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Turbulence and productivity in the Netherlands

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1 Introduction

Entry and exit of firms is an item of major importance in economic policy. For the Netherlands, this is emphasised by the Amendment to the Establishment Act, which came into force in 1996. One of the main reasons for passing the amendment was to make it easier to start a firm. That is why, for example, the educational qualifications required to start an enterprise were lowered or even no longer applicable. Another example of the importance attached to firm dynamics is the fact that the Dutch Bankruptcy Act, dating from 1893, is also under discussion. The aim of changes to the Act would be to prevent unnecessary bankruptcies without adverse effects for the creditors. Such changes in legislation are expected to remove barriers to starting a firm and to facilitate re-starts.

Taking into account the attention paid by policy makers to the entry and exit of firms, there is a definite need for an adequate assessment of the influence of firm dynamics on economic performances.

The purpose of this report is to investigate whether entry and exit of firms affects productivity. A model for total factor productivity is developed and estimated using a panel of regional data for the years 1988 up to and including 1996.

The structure of this report is as follows. Section 2 deals with previous research into the effect of turbulence. Our approach and findings are explained in section 3. Besides results at macro level, results for services and manufacturing are presented. We end with an evaluation.

2 Summary of previous research

The theory attached to turbulence (entry and exit of firms) goes back to Schumpeter. His theory is 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, 1992). 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.

On the one hand 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.

On the other hand 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 (1996), using American regional data for the period 1980-1992, finds a positive correlation between job creation and various dynamic indicators. Furthermore, he regressed dynamic indicators on growth and concludes that turbulence partly explains economic growth.

Audretsch and Fritsch (1994) use data of regions in West Germany for the period 1986-1989 and find no evidence supporting the link between turbulence and growth.

3 Analyzing the impact of turbulence on productivity

3.1 Method and data

In this section we 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-areas). 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[1], 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 period 1988-1996.

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

	Macro	Services	Manufacturing
Production growth[b] (%)	6.39	7.63	4.51
Productivity growth (TFP[c], %)	3.00	2.95	3.34
Turbulence[d] (level, %)	11.9	12.1	10.9
Growth of turbulence (percentage points)	0.54	0.54	0.55

a Unweighted averages.
b Deflated value added.
c Total factor productivity.
d Turbulence = (entries plus exits) / (number of existing firms).

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 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.

(1) $\Delta y_{rt} - \alpha_{rt}\Delta l_{rt} - (1-\alpha_{rt})\Delta k_{rt} = \beta TURB_{rt\text{-}x}$

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)

TURB: turbulence of firms

r, t: indices for region and year, respectively ($r = 1,..,40$ en $t = 1989,..,1996$)

x lag (x = 1,2,3)

α: average share of labour costs in value added in period *t*, *t-1*

β: 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[1]. 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)[2]. Turbulence is included with a lag. It is assumed that it takes some time for turbulence to affect total productivity. Including a lag 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. The coefficients represent the direct effect of turbulence[3]. Further, including sector dummies and year dummies will shed more light on the relations found.

3.2 Results at macro level

Table 2 presents the estimated equations using region data without desaggregation into manufacturing and services. It appears that the

1 See for argumentation e.g. Griliches en Lichtenberg (1984, pp. 486-488).
2 For detailed information about the PCA: see Nieuwenhuijsen (1999) et al.
3 Estimating a long-term effect would be difficult because only 9 years are available.

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 the value-added value) results, in first instance, in a lower coefficient for turbulence (equations I en II). When 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 COROP effects. It is, therefore, advisable to include these additional variables. The negative sign 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 have been added 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. Alternatives for equation IV, where the turbulence is lagged either once, or three times, do not exhibit improvements[1]. They support, however, the suggestion that turbulence has a positive effect on total factor productivity growth.

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 ser-

1 The specification of the lag length determines the number of observations.

vice share is linked to the turbulence, could provide the explanation. The most important conclusion to be drawn from table 2 is perhaps that a distinction in sectors could help to trace out the impact of turbulence on productivity.

3.3 Results for services

Table 3 presents the 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.

3.4 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

Variables	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.

4 Evaluation

4.1 Summary of the findings

The purpose of this study was to investigate whether turbulence contributes to the growth of the total factor productivity in regions. The findings indicate some positive effects of turbulence on productivity.

At macro level it was found that turbulence contributes to the growth of the TFP. It should, however, also be stated that the service share (in terms of value added) in a region is an important explanatory factor in the growth of the TFP. Since the service component is linked to the turbulence, the precise effect of turbulence at macro level is not completely clear. Therefore, a further distinction was made into services and manufacturing.

In the service sector it was found that turbulence affects the TFP growth in a region. The coefficients were found to be positive and, on the whole, significant. Furthermore, the turbulence variable is more important than the region dummies. In the service sector, therefore, regional effects are to a major extent effects of turbulence. 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 direct effect is achieved after two years.

No TFP effect of turbulence was found for manufacturing. The turbulence coefficient was not significant in any of the models. Furthermore, the coefficients in most models were negative. Notice, however, that the model provides estimates of the direct effect of turbulence on TFP. The possibility of a long-term effect cannot be ruled out.

4.2 Explanation of the findings

Are the findings plausible? They seem to be.

- The macro findings seem to be in line with the service sector. This can be explained by the considerable services shares in most regions (in only 5 of the 40 regions the share of services is lower than 50%).

- For manufacturing no direct effects were found. This can be explained quite simply. To start a firm in manufacturing, considerable investments are often needed. So it takes time to achieve positive operating results.

- One problem with modelling the consequences of turbulence is the possibility of simultaneity: on the one hand economic growth encourages entry, entry in turn has consequences for exits and, on the other hand, entries and exits affect economic growth. In ideal circumstances this entire process should be modelled. We chose a simple approach in this study which can be refined later. Nevertheless this approach has provided reliable indications that turbulence does affect productivity assuming that the effect of turbulence takes some time. This assumption also circumvents the problem of simultaneity.

4.3 Interpretation of the results

How should we interpret the findings of this study? Let us take services as an example. The turbulence coefficient is 0.087. Average regional turbulence in services is roughly 12% and the annual TFP growth is roughly 3%. A one-percentage point increase of the turbulence in the service sector results in an extra growth in productivity of 0.087 percentage point after two years. The effect of a serious increase of turbulence can, therefore, be considerable.

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