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Turbulence and Productivity; An Analysis of 40 Dutch Regions in the period 1988-1996

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Abstract: From an empirical perspective there is growing evidence on the relation between size class distributions and economic performance. However, the question whether this change of the size class structure of industries has influenced economic performance is still underresearched. The purpose of this study is to assess the effect of entry and exit of firms on productivity in a regional approach. A model for total factor productivity is estimated using data of 40 Dutch regions for the years 1988 through 1996. The regions can be desaggregated into two separate sectors: manufacturing and services. The findings indicate some positive effects of turbulence on total factor productivity of regions and thereby on productivity and growth at macro-level. In the service sector it was found that turbulence has an upward impact on the TFP growth in a region.

I. Introduction

A series of empirical studies has identified that a pervasive shift in the industrial structure away from large corporations and towards small enterprises has taken place between the mid-1970s and early 1990s.[1] This shift occurred in virtually every single leading industrial country. The questions are whether such a shift is desirable and whether the resulting industrial structure should be promoted or avoided?

Prevailing economic theory provides a set of ambiguous answers. For instance, an endogenous growth model was developed by Schmitz (1989) predicting that an increase of the proportion of entrepreneurs in the work force generates an increase in long-run economic growth. Holmes and Schmitz (1990) develop a model of entrepreneurship in the spirit of T.W. Schultz and show that specialization in managerial tasks and entrepreneurship may affect economic development. Additional evidence of a long-term relationship between fluctuations in entrepreneurship and the rise and fall of nations has been assembled by Wennekers and Thurik (1999).[2]

From an empirical perspective there is growing evidence on the relation between size class distributions and economic performance. For instance, see Nickell (1996), and Lever and Nieuwenhuijsen (1999) who present evidence that competition, as measured by increased number of competitors, has a positive effect on the rate of total factor productivity growth. Carree and Thurik (1998, 1999) show that the share of small firms in manufacturing industries in European countries has a positive effect on the industry output growth.

The question whether this change of the size class structure of industries has influenced economic performance is underresearched. This has to do with a persistent lack in knowledge of market structure dynamics (Audretsch, 1995). In other words, there is a lack in knowledge concerning questions like who enters and exits, what determines this mobility and what are its effects, in particular on economic performance.

Clearly, the change in the size class structure has more consequences than on the mobility of firms. Acs (1992) surveys 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. Audretsch and Thurik (1999) point at a shift from the managed economy to the entrepreneurial economy. They identify fifteen trade-offs confronting these two economies. The common thread throughout these trade-offs is the increased role of new and small enterprises in the entrepreneurial economy.

The managed economy of the post-war period was characterized by remarkable stability. This stability is characterized by product homogeneity and durability of demand, resulting in a constant population of firms, and a low turnover rate of both jobs and workers. This stability was conducive to mass production. The entrepreneurial economy is characterized by less stability and more turbulence and is focused on the organization and management of foresight and the creation of new ideas. The selection between viable and non-viable ideas is the result of a market process rather than restricted to internal decisions imposed by decision-making hierarchies. The drive to appropriate the gains of the commercialization of ideas leads to the formation of new firms. Clearly, not all of these start-ups are successful. Empirical studies shows that start-up rates are greater in innovative industries than in non-innovative industries, and that the likelihood of survival is lower in innovative industries (Geroski, 1994). Audretsch (1995) finds that one-third of all U.S. manufacturing firms are less than six years old while these new start-ups account for only 5 percent of total manufacturing employment. Taken together, this evidence provides a view of the entrepreneurial economy as being remarkably turbulent, in that a large number of firms are started each year, while only a few of the firms actually survive.

The present paper deals with a major aspect of the entrepreneurial economy, being the turbulence of firms. The theory attached to turbulence (entry and exit of firms) goes back to Schumpeter. He argued that growth, innovation and business dynamics are inherently connected. According to him the economy develops through a process of competition and selection. Firms gain an advantage through innovation. In this way they achieve excess profits, which encourages imitation and entry. As a result, profits drop and the firms are stimulated to innovate again. As not all firms have the abilities to innovate, selection occurs. From this point of view the entry of new firms is essential because entrants bring with them new ideas, methods and products. The exit of some firms is equally important because the majority of these firms show bad performances and do no longer contribute to the growth of the economy. Furthermore, exit of firms creates room for new entries. In sum Schumpeter states that a high level of turbulence of firms contributes to economic growth because of its contribution to selection and innovation.

Another theory stresses the importance of the life cycles of products (Klepper, 1996). In new product markets turbulence is high because of many entries. In old product markets, turbulence is also high because of many exits. According to this theory there would be no connection between turbulence and growth. Turbulence (sum of entries and exits) is high in both growing and declining industries. However, if entry and exit is related to the number of existing firms, one would find correlations between turbulence and growth. In declining markets more firms are active. So the rate of turbulence in old declining markets is low while in new markets turbulence rates must be high as less firms are active in the new growing markets. The theory of the life cycle of products implicates that economic growth is a source of turbulence, while Schumpeter's theory implicates that turbulence is a source of economic growth. Combination and measuring of both ideas is possible by taking into account inter-industry turbulence. There is no contradiction between both theories if Schumpeter's creative destruction goes through the borders of industries. The fact that the theoretical concepts of turbulence and growth are not completely in balance and discussion is not finished yet explains probably the ambiguous results found in empirical studies. We give some examples.

Van der Wiel (1999) finds that, in some Dutch service sectors, entry and exit do cause low productivity growth. Using individual enterprise data for the period 1987-1995 he shows that starting firms are, for some years, less productive than existing firms and that the productivity of starters is approximately equal to that of exiting firms. However, van der Wiel notices that new firms are responsible for a major part of the increase in turnover and job creation.

Bartelsman et al. (1996) show for Dutch manufacturing that in the period 1980-1991 30 percent of labour productivity growth originates from entry and exit.

Reynolds (1999), using American regional data for the period 1980-1992, finds a positive correlation between job creation and entry and exit rates. Furthermore, he regressed dynamic indicators on growth and concludes that turbulence partly explains economic growth.

Audretsch and Fritsh (1996) use data of regions in West Germany for the period 1986-1989 and find no evidence supporting the link between turbulence and growth.

All in all, empirical findings regarding to the economic effects of turbulence show different results. As entry and exit rates are rising, knowledge about the the economic effects of turbulence is interesting for both science and policymakers. The purpose of this report is to asses the effect on productivity of entry and exit of firms. A model for total factor productivity is estimated using data of 40 Dutch regions for the years 1988 up to and including 1996.
The structure of this report is as follows. Section 2 deals with the data and the model. The results are presented in section 3 and the paper ends with a summary of the main conclusions.

II. Method and data

Data

To test whether exit and entry of firms influence productivity, we use an EIM-database consisting of a panel of 40 Dutch regions (so called COROP-area's). The regions can be desaggregated into two separate sectors: manufacturing and services. For the regions and sectors information about firm dynamics (number of entries, exits and existing firms) and economic variables is available for the years 1988-1996. Several indicators on firm dynamics can be derived from the number of entries, exits and existing firms. Furthermore, economic variables, nominal value added, deflated value added, capital stock[3], wages and employment are available. Table 1 presents averages of key variables. Service sectors in regions show more turbulence and growth than manufacturing sectors. However productivity growth is higher in manufacturing. Growth of turbulence appears to be a common phenomenon in the Netherlands in the periode 1988-1996.

Table 1 Averages for turbulence and performance across regions and time; 1988-1996

	Macro	Services	Manufacturing
Production growth[2] (%)	6.39	7.63	4.51
Productivity growth (TFP[3], %)	3.00	2.95	3.34
Turbulence[4] (level, %)	11.9	12.1	10.9
Growth of turbulence (percent points)	0.54	0.54	0.55

1) Unweighted averages

2) Deflated value added

3) Turbulence = (entries plus exits) / (number of existing firms)

4) Total factor productivity

Method

To investigate the impact of firm dynamics on productivity, equations for total factor productivity are estimated. The equations are based on the Cobb-Douglas production function framework. Besides factor inputs the production equation includes turbulence:

$$(1)\ \Delta y_{rt} - a_{rt}\Delta l_{rt} - (1 - a_{rt})\Delta k_{rt} = b\ TB_{rt-x}$$

Where:

Δ:	operator calculating differences (t, t-1)
y:	volume of added value (as logarithm)
l:	labour volume (as logarithm)
k:	volume of the stock of capital goods (as logarithm)
TB:	turbulence of firms
r, t:	indices for region and year respectively (r=1,..,40 en t=1989,..,1996)
x	lag (x=1,2,3)
a:	average share of labour costs in value added in period t, t-1
b:	impact of turbulence on productivity

The left hand side of equation (1) is the growth of the total factor productivity (TFP), which is defined as the growth of production volume corrected for growth of production factors (labour and capital). The TFP is calculated by subtracting a weighted average of the relative growth of the production factors from the relative growth of the production volume. The weightings of the production factors are based on the cost components. Advantage of this method is that weightings depend on region (and sector).

Turbulence is defined as entry plus exit scaled on the number of existing firms. This indicator is selected from a set of various indicators for firm dynamics by means of Principal Component Analysis (PCA)[4]. Turbulence is included with one or more lags. It is assumed that the effects of turbulence are not immediately observable. Including lags also circumvents the problem of simultaneity, brought up by the influence of production growth on turbulence.

Equation (1) is estimated by regressing TFP on turbulence using ordinary least squares (OLS). In this way it is possible to test whether turbulence contributes to the TFP. In addition, the estimated coefficients provide measures of this effect. Furthermore, sector dummies and year dummies will shed more light on the relations found.

Results

Results at macro level

Table 2 presents the estimated equations using regio data without desaggregation into manufacturing and services. It appears that the turbulence coefficient is positive in most cases, but not always significant. The share of services in a region (COROP-area) is also found to be of importance. Including the term for the share of services (measured in terms of value added) results, in first instance, in a lower coefficient for turbulence (equations I en II). If, regional dummies are also included the coefficient even appears to be negative. (equation III). If just the turbulence variable is included, the coefficient apparently also comprises other effects such as share of services or specific regional effects. Therefore the additional variables are included. The negative effect of turbulence in equation III is the consequence of the rather poor economic performance in the period 1992-1993. This becomes clear in equation IV. Annual dummies are included in this equation which results in a positive effect of turbulence. Equation IV appears to be the best variant. In this case turbulence is lagged twice. Alternative spexcifications, in which turbulence is lagged either once, or three times, support the evidence that turbulence conduce to productivity[5].

Table 2 Estimation results TFP equation; macro-level

Variables	I	II	III	IV	V	VI
Turbulence t-3						0,097
						(0,153)
Turbulence t-2	0,145	0,048	-0,197	0,213		
	(0,079)	(0,083)	(0,139)	(0,132)		
Turbulence t-1					0,065	
					(0,129)	
Share of services t-1		0,068	0,835	1,045	0,522	1,118
		(0,021)	(0,078)	(0,082)	(0,082)	(0,128)
Region dummies			√	√	√	√
Year dummies				√	√	√
Adjusted R^2	0,011	0,052	0,381	0,583	0,394	0,418
Number of observations	211	211	211	211	243	180

Turbulence = (number of entries and exits) / total number of enterprises

Standard errors between parentheses.

We may tentatively conclude that, at the macro level, turbulence has a positive effect on the TFP. It is striking that a positive coefficient is found for the service share, taking into account the fact that the development of the productivity in the service sector has lagged behind that of industry in recent years (table 1). The fact that the service share is linked to turbulence, could provide the explanation. The most important conclusion from Table 2 is perhaps that a distinction in sectors could help to trace out the impact of turbulence on productivity.

Results for services

Table 3 presents findings for the service sector. The turbulence coefficient is positive in four of the six equations. In the first equation only turbulence is included as an explanatory variable. In this case the turbulence coefficient is very small and insignificant. Regional dummies are included in the second equation, with as consequence that the turbulence coefficient becomes significantly negative. However, when annual dummies are included the coefficient is positive and significant (equation III). The turbulence coefficient becomes negative again if we additionally include regional dummies. The model without the regional dummies does not appear to be any worse though (in the sense that it is in econometric terms permissible to omit regional dummies). So, the conclusion here is that turbulence is a major cause of the differences in TFP growth between regions. The variants that include turbulence lagged once or three times confirm the findings of equation III. So the main conclusion is that the effects of turbulence are positive and significant.

Table 3 Estimation results TFP equation; services

Variables	I	II	III	IV	V	VI
Turbulence t-3						0,083
						(0,036)
Turbulence t-2	0,007	-0,296	0,087	-0,038		
	(0,041)	(0,080)	(0,034)	(0,076)		
Turbulence t-1					0,037	
					(0,036)	
Region dummies		√		√		
Year dummies			√	√	√	√
Adjusted R^2	-0,005	0,048	0,376	0,423	0,270	0,452
Number of observations	211	211	211	211	243	180

Turbulence = (number of entries and exits) / total number of enterprises

Standard errors between brackets

Results for manufacturing

Table 4 presents the findings for the manufacturing sector. In this table most of the coefficients (5 out of 6) are negative. In addition, in all equations the turbulence coefficient is not significant. In other words, no effect of turbulence on the TFP is found for manufacturing.

table 4 Estimation results TFP equation; manufacturing

Variable	I	II	III	IV	V	VI
Turbulence t-3						-0,280
						(0,156)
Turbulence t-2	-0,067	0,137	-0,119	-0,099		
	(0,157)	(0,369)	(0,150)	(0,401)		
Turbulence t-1					-0,027	
					(0,127)	
Region dummies		√		√		
Year dummies			√	√	√	√
Adjusted R^2	-0,004	-0,065	0,139	0,103	0,147	0,185
Number of observations	211	211	211	211	243	180

Turbulence = (number of entries and exits)/total number of enterprises

Standard errors between brackets

Conclusion

The purpose of this paper is to investigate whether turbulence of firms contributes to the productivity of the economy. The findings indicate some positive effects of turbulence on total factor productivity of regions and thereby on productivity and growth at macro-level.

In the service sector it was found that turbulence has an upward impact on the TFP growth in a region. It was also found that the effect of turbulence does not occur immediately. The estimates indicate that the effect can be measured after one year but that the maximum effect is achieved after two years.

No TFP effect of turbulence was found for manufacturing. The estimates for the coefficients of turbulence in the TFP models is not significant in any of the models. Obviously, only in servces the Schumpeterian process of innovation and selection is conducive to innovation and growth. In manufacturing the alternative hypothesis of Schumpeter about the importance of big firms in innovation processes is more important.

In sum we conclude that empirical evidence is found that turbulence contributes to economic growth. Hence it seems that the influence of smallness on growth is connected with turbulence of firms.

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Notes:

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[1] See the country studies included in Loveman and Sengenberger (1991), Acs and Audretsch (1993) and Thurik (1999).

[2] In this respect also the work of Eliasson (1995) on economic growth through competitive selection is of relevance. He shows (for the Swedish economy) how a lack of industry dynamics affects economic progress not so much on the short term but very strongly so on the long term (from about two decades on).

[3] Capital stock has been calculated with the so called Perpetual Inventory Method. In this method historical investments are summarised after correction for depreciation and price mutations. Investments are available for 1977-1995. For more details: see Nieuwenhuijsen (1999) et al.

[4] For detailed information about the PCA: see Nieuwenhuijsen (1999) et al.

[5] The specification of the lag length determines the number of observations.

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