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An empirical analysis of business dynamics and growth

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ABSTRACT:

This paper examines the relationship between business dynamics (entry and exit of firms) and employment growth at the country-industry level. We use a cross-country data set with harmonized data on numbers of entries and exits for a selection of fast-growing and innovative industries in six developed economies. In our regression analysis we allow for separate effects of both the *extent* of business dynamics (volatility of firms) and the *composition* of business dynamics (net-entry of firms). We also test for the existence of an ‘optimal’ level of business volatility, possibly indicating that entry and exit levels are too high in certain industries. We find positive employment effects of net-entry rates and volatility rates. These effects are found to be considerably stronger for manufacturing compared to services. We find no evidence for an ‘optimal’ level of business volatility.

JEL-CODES: J23, L10, M13, O57

KEYWORDS: business dynamics, employment growth, entrepreneurship

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1. INTRODUCTION

Several studies argue that in the last 25 years the innovative advantage has moved from large, established enterprises to small and new firms, because new technologies have reduced the importance of scale economies in many sectors (*e.g.*, Meijaard, 2001). Also, an increasing degree of uncertainty in the world economy from the 1970s onwards has created more room for innovative entry (Audretsch and Thurik, 2000). New firms challenge incumbent firms by introducing new inventions that crowd out current technologies and products. In Schumpeter's theory of *creative destruction* not only entries are important but also exits. A high number of exits in an industry might reflect a process of intensive competition, *i.e.*, less-competitive incumbent firms being displaced by new firms. After exiting the market, the human and physical capital that was present in the displaced firms can be allocated more productively elsewhere in the economic process. Hence, both entry and exit are important aspects of business dynamics and both aspects may contribute to the economic performance of an industry.

A commonly used measure of the extent of business dynamics in an industry is turbulence, defined as the sum of entries and exits scaled on some measure of the size of the industry. Several authors study the effect of turbulence on industry performance (*e.g.*, Bosma and Nieuwenhuijsen, 2002). However, a pitfall of these studies is that the *composition* of turbulence is not taken into account: the separate numbers of entries and exits are not distinguished. This is important as the impacts of firm births and firm deaths are fundamentally different. For instance, the direct effect is positive for firm births and negative for firm deaths. The indirect effect (effect on incumbent firms) is also different.

In the current paper we analyse the effect of business dynamics on employment growth at the country-industry level, allowing for separate effects of both the extent and the composition of business dynamics. The *extent* of business dynamics is an adjusted measure of turbulence, called volatility, while the *composition* is measured as net-entry (entry minus exit). Using both these measures enables to distinguish between situations of high net-entry and low volatility, possibly indicating high survival rates, and situations of low net-entry and high volatility, possibly indicating lower survival rates but more fierce competition (displacement). As these situations may have very different implications for economic growth, it is important to measure the effects of net-entry and volatility separately.

The current paper claims to make three advances on prior work. *First*, we make a distinction between the extent and the composition of business dynamics and include measures for both these aspects of business dynamics in a multiple regression model explaining employment growth. *Second*, we use a unique cross-country data set with harmonized data on numbers of entries and exits for a specific selection of fast-growing and innovative industries. It may be argued that the impact of business dynamics on growth is particularly important for these industries. *Third*, we test for the existence of an 'optimal' level of business dynamics. Such

an optimal level might exist in certain industries if entry and exit levels are too high, possibly indicating that survival probabilities of new firms are too low.

The organization of this paper is as follows. In section 2 we give an overview of the theory and earlier work. Section 3 provides a discussion of the pros and cons of various business dynamics indicators. Next, we present our data and discuss our model. Results are presented in section 5, while the final section is used for discussion.

2. THEORY AND EARLIER EMPIRICAL FINDINGS ¹

The role of business dynamics (entry and exit of firms) in economic development was first studied by Schumpeter (1934). According to his theory of *creative destruction*, growth, innovation and business dynamics are inherently connected. The economy develops through a process of competition and selection. Firms gain an advantage through innovation and in doing so they achieve excess profits, which encourages imitation and entry. As a result, average profits drop and the firms are stimulated to innovate again. As not all firms have the ability 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. Besides, they may force incumbents to perform better because of intensified competition.² Hence, the newcomers do not have to be successful themselves in order to contribute to economic development. As far as entry induces improvements on the side of the incumbents, it generates positive effects for the economy even if the new businesses fail and have to exit the market soon after entry (Fritsch and Mueller, 2004). Exiting firms are also important because they create room for new entries. Hence, exiting firms may also contribute to economic growth although their contribution is indirect. In sum Schumpeter states that a high level of business dynamics contributes to economic growth because of its role in selection and innovation.

Several studies have investigated the impact of business dynamics on economic growth. However, the empirical evidence is mixed. This may be caused by the use of different measures for business dynamics as well as for economic growth (Fritsch and Mueller, 2004). Furthermore, the relationship may change over time. Most studies use the regional gross startup rate (number of startups scaled on some measure of the size of the region) as measure of business dynamics. Positive associations between this measure of business dynamics and regional employment change are found for the United States by Reynolds (1999) and Acs and

¹ The first paragraph of this section is based on Bosma and Nieuwenhuijsen (2002).

² For instance, incumbents imitate innovations made by new firms. The incumbent firms are also stimulated to innovate themselves. Furthermore, to resist the threat of startups, incumbents lower their prices, which, in turn, increases demand for products and services. An overview of the various ways in which incumbents are influenced by startups is provided by Verhoeven (2004). He also presents a scenario analysis of how startups may affect aggregate labor productivity, taking into account both direct and indirect effects (influence on incumbents).

Armington (2004). Ashcroft and Love (1996) find a positive effect for Great Britain in the 1980s. However, Van Stel and Storey (2004), investigating the same relationship for Great Britain, find no such positive effect for the 1980s. Moreover, for one region, the North East of England, they find a negative effect. For the 1990s however, Van Stel and Storey do find a significantly positive effect of the number of startups on regional employment change in Great Britain. Audretsch and Fritsch (2002) find similar results for West-Germany: no effect in the 1980s and a positive effect in the 1990s. The above findings illustrate that there is no consensus in the empirical literature about the exact nature of the relationship.

A further reason for the mixed results between different studies, even when the same countries and the same periods are investigated, may be the different modeling of the time lag involved in the relationship between business dynamics and economic growth. It takes time for new firms to actually contribute to economic growth. According to Caves (1998) turnover from entry and exit makes only a small contribution to economic performance of industries in the short run, but the contribution of entry-exit turnover is far more important in the long run. Two aspects are involved here. *First*, it may take a new firm a couple of years to expand. *Second*, it also takes time to become competitive enough to actually challenge the incumbent firms, forcing the latter to perform better.³ Hence, it may be important to account for a considerable time lag when modeling the relationship. Whereas in most studies the relationship is examined either with no time-lag or with only a short period lag, two recent studies explicitly investigate the time lag of the effect of new firm formation on regional employment change. Van Stel and Storey (2004) report that the effect of new firms is strongest after five years for Great Britain, while Fritsch and Mueller (2004) report an optimal lag of eight years for West-Germany.

Although most studies investigate the relationship between business dynamics and economic growth at the economy-wide level, some studies investigate the relationship also at the sectoral level. For instance, Bosma and Nieuwenhuijsen (2002) investigate the impact of turbulence (sum of entries and exits) on growth of total factor productivity for Dutch regions in the period 1988-1996. They find a positive effect for services and no effect for manufacturing. Acs and Armington (2004) find a similar result for regions in the United States in the period 1991-1996. According to Geroski (1995) entry is not important for employment growth in manufacturing.

Because of these observed differences between services and manufacturing, these sectors will be studied separately in this paper. For a more extensive overview of the empirical evidence we refer to Carree and Thurik (2003) and Verhoeven (2004).

³ In the Netherlands, it takes 7 to 8 years before the productivity level of a new-firm startup equals that of an average firm (Verhoeven, 2004).

3. MEASURING BUSINESS DYNAMICS

Both entries and exits are important aspects of business dynamics. New-firm startups (entries) contribute to economic growth by increasing competition and introducing new innovative products. Exiting firms are also important, as high numbers of exits might reflect a process of intensive competition, *i.e.*, incumbent firms being displaced by new firms entering the market or non-surviving newcomers forcing incumbents to perform better (Fritsch and Mueller, 2004). Three indicators are often used in empirical work relating the extent of business dynamics to the level of economic growth. These indicators are turbulence (entry plus exit), net-entry (entry minus exit) and gross-entry.

Although various studies use turbulence or net-entry as indicator for business dynamics, it should be noted that there are important disadvantages attached to using combinations of entry and exit. This relates to the fact that employment impacts of births and deaths are fundamentally different. The biggest difference in the employment impact of births and deaths is obvious from the *direct* effect. The direct employment effect of births is positive whereas the direct effect of deaths is negative. The different employment impacts of births and deaths make combined indicators like net-entry or turbulence less appropriate, as various authors report. Ashcroft and Love (1996, p. 491) state that “a given change in the stock of firms may have a different impact on employment according to the composition of the stock change. The net employment impact of births and deaths is likely to differ so it is inappropriate to constrain their individual effect to be the same, which is the consequence of defining firm births in net terms”. In a study for West-Germany, Fritsch (1996) considers turbulence, net-entry and gross-entry. He states that, due to the often observed high correlation between entries and exits (reflecting processes of displacement and replacement), “the turbulence indicator primarily represents the impact of entries on economic development” (p. 247).

These problems involved in using combinations of entry and exit can be avoided by using the gross startup rate, which is indeed used in most studies investigating the relationship between business dynamics and economic development. However, this measure may still reflect different economic situations. For instance, a relatively high number of startups might reflect that there were too few firms in the market to begin with, *i.e.*, that the ‘carrying capacity’ of the market was not yet reached (Carree and Thurik, 1999). Alternatively, it might reflect fierce competition between newcomers and incumbents, battling for market share. In the latter case, the number of exits is expected to be higher than in the former case. The two situations might have very different implications for economic growth and hence, using the gross startup rate is still not ideal.

Ideally, in a regression model explaining some measure of economic growth, a researcher would like to incorporate both a measure of the *extent* of business dynamics (*e.g.*, turbulence) and a measure of the *composition* of business dynamics (*e.g.*, net-entry) in the model, as both

aspects are important in their own right. However, in reality, net-entry and turbulence are heavily correlated which makes inclusion of both these measures inappropriate due to multicollinearity (note that the absolute value of net-entry is a lower bound for turbulence).

We will use a measure of turbulence that is corrected for the value of net-entry. This corrected measure is called business volatility and is defined as turbulence (entries plus exits) *minus* the absolute value of net-entry. It is supposed to reflect the degree of turbulence that did not account for the observed changes in the number of firms (Audretsch and Fritsch, 2002). Using this measure enables to include both the *extent* of business dynamics (volatility) and the *composition* of business dynamics (net-entry) in a single regression model.

4. DATA AND MODEL

International benchmark study

In this section we discuss our data. The various measures of business dynamics are constructed from data on numbers of entries and exits taken from a comparative study of seven countries in the period 1992-1999, conducted by EIM (Verhoeven and Bruins, 2001). In this benchmark study entry and exit data were gathered for a specific set of 15 industries within manufacturing and services, that were considered to be either innovative or fast-growing industries. The industries had to be young, innovative, and/or oriented on competition from abroad (either through import or export), in order to be selected. The 15 industries are listed in table 1. The impact of business dynamics on competitiveness was thought to be especially important for these industries (as they met the above-mentioned criteria). Hence, this selection of industries seems particularly appropriate for the purpose of our study.

For the selected industries data on numbers of entries and exits were gathered from research institutes in six countries: Belgium, Denmark, Germany, Japan, the Netherlands, and the United States.⁴ Data were taken from Chambers of Commerce, VAT-registers and social security records of these countries. As each country uses its own definition of entry and exit, the data had to be harmonized in order to be comparable across countries. For instance, in some countries formations of merger companies or movements of businesses to other regions are counted as new entries, while in other countries these types of changes in business demographics are not counted as new entries.

EIM harmonized the data and used as definition of entry the start of a new economic activity by a new entrepreneur in a new business (startup) or the start of a new economic activity by an incumbent firm in a new subsidiary company. Furthermore, new firms had to be *active* in

⁴ The United Kingdom was also included in the benchmark study of EIM. However, we exclude the U.K. as there were too many missing data for the purpose of our study. In particular, there were no data on business dynamics for the period 1994-1996.

order to be counted as entry. Per week, at least one person (owner/manager or employee) has to work in the new business for at least one hour and the business must generate positive turnover. In this way, merger companies, holding companies, corporations that were formed strictly for legal purposes, and the like, were not counted. The definition of exit was chosen consistent with the entry definition.

We use the entry and exit data on the 15 industries reported in table 1 for the six countries from the benchmark study. More details on this data set on entries and exits are in Verhoeven *et al.* (2001).⁵

⁵ An alternative cross-country data set on firm demographics is introduced by Bartelsman *et al.* (2003). They present a harmonized time series data base for ten OECD countries, containing information on entry, exit, survival and employment growth at the firm-level. Their analysis reveals that high technology manufacturing industries and some ICT related industries have higher entry rates than average. In particular, several of the industries listed in table 1 are reported to have higher than average entry rates. This supports our idea that the selection of industries used in the present study may be particularly appropriate for studying the relationship between business dynamics and employment growth. An important difference between the data set used in the present paper and the data set used in Bartelsman *et al.* is that firms without employees are included in the present study whereas they are excluded in Bartelsman *et al.* Actually, many of the data sets on startups that are used in the literature exclude firms without employees, such as, for instance, the data set used by Fritsch and Mueller (2004) for Germany, and the data set used by Acs and Armington (2004) for the United States.

Table 1 Industries used in this study

NACE REVISION 1.1 CODE	INDUSTRY
	MANUFACTURING
2416/17	Manufacture of plastics and synthetic rubber in primary forms
2441/42	Manufacture of basic pharmaceutical products and pharmaceutical preparations
3001/02	Manufacture of office machinery and computers
3110/20	Manufacture of electric motors, generators, and transformers, and electricity distribution and control apparatus
3210/20/30	Manufacture of radio, television and communication equipment and apparatus
3310/20/30/40	Manufacture of medical, precision and optical instruments
3530	Manufacture of aircraft and spacecraft
37	Recycling
15-37, excluding above eight industries	Other manufacturing
	SERVICES
51.6	Wholesale of machinery, equipment and supplies
64.2	Telecommunications
7210/20/30/40/60	Computer and related activities (excluding maintenance and repair of office machinery)
7310	Research and experimental development on natural sciences and engineering
7420/30	Architectural and engineering activities and related technical consultancy; and technical testing and analysis
72-74, excluding above three industries	Other business services

Source: EIM

Model

In our multiple regression analysis we will explain the variation in employment growth rates by net-entry and volatility.⁶ Furthermore, country dummies and lagged employment growth are used as control variables. The dummy variables are included to control for country-specific effects not covered by the model.⁷ We also include lagged employment growth as an independent variable to correct for reversed causality, *i.e.*, country/industry combinations with high growth attracting new businesses. Even though we include lagged business dynamics indicators only, the employment impact of net-entry or volatility might be overestimated, due to positive path dependency in the economic performance of country/industry combinations (reflecting business cycle and industry life-cycle effects). We correct for this by including a lagged dependent variable.⁸

Although distinguishing between net-entry and volatility gives more insight than just using turbulence, interpretation of regression results is still not straightforward, particularly for net-entry. For instance, if a positive effect of net-entry on employment growth is found, what does that mean? It is conceivable that, in that case, new firms in industries with high net-entry rates are –on average– of a higher quality than new firms in industries with low net-entry rates. In this interpretation a higher net-entry rate would be consistent with a higher proportion of the new-firm startups surviving. This would signal a higher quality of the new firms, which, in turn, would have a positive impact on growth. In addition, the higher number of competing firms, which results from a high net-entry rate, positively affects industry growth. However, we have to be careful with this interpretation, for two reasons. *First*, a low net-entry rate does not necessarily mean that relatively many new firms did not survive. It may also reflect that incumbent firms were forced out of the market by the increased competition by the new firms. These possibilities cannot be distinguished using our data. *Second*, a positive effect of net-entry may also reflect an industry life-cycle effect. If demand for products and services produced by a certain industry is growing, then both the number of firms and employment in the industry increase, consistent with a positive coefficient. This

⁶ Data on value added growth or productivity growth were not available. Employment growth may not be the most ideal dependent variable. Although the Schumpeterian process of creative destruction leads to a replacement of less efficient firms with more efficient ones, these efficiencies may manifest themselves in terms of *labour-saving* productivity. Nevertheless, while such a labour-saving effect may occur, it also concurrently results in improved competitiveness as incumbent firms are forced to perform better in order to survive. This, in turn, may lead to rising market shares, for instance by way of a larger supply of different goods through innovation. These *indirect supply-side effects* make that the impact on industry employment can still be positive (Fritsch and Mueller, 2004).

⁷ We do not include industry dummies. Structural differences between industries are partly captured by the lagged dependent variable. Also, the model is estimated separately for manufacturing and services.

⁸ The concept of using lagged dependent variables to correct for reversed causality is known in the econometric literature as Granger-causality. The Granger (1969) approach to the question of whether *x* causes *y* is to see how much of the current *y* can be explained by past values of *y* and then to see whether adding lagged values of *x* can improve the explanation. *y* is said to be Granger-caused by *x* if *x* helps in the prediction of *y*, or equivalently if the coefficients on the lagged *x*'s are statistically significant (Audretsch *et al.*, 2001).

would not necessarily imply that the new firms are of an above-average quality. However, the industry life-cycle effect is –at least in part– captured by the lagged dependent variable.

Variables and sources

The definitions of the variables used in this paper and their data sources are listed below.

- Average annual employment growth rates are measured over the period 1997-2000 (dependent variable) and 1994-1997 (lagged dependent variable).

- Turbulence rate: this is the summation of the numbers of entries and exits, scaled on the stock of businesses.

- Net-entry rate: this is the difference between the numbers of entries and exits, scaled on the stock of businesses.

- Volatility rate: this is turbulence minus the absolute value of net-entry, scaled on the stock of businesses.

The three indicators of business dynamics are all measured over the period 1994-1996. We use a three-year average to correct for outlier years, and we measure business dynamics in a period prior to employment growth (*i.e.*, we use a time-lag) in order to obtain the correct direction of causality.

The source of all four above-mentioned variables is the international benchmark study conducted by EIM (Verhoeven and Bruins, 2001).

Descriptive statistics

As mentioned, we use data for six countries and 15 industries, yielding a maximum number of observations of 90. However, for some country/industry combinations data on business dynamics were missing, especially for Japan. Furthermore, there was one clear outlier, the telecommunications industry in the United States, which has values for turbulence and volatility greater than one.⁹ This observation is removed as well. We end up with a data set of 78 observations.

Means and standard deviations of business dynamics indicators for our sample are presented in table 2, both by country and by sector. We see that turbulence, net-entry and volatility are higher for services industries than for manufacturing industries. This reflects the fact that it is easier to start a new business in services than in manufacturing, as –in general– less startup capital is required.

⁹ In their study for ten OECD countries Bartelsman *et al.* (2003) also find very high entry rates for this industry. They give two explanations for this: *first*, the privatization of telecoms in a number of countries that has led to the entry of a number of new private operators, and *second*, the rapid increase in the number of firms operating in the communications area, related to the spread of Internet and e-commerce activities.

When looking at the data per country, we notice two interesting cases. The United States shows a very high value of volatility and a below-average value of net-entry.¹⁰ This pattern might reflect a process of intense competition where the strongest firms are selected through the market mechanism. This, in turn, might result in high growth rates. Alternatively, however, it might reflect that survival rates of new firms are (too) low, for instance because entry barriers are too low. This would imply lower growth rates. For the Netherlands we see a reverse pattern: volatility is relatively low while net-entry is relatively high. The high net-entry rate might reflect a higher probability of survival of new firms, possibly indicating a higher quality of the new firms.¹¹ However, the low volatility might point to a lack of competition, possibly indicating that there is not enough pressure from the market for new and incumbent firms to increase their performance.

In our empirical analysis we try to find out which of the two patterns is more conducive to economic growth. To this end we will include both net-entry and volatility in our regression model.

¹⁰ Germany has a relatively high average volatility rate as well. This is caused mainly by two industries with values above 0.6: telecommunications and recycling.

¹¹ It may also reflect industry life-cycle effects.

Table 2 Means and standard deviations of business dynamics indicators by sector and country

	Turbulence rate	Net-entry rate	Volatility rate
Manufacturing (46)	0.160 (0.128)	0.022 (0.054)	0.122 (0.110)
Services (32)	0.288 (0.184)	0.085 (0.080)	0.202 (0.143)
TOTAL (78)	0.212 (0.165)	0.048 (0.073)	0.155 (0.130)
Belgium (15)	0.129 (0.061)	0.027 (0.046)	0.095 (0.039)
Denmark (14)	0.184 (0.084)	0.023 (0.096)	0.127 (0.059)
Germany (15)	0.295 (0.261)	0.082 (0.074)	0.213 (0.194)
Japan (6)	0.121 (0.051)	0.018 (0.055)	0.080 (0.042)
Netherlands (15)	0.206 (0.123)	0.083 (0.074)	0.123 (0.065)
United States (13)	0.293 (0.186)	0.033 (0.046)	0.257 (0.167)
TOTAL (78)	0.212 (0.165)	0.048 (0.073)	0.155 (0.130)

Source: EIM. Note: Figures between brackets are numbers of observations (first column) or standard deviations (second to fourth column). Statistics for manufacturing and services are based on pooled country/industry data of the respective industries listed in table 1 (unweighted averages).

Correlations between business dynamics indicators

In section 3 it was described that turbulence and net-entry should not be used in one and the same regression model because of problems of multicollinearity. Therefore, we use a corrected measure of turbulence, volatility. As an illustration table 3 presents correlation coefficients between turbulence, net-entry and volatility for our data sample of 78 observations. We see that correlations between net-entry and *turbulence* are indeed strong and highly significant, while the correlation between net-entry and *volatility* is much weaker. This underlines the need to correct the turbulence rate for the impact of net-entry.

Table 3 Correlations between business dynamics indicators, by sector

	Manufacturing (46 observations)			Services (32 observations)		
	Turbulence	Net-entry	Volatility	Turbulence	Net-entry	Volatility
Turbulence	1			1		
Net-entry	0.519 ***	1		0.669 ***	1	
Volatility	0.942 ***	0.274 *	1	0.911 ***	0.304 *	1

*** Significant at 0.01 level. ** Significant at 0.05 level. * Significant at 0.10 level.

5. RESULTS

The regression model is estimated separately for manufacturing and services, using OLS. For both sectors we use a pooled estimation sample, containing the respective industries for the six countries listed in table 1. Results are shown in tables 4 and 5. Each table contains four model specifications. We start by including net-entry only (model I). Next, we add volatility (model II).

Extremely high entry and exit rates in an industry may reflect that survival probabilities are too low, and that the industry attracts too many ‘marginal’ entrepreneurs, absorbing capital and human energy that could have been allocated more productively elsewhere (Carree *et al.*, 2002). This would imply that volatility can actually be too high (possibly indicating that entry barriers are too low), and that from a certain level of volatility onwards, further increases may have a negative effect on growth. This would be consistent with the existence of an *optimal* level of volatility. To test this we also include a squared volatility term (model III). If the parameter estimate of the linear volatility term is positive and the estimate of squared volatility is negative and significant, this implies that there is a level of volatility beyond which further increases negatively influence growth.¹²

Although the absolute value of net-entry is corrected for in the volatility rate, the two measures are still correlated, both for manufacturing and services (see table 3). Therefore, we are also interested in the results when including a combined measure such as turbulence. This enables comparison between specifications using measures for both the composition and the extent of business dynamics on the one hand, and specifications using a combined measure on the other hand. The results of the turbulence specification are in the last column of tables 4 and 5 (model IV).

Manufacturing

Model IV in table 4 shows that turbulence has a significantly positive effect on employment growth for manufacturing industries. From model II we see that this result reflects positive effects of both net-entry and volatility. The positive effect of net-entry might reflect that high survival probabilities are important for achieving industry growth. However, as described in section 4, we have to be careful in interpreting the effect of net-entry. The positive effect of turbulence (volatility) suggests that a process of ‘creative destruction’ as described by Schumpeter (1934), may indeed be a requirement in manufacturing industries of modern economies for achieving growth. Innovating new firms challenge incumbent firms by introducing new inventions that render current technologies and products obsolete. The significantly positive effect of volatility underlines the importance of variety and selection through the market in this process. Strong competition between new ideas (either new products or new processes) being exploited by different firms, makes that the best ideas, and

¹² This optimal level could then be calculated as $-b/2a$, where a and b are the parameter estimates of volatility squared and volatility, respectively. At this volatility level the effect on growth is maximised.

hence the best firms, survive in the market.¹³ The high quality of the surviving firms, in turn, positively affects economic growth.

From model III –which includes volatility squared– it is clear that we have not found evidence for the existence of an ‘optimal’ level of volatility in manufacturing. Inclusion of the squared term does not lead to an increase of adjusted R² and t-values for both the linear and the squared term are low. Hence, there are no indications that volatility levels are too high for the manufacturing industries in the countries that we consider.

Table 4: Estimation results MANUFACTURING, dependent variable growth of employment

	Model I	Model II	Model III	Model IV
Constant	-.005 (0.2)	-.055 (1.6)	-.029 (0.6)	-.054 (1.6)
Net-entry	.48 * (1.8)	.45 * (1.8)	.44 * (1.7)	
Volatility		.28 ** (2.3)	.012 (0.0)	
Volatility squared			.45 (0.7)	
Turbulence				0.28 ** (2.5)
Lagged growth	.23 ** (2.0)	.12 (1.0)	.094 (0.8)	.16 (1.3)
Adjusted R ²	.163	.253	.243	.223
Observations	46	46	46	46

Note: Absolute t-values are between brackets. Dependent variable is average annual employment change 1997-2000. Lagged growth is average annual employment change 1994-1997. Turbulence, net-entry, and volatility rates are averages over the period 1994-1996. Country dummies not reported.

*** Significant at 0.01 level. ** Significant at 0.05 level. * Significant at 0.10 level.

Services

Model IV in table 5 shows that there is also a positive effect of turbulence on employment growth for services industries. Again, this reflects positive effects of volatility and, to a smaller extent, net-entry (model II). The coefficient of net-entry is not significant though. Model III provides no evidence for the existence of an ‘optimal’ volatility rate in the services industries, as t-values for both the linear and the squared term are low.¹⁴

¹³ Indeed, the manufacturing sector is known as a very competitive sector in the sense that there is not only domestic competition but also a considerable amount of competition from abroad. Hence, both new firms and incumbents have to be innovative in order to survive.

¹⁴ In part this is caused by the removal of the US telecommunications industry from the sample (see section 4). Estimation results of a test regression for a sample which included this observation, implied that for telecommunications in the United States the volatility rate could be considered suboptimal (*i.e.*, too high).

Table 5: Estimation results SERVICES, dependent variable growth of employment

	Model I	Model II	Model III	Model IV
Constant	.045 * (2.0)	-.003 (0.1)	.026 (0.5)	-.005 (0.2)
Net-entry	.24 * (2.0)	.16 (1.4)	.13 (1.0)	
Volatility		.14 * (1.7)	-.060 (0.3)	
Volatility squared			.31 (0.9)	
Turbulence				.15 *** (2.8)
Lagged growth	.21 * (1.7)	.21 * (1.8)	.22 * (1.8)	.21 * (1.9)
Adjusted R ²	.339	.394	.388	.420
Observations	32	32	32	32

Note: Absolute t-values are between brackets. Dependent variable is average annual employment change 1997-2000. Lagged growth is average annual employment change 1994-1997. Turbulence, net-entry, and volatility rates are averages over the period 1994-1996. Country dummies not reported.

*** Significant at 0.01 level. ** Significant at 0.05 level. * Significant at 0.10 level.

Comparing tables 4 and 5 we notice that the effects of business dynamics on employment growth are stronger for manufacturing than for services. The coefficients for the business dynamics indicators are considerably higher for manufacturing in all four model specifications. Significance levels are also higher (model II). The weaker effect for services may be related to the different character of innovation in services, compared to manufacturing. In particular, innovations in service industries are often non-technological and they mostly involve small and incremental changes in processes and procedures (De Jong *et al.*, p. 16). To the contrary, innovations in manufacturing require more R&D and are more radical in nature. In modern economies radical innovation is more conducive to economic growth than incremental innovation. This is because industry life-cycles are shorter and hence, at a given point in time, more (niche) markets are in an early stage of the life cycle where R&D is highly productive and the costs of radical innovation tend to be relatively low (Audretsch and Thurik, 2001). Hence, a lack of business dynamics in manufacturing industries may be particularly damaging to economic performance, as it may imply a lack of incentives to create (radical) innovations.

We have seen that both net-entry and volatility contribute positively to growth at the country-industry level. Hence, judging from table 2, countries like Belgium and Japan should improve on both these aspects. We also observe that, although the United States is often considered the world's most dynamic economy (in terms of turbulence this is correct), there

is still room for improvement as the US has a below-average value of net-entry (both for manufacturing and for services).¹⁵

6. DISCUSSION

In this paper the relationship between business dynamics and employment growth has been examined for 15 fast-growing and innovative industries in six developed economies. Harmonized data on numbers of entries and exits are used from an international benchmark study conducted by EIM in 2001. In our multiple regression analysis we allow for separate effects of both the *extent* of business dynamics (volatility of firms) and the *composition* of business dynamics (net-entry of firms). We also test for the existence of an ‘optimal’ level of business volatility, possibly resulting from too high levels of entry and exit prevailing in certain industries. We find positive employment effects of net-entry rates and volatility rates. These effects are found to be considerably stronger for manufacturing compared to services. We find no evidence for an ‘optimal’ level of volatility.

Our study has two important research implications. *First*, in investigating business dynamics, it is important to make a distinction between the extent of business dynamics (volatility of firms) and the composition of business dynamics (net-entry of firms). Our paper shows that the relative importance of volatility and net-entry may differ across sectors. A *second* research implication is that the relationship between business dynamics and growth may be industry-specific, even within broader sectors such as manufacturing and services. For instance, the positive effect for manufacturing found in this study is in contradiction with earlier studies that did not find an effect of business dynamics on performance for manufacturing (Acs and Armington, 2004; Bosma and Nieuwenhuijsen, 2002). However, these two studies used the manufacturing sector as a whole as unit of analysis, while the present study used a specific selection of fast-growing and innovative industries. The industries in our study are young, innovative, and/or oriented on competition from abroad (either through import or export). The difference between the non-result in the earlier studies and the highly significant positive result found in the present study suggests that the process of creative destruction as described by Schumpeter may be particularly prevalent for manufacturing industries with these characteristics (*i.e.*, industries that are fast-growing and/or innovative). More research at sufficiently low sectoral aggregation levels is needed to be able to draw definitive conclusions about this conjecture.

Also some policy implications arise from our study. It is often argued by scholars and policy makers that high levels of business dynamics foster economic growth. This conjecture is

¹⁵ Bartelsman *et al.* (2003) report that entry size in the United States is smaller compared to that of most other countries in their data set and conclude that entrant firms in the United States are further away from the minimum efficient scale than entrant firms in most other countries. However, they also report higher post-entry employment growth amongst *surviving* firms in the United States, compared to other countries in their data set.

confirmed by the results of the present paper. We find that both net-entry and volatility are important for achieving growth. The positive effect of net-entry suggests that for the (manufacturing) industries used in this study, it may be good policy to focus on the quality of new-firm startups in order to increase survival probabilities of the new firms. For instance, a larger initial size of the startups might have a positive impact on the chances of survival, and ultimately on the performance of the industry (see Verhoeven, 2004, for evidence for the Netherlands). The positive effect of volatility implies that a process of competition between new ideas and market selection of the most innovative firms contributes positively to economic growth. To stimulate this process, entry barriers such as high administrative burdens and limited access to finance should be reduced in order to enable as many entrepreneurs as possible to pursue commercialization of their idea in the market. This stimulates the market selection process, which, in turn, positively affects the performance of the industry. A mixture of these different policies is probably the best way to go.

We also find evidence that the importance of business dynamics for achieving growth is higher for manufacturing than for services. The stronger effect for manufacturing may be related to the different character of innovation in manufacturing (more often radical), compared to services (more often incremental). In modern economies radical innovation is more conducive to economic growth than incremental innovation (Audretsch and Thurik, 2001). Hence, a lack of business dynamics in manufacturing industries may be particularly damaging to economic performance, as it may imply a lack of incentives to create radical innovations.

One has to bear in mind that the results found in the present paper apply to a specific set of industries (see table 1). Future research should investigate the relationship between business dynamics and growth for more industries at low sectoral aggregation levels. In this way we can see whether the results found in this paper may be generalized to the manufacturing and services sectors as a whole.

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