Papers in Evolutionary Economic Geography

08.13

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Version 7 August 2008

Abstract: Do processes of firm entry and exit improve the competitiveness of regions? If so, is this a universal mechanism or is it contingent on the type of industry or region in which creative destruction takes place? This paper analyses the effect of firm entry and exit on the competitiveness of regions, measured by Total Factor Productivity (TFP) growth. Based on a study across 40 regions in the Netherlands over the period 1988-2002, we find that firm entry is related to productivity growth in services, but not in manufacturing. The positive impact found in services does not necessarily imply that new firms are more efficient than incumbent firms; high degrees of creative destruction may also improve the efficiency of incumbent firms. We also find that the impact of firm dynamics on regional productivity in services is higher in regions exhibiting diverse but related economic activities.

Keywords*:* entrepreneurship, entry & exit, turbulence, creative destruction, regional competitiveness, total factor productivity

JEL Codes: L10, M13, O18, R11

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> "…The fundamental impulse that sets and keeps the capitalist engine in motion comes from the newcomers' goods, the new methods of production or transportation, the new markets, the new forms of industrial organisation that capitalist enterprise creates. … [This is a] process of industrial mutation – if I may use that biological term – that incessantly revolutionises the economic structure *from within*, incessantly destroying the old one, incessantly creating a new one. This process of Creative Destruction is the essential fact about capitalism …(Schumpeter 1942, p.83)

> "… a large portion of aggregate productivity growth is attributable to resource reallocation. The manufacturing sector is characterized by large shifts in employment and output across establishments every year – the aggregate data belie the tremendous amount of turmoil underneath. This turmoil is a major force contributing to productivity growth, resurrecting the Schumpeterian idea of creative destruction…." (Bartelsman and Doms 2000, p.571)

Introduction

In the last decades, entrepreneurship has increasingly been linked with economic growth (Wennekers and Thurik 1999; Carree and Thurik 2003). Rooted in Schumpeter's seminal work (Schumpeter, 1934), there is now a widespread agreement that entrepreneurship is important for competitiveness of nations (Porter 1990), and productivity growth in particular (Baumol 2004). At the same time, many authors have argued that in the current era of globalization, regions have become more important than countries in the creation of economic growth (Castells and Hall 1994; Storper 1997; Porter 2000; Camagni 2002), and competitiveness (Krugman 2005). Entrepreneurship is also highly sensitive to regional conditions (Feldman 2001; Bosma and Schutjens 2007). These findings suggest that, for establishing a link between entrepreneurship and economic growth, the region is a more appropriate unit of analysis than the nation. Especially for entry, competition and learning, the regional level might be more relevant than the national level (Fritsch and Schmude 2006).[1] In addition, Audretsch and Keilbach (2004a), found that entrepreneurship stimulates labor productivity at the regional level.

This article seeks to clarify the combined effects of entry and exit (as a measure of creative destruction) on competitiveness within a national policy setting that is characterized by a consistent emphasis on entrepreneurship (the Netherlands) and early-stage entrepreneurship in

[1] Competition in product markets, but especially in labour markets is likely to be concentrated in the home-region of the firm. Even more localized is probably the learning that takes place through knowledge spillovers (see Jaffe et al. 1993; Breschi and Lissoni 2003).

particular. For the Netherlands it can be said that at the national level there has been a pronounced and stable policy program directed to stimulating entrepreneurship, during 1988-2002, the period we observe in this paper (Stevensson and Lundström 2001; Wennekers 2006).[2] Our study analyses the dynamics in firm entry and exit in two distinctive sectors at the regional level. This regional orientation is due to the fact that the majority of firm founders set up their business in the location where they were born (Michelacci and Silva 2007) or where they were previously employed or located (Stam 2007). Also the market scope of these entrepreneurs is largely local or regional, as their knowledge of the specific business and market environment leads to a better exploitation of opportunities (Bosma et al. 2008a). According to Schutjens and Stam (2003), this regional focus in market and business relations is quite persistent as "…firms tend to even narrow their spatial scope in their first three years..." (p. 115). In addition, competition between local firms is likely to be much fiercer than between firms located in different regions.

This article makes three contributions to the existing literature. First, we acknowledge that entrepreneurship (as a determinant of productivity growth) includes both firm entry and exit. Second, we analyze firm entry and exit and its effect on productivity growth in the most relevant level of analysis, namely the region, and allow effects of firm dynamics on regional growth to differ along some specific attributes of the region. Third, the effect of firm entry and exit is studied both in manufacturing as well as in services. In particular for the services sector new firms' orientation can be expected to be primarily local or regional.

The article is organized as follows. First, we review the literature on (elements of) creative destruction and its effect on competitiveness. After this, we will present the data, method and outcomes of our empirical analyses. We analyze the effect of entry and turbulence (defined as the sum of firm entry and exit) on regional competitiveness (measured as total factor

[2] In the Netherlands there are practically no regions where regulations differ from those set by national legislation.

productivity growth) across 40 regions in the Netherlands over the period 1988-2002. Our analyses suggest that firm entry and exit lead to productivity growth in services but not in manufacturing. Finally, we discuss our findings and conclude.

Creative destruction and regional competitiveness

Many studies on competitiveness are inspired by Schumpeter's (1934; 1942) work on the mechanisms of economic development, especially the role of entrepreneurship. These studies in general equate entrepreneurship with new firm formation, and in fact disregard the firm exit mechanism as another important aspect of entrepreneurship. Schumpeter's (1942) theory of "creative destruction" involves both creation (new firm formation) *and* destruction (firm exit). Firm exit reflects the selection mechanism that is a crucial outcome of the process of competition and one of the causes of territorial competitiveness (Porter 1990). The so-called Schumpeter Mark I argument on creative destruction ('entrepreneurial regime') goes as follows (cf. Eliasson 1996). Entrepreneurs introduce new combinations embodied in new firms. These innovative entrants enforce incumbents to either adapt to the new efficiency standard or to exit the industry. This leads to a new situation in which the productivity of the industry has improved. This improvement is brought about by innovative entrants that are more productive than the average incumbent, and the exit of less productive incumbents via the competition process. These exits are important as resources are released that can be allocated to more productive activities. The productivity gains might be reinforced if incumbents are able to improve their productivity (cf. Aghion and Bessonova 2006). The competitive threat of entrants in the same region and sector as the incumbent is likely to be much higher than that of entrants in other regions and sectors. This means that the productivity of incumbents is most likely to be spurred by entrants in the same sector and region. In the end, creative destruction will lead to improved total factor productivity (TFP), not necessarily to higher employment levels: more output is realized with the same amount of labor and capital inputs.

However, if new entrants are less efficient than incumbents, the efforts involved in the emergence of entrants may even waste valuable resources. In the latter situation entrepreneurship – measured as new firm formation – is not a driver of competitiveness at all.[3] This situation has been identified in the literature as a 'revolving door regime': entrants that have to exit relatively soon after start-up due to an insufficient level of efficiency (Audretsch and Fritsch 2002). This revolving door regime reflects a situation with high entry rates, but with no subsequent improvement of either employment levels or productivity. There are several explanations for this phenomenon. For example, Jovanovic's (1982) theory of passive learning assumes that individuals do not know their entrepreneurial talents in advance, and can only find out by experience in a spell of entrepreneurship. This means that many individuals start inefficient firms, only to find out that they are not successful in entering the market with a new firm. Relatively many individuals will do so if the prospects of business-ownership are perceived to be very attractive, for example in the emergence of a new industry or a large upturn of the economy (like in the late 1990s). Another situation in which relatively many inefficient firms enter is in a period of economic depression, when individuals are pushed out of the labor force into self-employment.

A more structural view of economic change provides a different role of entrepreneurship. New entrants cause structural change when they introduce innovations that create completely new knowledge (Metcalfe 2002) and possibly new markets. In this respect, Audretsch and Keilbach (2004b) have argued that there is a gap between scientific and technological knowledge (developed in research and development activities) and exploitable knowledge or economic knowledge. In their view, economic knowledge emerges from a selection process across the generally available body of knowledge. They suggest that entrepreneurship is an

[3] Perhaps innovative entrants are the strongest stimulators of competitiveness. For example, Geroski (1989) found that higher entry rates lead to higher productivity growth, which he explains by assuming that entry stimulates competition, and greater competition spurs productivity growth. But he also showed that innovation was an even more important driver of productivity (cf. Baily and Chakrabarti 1985).

important mechanism in driving that selection process hence in creating diversity of knowledge, which in turn serves as a mechanism facilitating the spillover of knowledge. They provide empirical evidence that regions with higher levels of entrepreneurship indeed exhibit stronger growth in labor productivity. This kind of entry does not necessarily drive out incumbents, but might do so when the new markets substitute existing markets (e.g. the personal computers driving out typewriters, and digital cameras driving out analogue film cameras). The situation where incumbent firms are not affected might be called creative *construction* (Agarwal et al. 2007), whereas the crowding out of incumbents reflects creative *destruction*. This structural change might improve TFP, and possibly employment if the newly created market does not fully cannibalize existing markets.

Several studies have confirmed the effect of turbulence on total factor productivity (TFP) growth in manufacturing; see for example: Geroski (1989); Bailey et al. (1992); Liu (1993); Carlin et al. (2001); Callejón and Segarra (1999); and for a review Bartelsman and Doms (2000). A Recent studies by Braunerhjelm and Borgman (2004) and Dejardin (2008) also analyzed the services sector and found a positive effect of respectively firm entry on labor productivity in regions, and of net entry rates on value added growth in Belgium.

Since the present study adopts a regional approach it is important to highlight some specific regional features that may have an impact on regional competitiveness. First, urbanization economies that reflect external economies available to all local firms irrespective of sector and arising from population density. High population density might stimulate competitiveness because of the high levels of competition between different suppliers (lowering input costs) and the possibilities to achieve economies of scale with relatively large demand. Possible negative effects of high population density on competitiveness arise when low entry barriers give room to too many inefficient entrants, and when cost levels (housing, wages) increase along with population density. The latter could deter employment growth but might also stimulate entrants to be more labor productive (cf. Kleinknecht 1998; Madsen and Damasia 2001).

Second, Jacobs externalities involving external economies available to all local firms stemming from a variety of sectors. The latter externalities are best captured with the notion of related variety (see Frenken et al. 2007). Related variety reflects both sector diversity and the degree to which the sectors are related. Related variety is assumed to have a positive effect on the probability of new combinations given the possibilities to combine ideas from different but related sectors (Jacobs 1969; Frenken et al. 2007). High levels of related variety in a region are likely to have a catalyzing effect on variety creation, which has been regarded as a source of competitiveness (Jacobs 1969; Glaeser et al. 1992; Van Oort 2002). In our analysis we control for these regional features but also allow for a moderating effect when investigating the impact of firm dynamics on regional productivity growth. In accordance to the findings of Fritsch and Schroeter (2008), who analyze several regional characteristics we expect a positive impact of firm dynamics in particular for regions with higher population density and higher related variety.

Data and Methodology

Until now, most regional studies linking entrepreneurship with economic growth have measured entrepreneurship as firm formation rates and regional competitiveness as employment growth (Van Stel and Storey 2004; Acs and Armington 2004). Both indicators are open for improvement. First, these studies are inspired by Schumpeter's (1934; 1942) work on the mechanisms of economic development, in which the role of entrepreneurship was central. Although these studies in general equate entrepreneurship with new firm formation, originally Schumpeter's (1942) theory of "creative destruction" involved both creation (new firm formation) *and* destruction (firm exit). This latter aspect reflects the selection mechanism that is a crucial outcome of the process of competition and a cause of competitiveness and economic growth. In this paper we analyze entry rates, but also take into account the combined measure of entrepreneurship - i.e. turbulence rates defined as the sum of entry and exit rates.[4] As regards measuring firm dynamics, the sectors under consideration are situated in a certain territorial context. In this study we adopt the regional approach and specify firm dynamics (entry and turbulence) relative to the stock of firms in two different sectors.

Regional competitiveness is a popular term but hard to define (Kitson et al. 2004). Even though employment growth is indeed an important element of economic development, competitiveness might better be measured with productivity growth, reflecting increasing economic efficiency within firms and regions.[5] Authors like Porter (1990; 1998) and Krugman (1990) have made a plea for using productivity as the indicator of competitiveness. A rising standard of living in the long run depends on the productivity with which resources are employed. An important empirical drawback of this indicator is that there is hardly any data available at the sub-national scale (Kitson et al. 2004), and from industries other than manufacturing (Van Ark et al. 1999; Bartelsman and Doms 2000). Another possible drawback is that it might reveal perverse effects, when labor shedding (e.g. with an extensive shakeout of workers and closure of plants) is the cause of improved (labor) productivity. Ideally, both employment growth and productivity growth should go together: a virtuous circle of increasing productivity causing improved competitiveness, which leads to higher demands of the goods and services produced, which then leads to an increased demand for labor inputs.

In addition to these measurement issues, there is also a need for improving the insight in the role of creative destruction in the service sector. Although the service sector has become much more dominant than manufacturing in capitalist economies, most studies on productivity growth are based on studies in the manufacturing sector.

[4] Turbulence rates are often also defined as firm turnover rates, see e.g. Caves (1998).

[5] Competitiveness is often measured with either employment growth or growth in total factor productivity (TFP). There are some notable differences between these measures of growth. For example, during recessions the efficiency measures by managers in incumbent firms might lead to employment loss and TFP growth on the short term. On the medium term, unemployment push entrepreneurship might absorb the employment loss, and decrease TFP.

Dataset

We have specified two sectors: manufacturing (ISIC 15-37) and services (ISIC 65-74, 85, 90-93). The distinction between these two major sectors is primarily data-driven, i.e. the limited availability of TFP data in the Netherlands. As a result we are unable to disaggregate the data into more specific industries.[6] We prefer a measure of TFP rather than labor productivity because capital deepening may have a serious impact and labor productivity would therefore be biased. We have used the most suitable level of territorial aggregation for the Netherlands: the Corop-level of analysis (EU Nuts 3) (cf. Van Stel and Nieuwenhuijsen 2004; Kleinknecht and Poot, 1992). The division in 40 Corop-regions is based on regional commuting patterns that indicate regional labor markets.

For deriving TFP growth, data on annual employment, value added and investment at the regional level have been taken from Statistics Netherlands. The capital stock has been calculated using the Perpetual Inventory Method (PIM, see e.g. Hall and Mairesse, 1995). An initial regional capital stock level for 1989 was derived based on investments on the regional level for 1977-1988 and assuming a constant annual growth rate g of investments in the period before 1977; this growth rate g was estimated at 4.5% using available time series data on investments between 1960 and 1976. The capital stock for every following year has been calculated as the sum of the depreciated capital stock, plus investments in the current year. The depreciation rates for both sectors have been estimated using the initial levels of the capital stock in 1989 and investment levels from 1960-1976 per region.[7]

The panel dataset on annual entry and exit and the total number of existing firms for the Netherlands in 40 regions is available for a 15 year period (1988-2002). Registrations and deregistrations are provided by the Dutch Chambers of Commerce. Entry includes

[6] As a robustness check we excluded five regions from the analysis in the manufacturing sector because their regional growth rates are heavily determined by extraction (gas and electricity), which could possibly interfere with our model since regional output may primarily be caused by one or two large companies. There appears to be no significant change in the results if we exclude these five regions.

[7] The derived depreciation rates were 5.8% for manufacturing and 4.7% for services.

independent new businesses as well as subsidiaries; exit includes bankruptcies as well as other modes of firm exit.[8] Unfortunately we cannot distinguish between exit due to business closure (varying from simply finishing economic activity to forced liquidation) and exit due to changes in ownership (i.e. mergers or acquisitions). Firm relocations within Corop regions are not counted as entry or exit. The dataset excludes inactive firms. The sector structure varies over the regions. In every region there are more firms in services as compared to manufacturing, with even higher concentrations of service firms in urban regions. The rate of service firms to manufacturing firms varies between 2 and 10. The importance of the services sector is clear if we examine levels of gross value added. Figure 1 shows the share of gross value added in services as a percentage of value added for manufacturing and services combined.

Two control variables reflect the nature of the region, and the possible economic advantages stemming from this: urbanization economies and Jacobs externalities. Urbanization economies are measured with population density. Population density is defined as the percentage of people in the region living in urbanized or highly urbanized areas, in 2000. Jacobs externalities are captured with the notion of related variety. This measure is introduced by Frenken et al. (2007) and involves both sector diversity (variety) and the degree to which the sectors are related. Entropy statistics have been used to calculate this measure. Related variety is thus measured for each region as the weighted sum of industrial variety (over 5-digit classes) within each of two digit classes (for a detailed description and formal computation see Frenken et al. 2007).

[8] We use a general measure of firm entry, and do – apart from the distinction between manufacturing and services - not focus on a specific type of entry. Aghion and Bossanova (2006), for instance, focus on entry of foreign firms. They argue that foreign firms are on average larger and more likely to enter at the technological frontier than domestic entrants, and are thus more likely to be a threat to incumbents, triggering a process of creative destruction. Our data does not enable us to test the differential impact of foreign entries.

Ideally we would require variables capturing urbanization and Jacobs externalities to vary over years, but unfortunately we only have a single year at our disposal for population density (2000) and two years for related variety (1996 and 2002). Including these determinants is still relevant since they vary only very limitedly over time[9]. As such they are useful for controlling for structural regional differences in explaining TFP growth, without making inferences on causality over time. The geographical pattern of both measures is shown in Figure 2.

INSERT FIGURES 1 & 2 ABOUT HERE

Table 1 shows descriptive statistics of our dependent and independent variables for services and manufacturing, while table 2 shows the correlation coefficients for both sectors. Averages over the 40 Dutch regions for TFP growth and firm dynamics are also depicted over five time frames. The average turbulence rates have risen gradually over the period 1988-2002, in particular in services. Although the turbulence rates are somewhat lower than Bartelsman et al. (2005) have found over the 1989-1994 period, the higher rate in the service sector as compared to manufacturing still holds. This is probably due to lower start-up costs in the service sector. There appears to be a substantial variation between these firm dynamics measures across regions, especially where turbulence is concerned.[10] Figure 2 and 3 picture these regional differences in turbulence rates for manufacturing and services. Since the business cycle may be affecting our analysis of productivity growth, we will account for business cycle effects in our regression model in order to minimize the possible effects of spurious correlations.

[9] Indeed the 1996 values appeared to be strongly correlated with the 2002 values. Because of the time frame explored in our study (1990-2002) we chose to include the 1996 level only.

[10] The F-statistics with respect to variance between regions for turbulence in services amounts to 20.7. In manufacturing the corresponding F-value is 9.0; all significantly different from zero (p>0.95).

INSERT TABLE 1 ABOUT HERE

INSERT TABLE 2 ABOUT HERE

INSERT FIGURES 3 & 4 ABOUT HERE

National and historical context

Since 1988 the annual number of new firms in the Netherlands has expanded enormously, which is confirmed by our data. The increase in the annual number of new firms has been promoted by several institutional changes (see also Bosma et al. 2005). One of the most important institutional changes is the so-called Wassenaar Treaty in 1982, which started a long period of constrained wage increases. These limited wage increases in the Netherlands may have contributed to the attractiveness of becoming self-employed.[11] Occupational choices are influenced by the risks of entrepreneurship (failure) versus those of wage employment (dismissal). In this respect the increased flexibility of the labor market in the Netherlands as a result of the 1982 Treaty has lowered opportunity costs of entrepreneurship. In addition, major general policy initiatives implemented in the past two decades include (i) a significant relaxation in the (old) Establishment Act of 1937, implemented in several steps between 1993 and 2006; (ii) a persistent effort to diminish administrative burdens for entrepreneurs (see Worldbank 2007); (iii) a modernization of the bankruptcy regulation, in particular enabling a timely interference in case of problems that challenge survival of the firm – both in terms of early closure of hopeless cases and in terms of providing assistance in

[11] This Treaty of Wassenaar resulted in long-term agreements between the national government, bodies representing employers and labor unions.

re-starting ventures; (iv) ongoing deregulation of several markets; and (v) a recent simplification of the juridical aspects associated with limited liability companies.

Although it is hard to establish the effect of this 'package' of policy initiatives conducive to entrepreneurship on observed entrepreneurial behavior empirically, the circumstantial evidence at least points in this direction. Bosma et al. (2008b) find entry rates, controlling for a range of determinants, to be significantly higher for the years after 1993 and attribute this to the Dutch policy and the relaxation of the Establishment Act in particular. Carree and Nijkamp (2001) find evidence for the Dutch retail sector: after the relaxation they found that the number of entries increased significantly, especially in the non-food retail sector. A joint characteristic of the policy package is that it is especially directed at the entry and exit of small firms. The policy measures will have limited success if the minimum efficient scale (MES) in the market is high and entry barriers remain accordingly. This argument is reflected in our distinction between manufacturing and services. In manufacturing the minimum efficient scale is much higher than in services (see Audretsch et al. 2004), and indeed new firm formation rates have grown less (if grown at all) as compared to services.

Empirical Model

Following Geroski (1989) and Calléjon and Segarra (1999) we model firm dynamics as a component of the total productivity in region *i* and year *t*, controlling for the effects of labor and capital. For region *i* and year *t*, the quantity of output (value added) Y_{it} is the result of the combination of capital and labor:

$$Y_{it} = F(A_{it}, K_{it}, L_{it}) \quad (1)$$

where output depends on the number of employees (*L*), the stock of physical capital (*K*) and a 'productivity index' (*A*) that captures the variations in production that are not attributable to changes in the use of labor and capital. More specifically, we specify equation (1) in growth rates, and assume constant returns to scale in terms of output in labor and capital:

$$\mathrm{d}y_{it} = \mathrm{d}a_{it} + \alpha \mathrm{d}l_{it} + (1-\alpha)_{it}\mathrm{d}k_{it} + \eta_{it}, \tag{2}$$

where the operator d reflects the growth rates and is expressed as first differences in logarithms. Suppose that the growth of the corrected productivity index (d*a*) can be modeled in several components for region *i* and year *t*: percentage changes in industry productivity which are constant over time and region (θ) and improvements in productivity resulting from firm dynamics (*FD*), the degree of related variety in the region (*RV*) and population density (*PD*). We minimize the danger of reversed causality by incorporating lagged effects of firm dynamics on TFP growth. This extension of equation (2) leads, after subtracting $\alpha_{it}\mathrm{d}l_{it} + (1-\alpha_{it})\mathrm{d}k_{it}$ on both sides to an expression in which the dependent variable is Solow's residual θ^{s}_{it}:

$$\theta^{s}_{\mathrm{it}} = \theta + \beta_1 FD_{i,t-p} + \beta_2 RV_i + \beta_3 PD_i + \varepsilon_{it} \tag{3}$$

$$\text{with } i \in (1,\ldots,n),\ t \in (T_0,\ldots,T),\ 0 \le p \le T - T_0$$

In our empirical analysis values of α are based on cost components (for argumentation see e.g. Griliches and Lichtenberg (1984, p. 486-488)). Advantage of this method is that weightings depend on region and sector. We control for general business cycle effects (affecting all regions) by including dummy variables representing every year of observation. Summarizing, equation (3) measures total factor productivity (TFP) growth or Solow's residual for region *i* in year *t* as the sum of: (i) technical industrial progress in the strict sense (θ), (ii) additional efficiency caused by firm dynamics (coefficient β_1), the degree of related variety (coefficient β_2) and population density effects (coefficient β_3). We also tested for spatial autocorrelation, i.e. the possibility that benefits in one region spill over to neighboring regions. To this end we examined the residuals by region (for separate years and averaged over the years) and examined the Moran's-I values, using a spatial weight matrix identifying each neighboring region. The Moran-I values indicated that spatial errors were not a problem in our models[12]. This finding is different from studies investigating the impact of entry rates on employment growth (e.g. Van Stel and Storey 2004; Fritsch and Mueller 2004; Van Stel and Suddle 2008). In our case with TFP as the dependent variable, size and significance of the Moran-I dramatically increase if we exclude year dummies in the regression.[13] To prevent multicollinearity problems, we do not model entry and exit together in one single model but use separate models for entry rates and the combined measure of turbulence. In line with arguments made in the theoretical section, we allow a time lag for entry but not for exit; exit of inefficient firms should have a direct positive impact on regional productivity growth.

We estimate equation (3) using ordinary least squares while including the lagged dependent variable. In addition, and as a test for robustness, we discuss a dynamic panel data regression in the Appendix. The panel nature of our data combined with the temporal correlation of some of our variables (hinting at the probability of spurious correlations) calls for the dynamic panel data estimation technique known as the GMM-sys estimator. GMM-sys is appropriate to our model, because it takes care of endogeneity issues exploiting the panel data structure. However, it comes at the cost of losing observations (degrees of freedom) and therefore we consider it as a check for robustness to our results using ordinary least squares.

[12] Using spatial weight matrices on distances rather than neighboring regions produced very similar results.
[13] This suggests that the (designed) spatial autocorrelation effect may unintentionally pick up some temporal autocorrelation as a result of business cycles. It is therefore important to account for business cycle effects.

Results

Estimation results of equation (3) are depicted in tables 3 and 4 for manufacturing and services respectively. The first two columns in both tables (model A) present the results of a basic model excluding moderating effects, for entry rates and turbulence rates respectively. Our analyses thus suggest that for the Netherlands, entry and turbulence rates are important drivers of productivity growth in services, but not in manufacturing.

We find some evidence of moderating effects of urbanization economies and Jacobs externalities, in particular for the effect of firm dynamics on productivity growth in services. Firm dynamics has an additional positive effect on productivity growth in regions with relatively high population density or relatively high related variety (see Table 2, models B and C). The moderating effect with related variety seems to dominate the effect with population density witness the outcomes in model D.

We also tested for the presence of a curvilinear effect in the sense that, at certain point, increases in entry or turbulence rates might *deter* rather than increase competitiveness. In this way 'optimal levels' of entry and turbulence can be derived, something Fritsch and Schroeter (2008) found for German regions but other studies have not been able to identify (see Robinson et al. 2006). The likelihood ratio test supports the relevance of the inclusion of a quadratic term ($p<0.05$) for services but not for manufacturing. Figure 3 describes the curvilinear effects for model C2 in services. The top of the curve indicating maximum effect occurs at turbulence rates around 15% whereas observed regional turbulence rates range from 7% to 22%. The maximum effect for entry rates occurs between 10% and 11%[14]. Figure 3 also displays the curve that would result from a relatively high and low degrees (plus and minus one standard deviation from the mean) of related variety, taking into account the

[14] The estimated maximum effect by Fritsch and Schroeter (2008), who also find an inverse U-shaped impact, occurs at a start-up rate of about 8%. However, the percentages are not directly comparable. First, their estimated curve is for Manufacturing, while we only find such a curve in Services. Second, their approach differs in that they use the workforce as a denominator when deriving entry rates, and use employment growth ads the dependent variable.

estimated negative effect of related variety (single effect) on regional productivity growth in services. Thus, Figure 5 gives the total picture of the combined effect of turbulence and related variety resulting from model C2, *ceteris paribus*.

INSERT FIGURE 5 ABOUT HERE

Results of the GMM-sys approach are shown in the appendix and confirm the main findings. Productivity growth in manufacturing seems to be driven mainly by restructuring of incumbents. In manufacturing the most spectacular improvements in TFP revealed to go hand in hand with severe decline in employment, indicating labor shedding processes. We tested some more alternative models. For instance, in accordance with the arguments on creative destruction in the theoretical section, we allowed exit rates to have a moderating effect on the impact of entry rates on TFP growth. We did not find evidence for this relationship, but this may be due to the high sectoral aggregation in our study. We also specified models with longer time lags in manufacturing (3-9 years). These did not improve the model fit and the effects of entry and turbulence were still insignificant.[15]. Allowing a one-year lag and a three-year lag for entry and turbulence to impact TFP growth in services resulted in very similar results as presented in Table 2.[16]

Discussion

Despite a long tradition of productivity studies and endogenous growth theory, it is still hard to explain productivity growth. In this article we have attempted to analyze the effects of firm entry and turbulence on competitiveness at the most relevant level of analysis, namely the region. We have used total factor productivity growth as a measure of competitiveness and

[15] Also, we did not find a polynomial lag impact structure that resembles the one discussed in Fritsch (2008) This lag structure is characterized by positive short-term employment effects (typically between 0-2 years) diminishing effects because of replacement effects that may even become negative (3-7 years) and positive long term (carrying capacity) effects surfacing only after that.

[16] Results of these additional analyses are not reported but available on request.

regressed this on firm entry and exit and TFP growth in manufacturing and services in regions in the Netherlands over a 14 year period. Our results suggest that firm entry and exit is important for regional competitiveness in services, but not in manufacturing.

Why do firm entry and exit in manufacturing not have a positive effect on TFP growth? One reason might be that productivity growth in manufacturing in the Netherlands is driven by a few large players, and that new entrants and firm exits only have marginal effects on aggregate productivity growth. This intuition seems to be confirmed by the relatively low explained variance of the statistical models of TFP growth in manufacturing in comparison to the services models. In addition, most studies on the effect of entry on TFP growth in manufacturing are based on data from the 1970s and 1980s, while our study is based on data from a much more recent period. In the recent decades productivity growth in manufacturing is increasingly driven by incumbents (due to industry restructuring, de-industrialization), while the contribution by new entrants (and exit) has declined over time (see Baldwin and Gu 2006). This might partly explain the differential outcomes of our study in comparison to other older studies on the role of entry in productivity growth in manufacturing.

One reason why entry and exit *do* have a positive effect on productivity growth in services may be the relatively low minimum efficient scale of service activities (see Audretsch et al. 2004), which means that (often small) entrants in services contribute more easily to productivity improvements of the sector than entrants in manufacturing. However, another study in the Netherlands found that young services firms are relatively inefficient, and do thus not directly contribute to productivity improvements in the sector (Bangma et al. 2004). This is consistent with other studies focusing at the firm level (Bartelsman and Doms 2000). This paradox can be explained by the difference in level of analysis. While entrants may, relative to incumbent firms, not be more efficient in the initial phase, their potential pressure may invoke incumbents in the same region to stay alert and improve their efficiency – in the extreme case this could even induce established companies to acquire new and promising firms or else to appropriate the new knowledge provided by the new firms, a process of creative construction. Such a spill-over process, although well-documented by the literature, is not acknowledged by directly comparing productivity rates at the firm level. The research design of our study enables the inclusion of potential spill-over processes by analyzing the effects of firm entry and exit at the regional level and allowing for time lags for the changes in firm dynamics to affect productivity growth. In comparison to the manufacturing sector where knowledge is generally more appropriable and patented more frequently, knowledge spillovers may take place more frequently in the service sector. Of course sectors are linked and it is conceivable that entry in services has an impact on regional productivity growth manufacturing. We did not account for this in our model and future research might take a closer look at these interlinkages.

We should note that we did not control for the innovativeness of entrants, which is an important part of the creative destruction story: entrants should potentially be innovative in order to destruct less innovative (or construct better) incumbents. Our approach basically assumes that an increase in entry rates goes together with an increase in innovative potential stemming from new firms. For innovative potential, creative *use* of technology that recently became available is just as relevant as *production* of innovation. Inklaar et al. (2003) for instance show that productivity growth is particularly high in ICT-using sectors. This also links to the policy conclusion for the Netherlands by Bartelsman (2004) where, commenting on Baumol (2004), he stresses that policy should not aim at entry or small businesses in general, but at "..the number of firms (…) that experiment with new methods to serve the market…" (Bartelsman 2004, p. 361). Future research might take a closer look on this and make an attempt to separate new firm activity with innovative potential from new firm activity that has no innovative potential - regardless of sector classification. Similarly, it will also be fruitful to explore different types of exit; in our study we were not able to distinguish between exits that recently entered the market and exits of firms that have been operational for several years. A distinction between voluntary and involuntary exit would also be highly relevant.

Policy makers increasingly aim at fostering entrepreneurship for stimulating the competitiveness of regions. Prior studies showed that entrepreneurship is an important vehicle for achieving employment growth in many settings. Our study for the Netherlands shows that entrepreneurship can be important for regional competitiveness. In order to increase the effectiveness of public policy in economies like the Netherlands one should perhaps not stimulate entry and possibly exit in general, but should focus at lowering the entry *and* exit barriers in the service sector. Also, policymakers should be aware that firm dynamics will have larger impacts on regional competitiveness in some regions, especially those with higher degrees of relatedness and, to lesser extent, higher population density. Finally, one should know where to stop when stimulating entrepreneurship; our results also indicate that *too* much entry can lead to decreases in competitiveness.

Acknowledgement:
The authors would like to thank Koen Frenken, Michael Fritsch, Frank Neffke, Richard Nelson, Roderik Ponds, André van Stel and two anonymous referees for comments on previous versions. Previous versions of this paper have been read at the International Schumpeter Society Conference 2006 (Sophia-Antipolis, Nice, 21-24 June 2006), and the DIME Workshop "Policy Implications from Recent Advances in the Economics of Innovation and Industrial Dynamics (Open University London, 15-16 December 2006). All errors are ours.

References

Acs, Z. J. & Armington, C. (2004).Employment Growth and Entrepreneurial Activity in Cities. *Regional Studies, 38*, 8, 911-927

Agarwal, R, Audretsch, D.B. & Sarkar, M.B. (2007). The Process of Creative Construction: Knowledge Spillovers, Entrepreneurship and Economic Growth, *Strategic Entrepreneurship Journal 1*, 263-286.

Aghion, P. & Bessonova, E. (2006). On entry and growth: Theory and evidence. *Revue de l'OFCE* June 2006: 259-278

Arellano, M. & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Review of Economic Studies*, *58*, 277–97

Audretsch, D.B. & Fritsch, M. (2002). Growth regimes over time and space. *Regional Studies, 36*, 113-124

Audretsch, D.B. & Keilbach, M. (2004a). Does Entrepreneurship Capital Matter? *Entrepreneurship Theory and Practice*, *28*, 5, 419-430

Audretsch, D.B. & Keilbach, M. (2004b), Entrepreneurship Capital and Economic Performance. *Regional Studies, 38*, 949-959

Audretsch, D. B., Klomp, L., Santarelli, E. & Thurik, A.R. (2004). Gibrat's Law: Are the Services Different? *Review of Industrial Organization*, *24,* 3, 301-324

Baily, M.N. & Chakrabarti, A.K. (1985). Innovation and Productivity in U.S. Industry. *Brookings Papers on Economic Activity, 2,* 609-639
Baily, M.N., Hulten, C. & Campbell, D. (1992). Productivity Dynamics in Manufacturing Plants. *Brookings Papers on Economic Activity: Microeconomics,* 187-267
Baldwin, J.R. & Gu, W. (2006). Plant turnover and productivity growth in Canadian manufacturing. *Industrial and Corporate Change, 15,3,* 417-465.
Bangma, K., Gibcus, P., Kuijpers, J. & De Wit, G. (2004). *Arbeidsproductiviteit in de Nederlandse dienstensector*. (Zoetermeer: EIM Business and Policy Research)
Bartelsman, E.J. (2004). Firm Dynamics and Innovation in the Netherlands; A comment on Baumol. *De Economist, 152,3,* 353-363
Bartelsman, E.J. & Doms, M. (2000). Understanding Productivity: Lessons from longitudinal microdata. *Journal of Economic Literature, 38,* 569-594
Bartelsman, E.J., Scarpatta, S. & Schivardi, F. (2005). Comparative analysis of firm demographics and survival: evidence from micro-level sources in OECD countries. *Industrial and Corporate Change, 14,* 365-391
Baumol, W.J. (2004). Four Sources of Innovation and Stimulation of Growth in the Dutch Economy. *De Economist, 152,* 3, 321-351
Blundell, R. & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics, 87,* 115–143
Bosma, N.S., De Wit, D. & Carree, M.A. (2005). Modelling Entrepreneurship: Unifying The Equilibrium and Entry/Exit Approach. Small Business Economics, *25,* 1, 35-48
Bosma, N.S. & Schutjens, V.A.J.M. (2007). Outlook on Europe: Patterns of Promising Entrepreneurial Activity in European Regions. *Tijdschrift voor Economische en Sociale Geografie, 98,* 5, 675-686
Bosma, N.S, Suddle, K. & Schutjens, V.A.J.M. (2008a). *Whither a flat landscape? Regional differences in Entrepreneurship in the Netherlands.* EIM SCALES Paper, nr. H200805 (Zoetermeer: EIM)
Bosma, N.S., Van Stel, A.J. & Suddle, K. (2008b). The Geography of New Firm Formation: Evidence from Independent Start-ups and New Subsidiaries in the Netherlands. *International Entrepreneurship and Management Journal, 4,* 2, 129-146
Braunerhjelm, P. & Borgman, B. (2004). Geographical concentration, entrepreneurship and regional growth: Evidence from regional data in Sweden, 1975-99. *Regional Studies, 38,* 8, 929-947
Breschi, S. & Lissoni, F. (2003). *Mobility and Social Networks: Localised Knowledge Spillovers Revisited.* CESPRI Working Papers 142 (Milano: CESPRI, Centre for Research on Innovation and Internationalisation, Universita' Bocconi)
Callejón, M. & Segarra, A. (1999). Business Dynamics and Efficiency in Industries and Regions: The Case of Spain. *Small Business Economics, 13,* 253-271
Camagni, R. (2002). On the concept of territorial competitiveness: sound or misleading? *Urban Studies, 39*, 13, 2395–2411
Carlin, W., Haskel, J. & Seabright, P. (2001). Understanding 'the essential fact about capitalism': Markets, competition and creative destruction. *National Institute Economic Review, 175,* 67-84
Carree, M.A. & Nijkamp, J. (2001). Deregulation in retailing: The Dutch experience. *Journal of Economics and Business, 53,* 2-3, 225-235
Carree, M.A. & Thurik, A.R. (2003). The impact of entrepreneurship on economic growth. (In Z.J. Acs & Audretsch, D.B. (Eds.), *Handbook of Entrepreneurship Research* (pp. 437-472). Dordrecht: Kluwer Academic Publishers).
Castells, M. & Hall, P. (1994). *Technopoles of the World: The making of 21st Century Industrial Complexes.* (London: Routledge)
Caves, R. (1998). Industrial Organization and New Findings on the Turnover and Mobility of Firms. *Journal of Economic Literature, 36,* 1947-1982
Dejardin, M. (2008). Linking Net Entry to Regional Economic Growth. *Small Business Economics,* AA, B, xxx-yyy (this issue)
Eliasson, G. (1996). *Firm Objectives, Controls and Organization.* (Dordrecht: Kluwer Academic Publishers).
Feldman, M.P. (2001), The entrepreneurial event revisited: Firm formation in a regional context. *Industrial and Corporate Change, 10,* 4, 861-891
Frenken, K., Van Oort, F. & Verburg, T. (2007). Related variety, unrelated variety and regional economic growth. *Regional Studies, 41,* 5, 685-697
Fritsch, M. & Mueller, P. (2004). The Effects of New Business Formation on Regional Development over Time. *Regional Studies, 38,* 961-975

Fritsch, M. & Schmude, J. (Eds.)(2006). *Entrepreneurship in the Region. International Studies in Entrepreneurship, 14* (New York: Springer Science)

Fritsch, M. & Schroeter, A. (2008). *Why Does the Effect of New Business Formation Differ Across Regions? Small Business Economics*, AA, B, xxx-yyy (this issue)

Geroski, P. A. (1989). Entry, Innovation and Productivity Growth. *Review of Economics and Statistics*, *71*, 572-578

Glaeser, E.L., Kallal, H.D., Scheinkman, J.A. & Shleifer, A. (1992). Growth in Cities. *Journal of Political Economy*, *100*, 6, 1126-1152

Griliches, Z. and F.Lichtenberg (1984). Productivity and R&D at the Firm Level. in: Z. Griliches (ed.), *R&D, Patents and Productivity*. Chicago: University of Chicago Press, 330-74.

Hall, B.H., and J. Mairesse (1995), Exploring the relationship between R&D and productivity in French manufacturing firms, *Journal of Econometrics*, 65, 263-293

Inklaar, R., O'Mahony, M., Robinson, C. & Timmer, M.P. (2003). Productivity and competitiveness in the EU and the US. In M. O'Mahony & B. van der Ark (Eds.), *EU productivity and competitiveness: An industry perspective* (pp. 73-147*).*(Luxembourg: Office for Official Publication of the European Communities)

Jacobs, J. (1969). *The Economy of Cities*. (New York: Random House)

Jaffe, A.B, Trajtenberg, M. & Henderson, R. (1993). Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations. *Quarterly Journal of Economics*, *108*, 3, 577-598

Jovanovic, B. (1982). Selection and the Evolution of Industry. *Econometrica*, *50*, 649-670

Kitson, M., Martin, R. & Tyler, P. (2004). Regional Competitiveness: An elusive yet key concept? *Regional Studies*, *38*, 9. 991-999

Kleinknecht, A. & Poot, T. (1992). Do regions matter for R&D? *Regional Studies*, *26*, 221-232

Kleinknecht, A. (1998). Is Labor Market Flexibility Harmful to Innovation? *Cambridge Journal of Economics*, *22*, 387–396

Krugman, P. (1990). *The Age of Diminished Expectations*. (Cambridge, MA: MIT Press),

Krugman, P. (2005). Second winds for industrial regions? (In D. Coyle, W. Alexander and B. Ashcroft (Eds), *New Wealth for Old Nations: Scotland's Economic Prospects* (pp. 35-47). Princeton: Princeton University Press)

Liu, L. (1993). Entry-exit, learning, and productivity change Evidence from Chile. *Journal of Development Economics*, *42*, 2, 217-242

Madsen, J.B. & Damania, R. (2001). Labor Demand and Wage-induced Innovations: evidence from the OECD countries. *International Review of Applied Economics*, *15*, 3, 323-334

Metcalfe, J.S. (2002). Knowledge of growth and growth of knowledge. *Journal of Evolutionary Economics*, *12*, 3-15

Michelacci, C. & Silva, O. (2007). Why so many local entrepreneurs? *The Review of Economics and Statistics*, *89*, 4, 615-633

Porter, M.E. (1990). *The Competitive Advantage of Nations.* (New York: The Free Press)

Porter, M.E. (1998). *On Competition.* (Boston: Harvard Business School Press)

Porter, M.E. (2000). Location, competition and economic development: local clusters in the global economy. *Economic Development Quarterly*, *14*, 15–31

Robinson, C., O'Leary, B. & Rincon, A. (2006). *Business start-ups, closures and economic churn. A review of the literature*. (London: National Institute of Economic and Social Research)

Roodman, D. (2006). *How to Do xtabond2: An Introduction to "Difference" and "System" GMM in Stata*. Working Paper 103 (Washington DC: Center for Global Development)

Schumpeter, J.A. (1934). *The Theory of Economic Development*. (Cambridge Mass: Harvard University Press)

Schumpeter, J.A. (1942). *Capitalism, Socialism and Democracy*. (New York,: Harper and Row)

Schutjens, V. & Stam, E. (2003). The Evolution and Nature of Young Firm Networks: A Longitudinal Perspective. *Small Business Economics*, *21*, 115-134

Stam, E. (2007). Why Butterflies Don't Leave: Locational Behavior of Entrepreneurial Firms. *Economic Geography*, *83*, 1, 27-50.

Stevenson, L. & Lundström, A. (2001). *Patterns and trends in entrepreneurship/SME policy and practice in ten economies*. Entrepreneurship Policy for the Future Series 3 (Stockholm: Swedish Foundation for Small Business Research)

Storper, M. (1997). *The Regional World: Territorial Development in a Global Economy*. (New York*:* Guilford Press)

Van Ark, B., Monnikhof, E. & N. Mulder (1999). Productivity in services: an international comparative perspective. *Canadian Journal of Economics*, *33* ,2, 471-499

Van Leeuwen, G. & Van der Wiel, H. (2003). *Do ICT spillovers matter?. Evidence from Dutch firm-level data.* CPB Discussion paper 26. (The Hague: CPB)
Van Oort, F. (2002). Agglomeration, economic growth and innovation; Spatial analysis of growth- and R&D externalities in the Netherlands. Dissertation Tinbergen Institute, Erasmus University Rotterdam
Van Stel, A.J. & Nieuwenhuijsen, H.R. (2004). Knowledge Spillovers and Economic Growth: An Analysis Using Data of Dutch Regions in the Period 1987-1995. *Regional Studies, 38,* 393-407
Van Stel, A.J. &. Storey, D.J. (2004). The Link Between Firm Births and Job Creation: Is there a Upas Tree Effect? *Regional Studies, 38,* 893-909
Van Stel, A.J. & Suddle, K. (2008), The Impact of New Firm Formation on Regional Development in the Netherlands. *Small Business Economics, 30,* 1, 31-47
Wennekers, A.R.M. (2006), Entrepreneurship at country level; Economic and non-economic determinants. Dissertation, Erasmus University Rotterdam
Wennekers, S. & Thurik, R. (1999), Linking entrepreneurship and economic growth. *Small Business Economics, 13***,** 27-55
Windmeijer, F. (2005). A finite sample correction for the variance of linear efficient two-step GMM estimators. *Journal of Econometrics, 126*, 25–51
Worldbank (2007)., *Review of the Dutch Administrative Burden Reduction Programme*. (Washington: Worldbank Group)

Figure 1 Turbulence rates in Manufacturing, by Nuts3 regions in the Netherlands, averages over 1988-2000

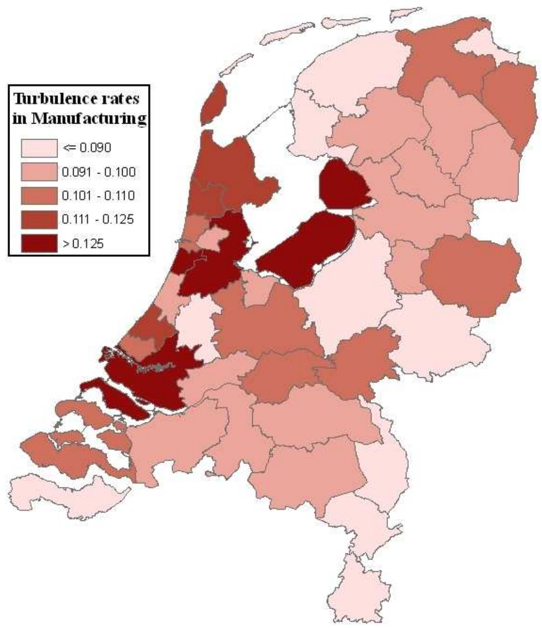

Figure 2 Turbulence rates in Services, by Nuts3 regions in the Netherlands, averages over 1988-2000

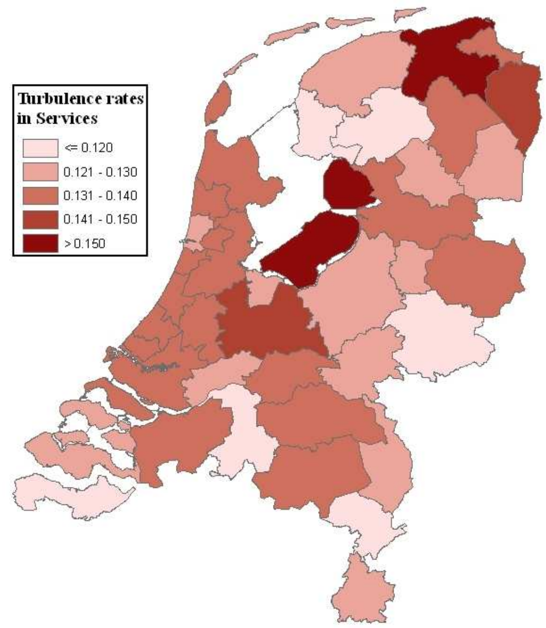

Figure 3 Related variety by Nuts3 regions in the Netherlands, in quartiles

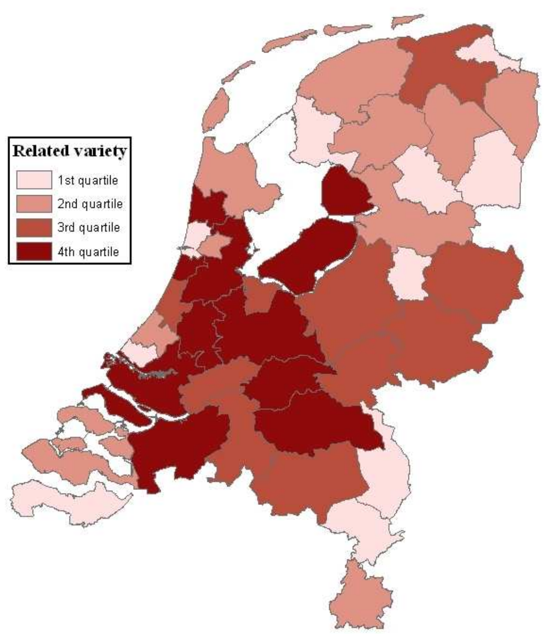

Figure 4 Population density, by Nuts3 regions in the Netherlands, in quartiles

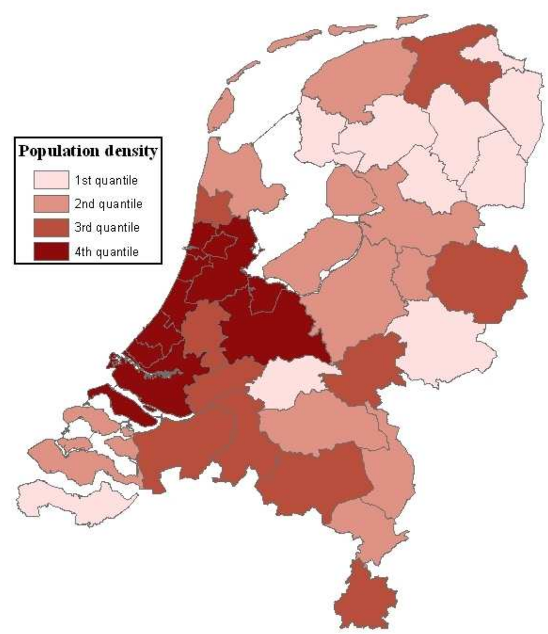

Figure 5. Graphical representation of curvilinear impact of firm dynamics on TFP and the moderating role of related variety in the region – based on coefficients Table 4, model C2.

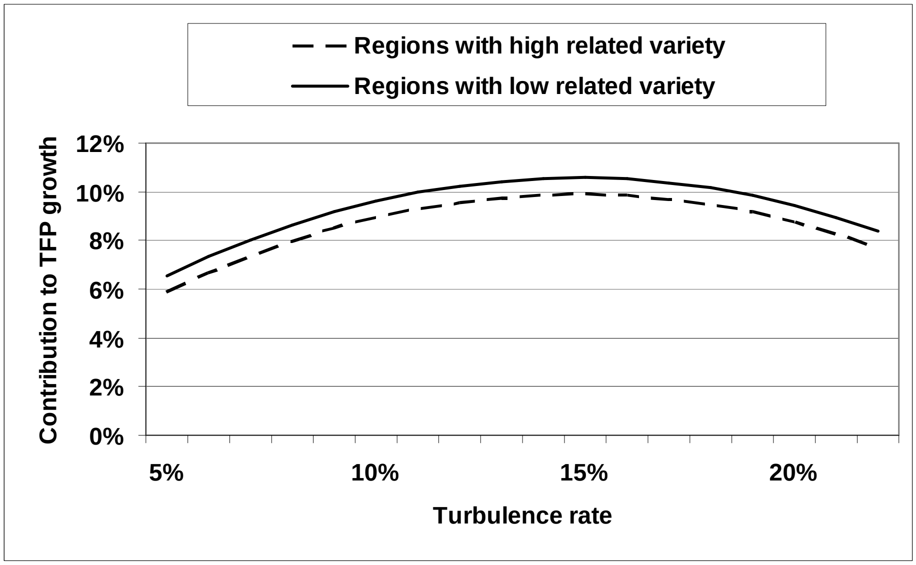

Table 1 Descriptive statistics of the variables used in this study, non-weighted averages

	Mean	St. .Dev	Averages over each time period 1990-1991	1992-1994	1995-1997	1998-2000	2001-2002
Manufacturing							
TFP	0.03	0.06	0.01	0.04	0.04	0.04	0.03
Entry (t-2)	0.06	0.02	0.06	0.06	0.06	0.07	0.06
Turbulence	0.11	0.03	0.09	0.10	0.11	0.11	0.10
Services							
TFP	0.00	0.02	0.00	0.01	0.00	0.00	-0.01
Entry (t-2)	0.09	0.02	0.09	0.09	0.09	0.10	0.11
Turbulence	0.13	0.03	0.11	0.12	0.13	0.15	0.16
Regional demography							
Population density	0.32	0.22					
Related Variety	0.93	0.09					

Table 2 Correlation Matrices

	Manufacturing 1.	2.	3.	4.	*Services* 1.	2.	3.	4.
1. TFP								
2. Entry (t-2)	0.06				-0.01			
3. Turbulence	0.06	0.71			-0.06	0.95		
4. Related variety	0.15	0.27	0.24		-0.03	0.23	0.16	
5. Population density	0.05	0.29	0.36	0.45	0.02	0.16	0.12	0.45

Table 3 Regression results for TFP growth in manufacturing.

	A1		A2		B1		B2		C1		C2		D1		D2	
Lagged dependent																
TFP (t-1)	-0.07		-0.07		-0.07		-0.07		-0.07		-0.07		-0.07		-0.07	
	(0.07)		(0.07)		(0.07)		(0.07)		(0.07)		(0.07)		(0.07)		(0.07)	
Firm dynamics																
Entry (t-2)	0.15				0.11				0.21				0.29			
	(0.16)				(0.17)				(0.16)				(0.17)			
Turbulence:			0.03				0.03				0.08				0.07	
Entry (t-2) + Exit (t)			(0.07)				(0.07)				(0.07)				(0.07)	
Regional demography																
Related variety	0.17	**	0.18	**	0.18	**	0.19	**	0.24	**	0.24	**	0.24	**	0.23	**
	(0.04)		(0.04)		(0.04)		(0.04)		(0.06)		(0.06)		(0.06)		(0.06)	
Population density	-0.01		-0.01		0.01		0.01		-0.01		-0.01		0.00		0.00	
	(0.01)		(0.01)		(0.01)		(0.02)		(0.01)		(0.01)		(0.02)		(0.02)	
Firm dynamics in regions With high levels of…																
Population density					-0.17	*	-0.20	**					-0.14		-0.14	
					(0.10)		(0.10)						(0.11)		(0.11)	
Related variety									-0.22	*	-0.21	*	-0.20		-0.16	
									(0.12)		(0.12)		(0.14)		(0.13)	
Constant	-0.14	**	-0.14	**	-0.15	**	-0.15	**	-0.20	**	-0.20	**	-0.21	**	-0.19	**
	(0.04)		(0.04)		(0.04)		(0.04)		(0.06)		(0.06)		(0.04)		(0.06)	
Number of obs.	511		511		511		511		511		511		511		511	
F statistic	5.15		4.95		4.90		4.69		5.00		4.78		4.75		4.52	
R^2	0.178		0.177		0.182		0.183		0.186		0.184		0.189		0.186	

Year dummies included but not reported. Robust standard errors in parentheses. Outliers (absolute value of standardized residuals > 2.5) are removed from the analysis
* p< .10, ** p< .05

Table 4 Regression results for TFP growth in services.

	A1		A2		B1		B2		C1		C2		D1		D2	
Lagged dependent																
TFP (t-1)	0.32	**	0.31	**	0.31	**	0.30	**	0.31	**	0.29	**	0.31	**	0.29	**
	(0.06)		(0.06)		(0.07)		(0.06)		(0.07)		(0.07)		(0.07)		(0.07)	
Firm dynamics																
Entry (t-2)	1.01	**			0.92	**			1.05	**			1.02	**		
	(0.42)				(0.42)				(0.42)				(0.42)			
Turbulence:			1.20	**			1.13	**			1.24	**			1.22	**
Entry (t-2) + Exit (t)			(0.32)				(0.32)				(0.32)				(0.33)	
Squared term	-4.54	**	-3.86	**	-4.12	**	-3.67	**	-4.93	**	-4.19	**	-4.90	**	-4.12	**
	(1.98)		(1.02)		(1.98)		(1.03)		(2.03)		(1.04)		(2.00)		(1.07)	
Regional demography																
Related variety	-0.00		-0.00		-0.01		-0.00		-0.04	**	-0.04	**	-0.04	**	-0.04	**
	(0.01)		(0.01)		(0.01)		(0.01)		(0.02)		(0.02)		(0.02)		(0.02)	
Population density	0.00		-0.00		-0.00		-0.01		0.00		-0.01		-0.00		-0.00	
	(0.00)		(0.00)		(0.00)		(0.01)		(0.00)		(0.00)		(0.01)		(0.01)	
Firm dynamics in regions																
With high levels of…																
Population density					0.04	*	0.03						0.02		0.01	
					(0.02)		(0.02)						(0.03)		(0.03)	
Related variety									0.06	**	0.08	**	0.07	**	0.08	**
									(0.03)		(0.03)		(0.03)		(0.03)	
Constant	-0.04	*	-0.08	**	-0.03		-0.07	**	-0.04		-0.07	**	-0.03		-0.07	**
	(0.02)		(0.03)		(0.02)		(0.03)		(0.03)		(0.03)		(0.03)		(0.03)	
Number of obs.	513		513		513		513		514		514		513		514	
F statistic	16.86		17.54		16.29		16.80		16.49		17.37		15.74		17.37	
R^2	0.379		0.381		0.382		0.391		0.379		0.392		0.381		0.392	

Year dummies included but not reported. Robust standard errors in parentheses. Outliers (absolute value of standardized residuals > 2.5) are removed from the analysis

* p< .10, ** p< .05

APPENDIX: Alternative Specifications Using Dynamic Panel Data Estimation Techniques

Estimates

Since we have a panel of regional observations, and temporal correlation of some of our variables is likely, it is appealing to employ the dynamic panel data estimation technique developed by Arellano and Bond (1991), and Blundell and Bond (1998) also known as the GMM-sys estimator. GMM-sys is appropriate to our model, not only because of potential endogeneity issues, but also because it includes a level and a difference equation. This implies that (i) potential multicollinearity issues arising from including multiple lags of independent variables are sufficiently dealt with, (ii) estimated effects are truly dynamic and (iii) it is still possible to control for regional effects – in our case related variety and population density.

The GMM-sys technique is particularly appropriate for panel data with a limited number of time observations. When the number of years increases, the number of instruments involved will increase exponentially and the GMM-sys technique becomes less applicable (Roodman, 2006). In this respect the length of our observed time period (14 years) is not particularly low relative to the number of regions. As a check for robustness, however, we do present our results based on GMM-sys estimation techniques. To this end we use the averages of non-overlapping periods; this implies we loose (time) observations but it renders the data more suitable for this kind of GMM panel data analysis. We use the two-step procedure and the finite-sample correction by Windmeijer (2005) in order to obtain robust estimation results. We compare our results with the outcomes using OLS techniques. The results for TFP growth are presented in tables A1 and A2. Firm dynamics seem to induce TFP growth in services but not in manufacturing. This is consistent with the OLS results in tables 2 and 3.

Table A1. Regression results for TFP growth in Manufacturing, non-overlapping periods:

Firm dynamics:	Turbulence		Entry	
	OLS	GMM-sys	OLS	GMM-sys
TFP (lagged)	-0.09	-0.06	-0.09	-0.08
	(0.08)	(0.10)	(0.08)	(0.08)
Firm Dynamics		-0.34		-0.66
		(0.54)		(1.26)
Firm Dynamics (lagged)	0.01	0.07	0.30	0.05
	(0.25)	(0.54)	(0.48)	(0.45)
Related variety	0.28**	0.40	0.27**	0.63
	(0.07)	(0.40)	(0.07)	(0.45)
Population density	-0.02	-0.11	-0.02	-0.08
	(0.03)	(0.16)	(0.03)	(0.21)
Spatial autocorrelation	0.01	-0.37	0.01	-0.47**
	(0.12)	(0.22)	(0.12)	(0.19)
Constant	-0.12*	-0.18	-0.13**	-0.45
	(0.07)	(0.57)	(0.07)	(0.56)
Number of observations	200	200	200	200
Number of instruments		40		40
F statistic	8.2	10.5**	8.3	17.8**
Adj. R^2	0.27		0.27	
AR(1) in first differences		-2.47**		-2.26**
AR(2) in first differences		-0.07		-0.45
Hansen test of overid. restrictions		25.2		24.5
Prob. > chi2		0.52		0.66

* p< .10, ** p< .05

Period dummies included (estimates not reported): 1990-1991, 1992-1994, 1995-1997, 1998-2000, and 2001- 2002

Note: all difference-in-Sargan tests of exogeneity of instrument subsets did not reject the Null hypothesis of exogenous instruments in the GMM-sys models. GMM-sys regressions were performed using Stata, xtabond2 procedure..

Table A2. Regression results for TFP growth in Services, non-overlapping periods

Firm dynamics:	Turbulence		Entry	
	OLS	GMM-sys	OLS	GMM-sys
TFP (lagged)	0.65**	0.31**	0.65**	0.45**
	(0.07)	(0.15)	(0.07)	(0.16)
Firm Dynamics		1.74**		1.71**
		(0.64)		(0.84)
Firm Dynamics (lagged)	0.05	-0.21	0.01	-0.36
	(0.13)	(0.56)	(0.18)	(0.73)
Related variety	-0.02	-0.15	-0.02	-0.13
	(0.03)	(0.18)	(0.03)	(0.15)
Population density	0.01	-0.00	0.01	-0.04
	(0.01)	(0.05)	(0.01)	(0.05)
Spatial autocorrelation	-0.25	-0.05	-0.25	-0.23
	(0.17)	(0.47)	(0.17)	(0.43)
Constant	0.03	-0.10	0.04	-0.04
	(0.03)	(0.28)	(0.03)	(0.21)
Number of observations	200	200	200	200
Number of instruments		40		40
F statistic	22.3**	20.0**	22.3**	25.3**
Adj. R^2	0.52		0.52	
AR(1) in first differences		-2.75**		-2.62**
AR(2) in first differences		-1.05		-0.88
Hansen test of overid. restrictions		27.9		32.8
Prob. > chi2		0.47		0.24

* p< .10, ** p< .05

Period dummies included (estimates not reported): 1990-1991, 1992-1994, 1995-1997, 1998-2000, and 2001- 2002

Note: all difference-in-Sargan tests of exogeneity of instrument subsets did not reject the Null hypothesis of exogenous instruments in the GMM-sys models. GMM-sys regressions were performed using Stata, xtabond2 procedure.