets on industry structure and its changes over time.

Table 5: *Estimation results*

Year	Par	OLS	OLS*	RLS	WLS	OLS	OLS*	RLS	WLS
1993	b1	-0.116	-0.126	-0.063	-0.049	-0.030	-0.022	0.115	0.151
		(2.1)	(2.4)	(1.6)	(1.5)	(0.3)	(0.2)	(1.3)	(1.7)
	b2					-0.080	-0.097	-0.200	-0.191
						(0.8)	(1.0)	(2.7)	(2.4)
1994	b1	-0.146	-0.170	-0.139	-0.164	0.018	0.036	0.064	0.283
		(2.2)	(2.8)	(2.6)	(3.7)	(0.1)	(0.3)	(0.6)	(2.4)
	b2					-0.153	-0.193	-0.208	-0.427
						(1.3)	(1.8)	(2.2)	(4.1)
1995	b1	-0.229	-0.272	-0.190	-0.307	0.000	0.033	0.263	0.353
		(2.3)	(3.4)	(3.1)	(5.1)	(0.0)	(0.2)	(2.1)	(2.3)
	b2					-0.214	-0.285	-0.403	-0.631
						(1.2)	(2.0)	(3.8)	(4.5)

Note: OLS is Ordinary Least Squares. OLS* is OLS without the outlying observation Sweden NACE 34. RLS is Reweighted Least Squares (after LMS) developed by Rousseeuw (1984). WLS is Weighted Least Squares with total industry employment as weighting variable. *Par* stands for the estimated parameter.

6 Conclusion

The consequences of the shift in economic activity from large to small firms have recently attracted the attention of ‘small business economists’. In the present contribution we supplement the work of the pioneers in this field by investigating whether a higher share of small business at the start of the 1990s has led to higher growth of value added in the subsequent three to five years in European manufacturing. Our results indicate that an industry with a low large firm presence relative to the same industries in other countries has performed better, on average, in terms of growth of value added. This suggests that lagging behind in the industrial restructuring process has come at a cost of lower economic growth. Countries which have been most active in improving the business environment for the small business sector in the 1980s may very well have reaped the fruits of this policy. However, the results also suggest that promoting the small business sector may be counter-productive in some parts of the manufacturing sector and in less developed economies. The findings are in line with our earlier results (Carree and Thurik (1998)) for output growth using a slightly different sample.

European politicians and representatives of social and institutional groups fear for a further rise of the already unacceptably high level of unemployment caused by the sheer endless series of efficiency and cost-cutting operations of the public and large business sectors. They hope that employment can be fought by stimulating smallness. There are several reasons which may warrant their hopes. Firstly, stimulating smallness lifts the dependency on possibly sluggish and transient resources like scale, scope and experience, and intensifies the dependency on resources like adjustment and effectiveness. The latter resources are likely to be more robust against uncertainty and change than the former. Secondly, stimulation of smallness means stimulation of labour intensity and hence employment by definition. See Loveman and Sengenberger (1991).

Thirdly, stimulation of smallness implies an increase in the variety of the range of products and services offered. This not only paves the way for a competitive selection process, and a process with different innovative approaches (Cohen and Klepper (1992a)) but may also satisfy a fragmented and differentiated demand. Finally, Murphy et al. (1991) argue that stimulating talented people to become entrepreneurs instead of rentseekers will benefit growth. In many Western countries, rent seeking has rewarded talent more than entrepreneurship has done, resulting in stagnation.

Throughout Europe, job layoffs and down-sizing of large firms, often in moderate-technology industries, have been common phenomena. Meanwhile, small firms replaced large firms in the United States not just in terms of generating almost all of the 18 million new jobs created in the 1980s, but also in terms of much of the innovative activity that has driven the rise of new industries and renewed international competitiveness. The empirical results in this study suggest that a policy of stimulating small firms, or more generally entrepreneurship, may be an effective way of combatting the current decrease in competitiveness of European industry. However, the results also show that the effectiveness of such a policy may differ significantly across industries and between different stages of economic development.

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