Scottish Journal of Political Economy

Scottish Journal of Political Economy, Vol. 59, No. 3, July 2012

FIRM GROWTH, EUROPEAN INDUSTRY DYNAMICS AND DOMESTIC BUSINESS CYCLES

*Harald Oberhofer**,**

Abstract

Based on the empirical firm growth literature and on heterogeneous (microeconomic) adjustment models, this paper empirically investigates the impact of European industry fluctuations and domestic business cycles on the growth performance of European firms. Since the implementation of the Single Market Program the 27 EU member states share a common market. Accordingly, the European industry business cycle is expected to become a more influential predictor of European firms' behavior at the expense of domestic fluctuations. Empirically, the results of a two-part model for a sample of European manufacturing firms reject this hypothesis. In addition, exporting firms and subsidiaries of multinational enterprises constitute the most stable firm cohort throughout the observed business cycle.

I Introduction

The global economy, especially industrialized regions, such as the United States of America (USA) and the European Union (EU), faced a severe downturn in the recent recession. From May 2008 onwards until the end of 2009, data of EU 27 total manufacturing industry production showed negative annual growth rates with a maximum (in absolute terms) of about −19.4% in April 2009 (Eurostat, 2010). At the same time, the harmonized unemployment rate increased from 6.8% in May 2008 to 9.6% in January 2010 (Eurostat, 2010). However, countries within the EU are asymmetrically affected by the recession. For instance, in July 2009 Ireland reported an annual total manufacturing industry production growth rate of 4.7%, whereas in Germany annual total manufacturing industry production declined by 17% (Eurostat, 2010).

In addition, some sectors within the European manufacturing industries seem to be more affected by the general downturn. For example, in the autumn of 2008 news on TV and in the print media stressed the dramatic downturn in the car manufacturing industry where prestigious producers, such

*University of Salzburg and Salzburg Centre of European Union Studies (SCEUS)
**The Austrian Center for Labor Economics and the Analysis of the Welfare State

as the US Ford Motor Company or the German Opel AG, struggled for their survival. In contrast, other manufacturing industries seemed to be confronted with regular cyclical production movements.

With the implementation of the Single Market Program (SMP) in the European Communities in 1992 the member states of the later EU committed themselves to dispose all remaining barriers to the free flow of goods, services, persons and capital. The SMP aims at finally constituting a single (European) market. Therefore, this common market potentially forms the target market for most firms located within the boundaries of the EU.[1] However, the domestic market might still be important, especially for small firms, as these firms most probably serve the domestic market only (see, e.g. Aw and Lee, 2008; Oberhofer and Pfaffermayr, 2012). However, given the observed variation in the cyclical behavior, it might be of special interest to what extent firms within the boundaries of the EU react to fluctuations in Europe-wide industry production and domestic business cycles.

For this reason, this study empirically analyzes the effects of fluctuations in European industry production and domestic total manufacturing production on firm growth.[2] In particular, this study contributes to the understanding of the influence of business cycles on firm growth in three ways: (1) It disentangles the impacts of (overall) European industry fluctuations and domestic business cycles, (2) it takes non-reaction of firms (i.e. zero growth rates) explicitly into account and (3) it distinguishes between purely domestically oriented and internationally oriented firms (i.e. exporting firms and subsidiaries of multinational enterprises (MNEs)). In addition, this study combines the empirical firm growth literature and heterogeneous (microeconomic) adjustment models, and tests for heterogeneous reaction to business cycle movements. The theoretical considerations and the structure of the European firm level data at hand (provided by AMADEUS database) support the use of a two-part model. Thereby, the first part of the model allows to investigate the probability of a reaction to business cycle fluctuations, whereas the second part examines the magnitude of the observed reaction.

Our empirical results suggest that domestic business cycles more accurately predict the probability of a reaction and the extent of the (non-zero) reaction, compared with European industry fluctuations. Furthermore, firms tend to react homogeneously to European business cycle movements. In contrast, fluctuations in domestic demand lead to heterogeneous adjustment across different firm cohorts. Finally, compared with larger and older firms as well as exporters and subsidiaries of MNEs the firm growth performance of small and young firms is more sensitive to recessions and recoveries.

[1] Geroski and Gugler (2004) empirically investigate the hypothesis of convergence in firm size within European industries after the implementation of the SMP, and find no evidence for increased convergence because of the SMP.

[2] European industry fluctuations and domestic business cycles are measured using value added to factor costs data, whereas firm growth is measured in terms of employment.

The remainder of the study is organized as follows. Section II reviews the related literature, whereas Section III describes the data and presents some descriptive statistics. Section IV specifies the two-part model and outlines the estimation strategy. Section V presents the estimation results and, finally, Section VI concludes.

II Related Literature

Since approximately 80 years the empirical firm growth literature analysis the relationship between a firms annual average growth rate and its initial firm size. Gibrat (1931) hypothesized that firm growth is independent of firm size (Gibrat's Law of proportionate growth). The majority of empirical contributions in the subsequent literature rejects the hypothesis of independence of firm growth and firm size.[3] In particular, a robust finding indicates that initially small firms exhibit higher growth rates in comparison with initially large firms. Moreover, the empirical firm growth literature lends support to the fact that young firms tend to grow more rapidly.

Consistent with these 'stylized facts', economists started to formulate theories which explain why, within cross-sections of firms, small and young firms show the highest growth rates. Among them are learning theories (Jovanovic, 1982), 'Penrose Effects' (Penrose, 1959), financial constraints (Fazzari *et al.*, 1988; Cabral and Mata, 2003) and organizational capabilities (Slater, 1980).[4]

The basic learning model à la Jovanovic, 1982, assumes that business owners do not know their actual level of productivity when they enter a market. However, over time they passively learn their productivity and thereafter adjust the size of their firms. Consequently, for the least productive firms the most efficient decision might be to exit the respective markets, whereas the most productively operating firms will increase their firm size over time. In either way, the prevailing uncertainty with regard to a firm's productivity leads to an inefficient small firm size for the more productive, later on surviving, firms.

Conversely, the other mentioned theories try to explain the above stated 'stylized facts' by different types of constraints. To start with, beginning with Fazzari *et al.* (1988) proponents of the financial constraints argument point to the limited availability of external and internal financial resources within newly created firms. Consequently, new entrants will not be able to (initially) finance all of their, maybe profitable investments and therefore will start business at an inefficient small scale. Over time, the productive firms gain reputation in the capital markets and therefore will be able to finance their adjustment to the efficient firm size.

[3] Surveys on the empirical firm growth literature are available, for e.g., in Evans (1987a), Sutton (1997), Audretsch *et al.* (2004), Bellak (2004), Cabral (2007) and Coad (2009).

[4] Another influential theory of firm growth stresses the crucial role of adjustment costs (see, e.g. Hamermesh and Pfann, 1996, for a survey). Moreover, this approach, provides a suitable guideline for our econometric model and therefore we will discuss it below in more detail.

Finally, based on the early insights provided by Penrose (1959), theories concerning managerial limitations and organizational capabilities focus on internal resources of firms. Thereby, a firm's management team is identified as the key resource with regard to its growth opportunities. More precisely, Penrose (1959, 2009) argues that growth-'planning' can only be carried out by a firm's management and therefore the development of growth strategies is firm-specific. This, in turn, implies that new managers can only collect firm-specific 'growth-knowledge' by inquiring already established management team members, and thereby create (additional) opportunity costs. Therefore, a firm's managerial resources will eventually be limited and so are its growth opportunities. Empirically, the predictions obtained from the so called 'Penrose Effects' are similar to those from adjustment cost theories discussed elsewhere in this article.

However, with regard to the specification of a typical empirical firm growth equation, the just mentioned theories commonly point to the importance of initial firm size and firm age as determinants of a firm's growth performance (see, e.g. Geroski and Gugler, 2004; Geroski, 2005). To sum up, in a survey on previous findings Hart (2000) concludes that the tendency of young and small firms to grow more quickly is the main reason why firm growth rates are not entirely stochastic. Consequently, our econometric firm growth model contains initial firm size and firm age as key determinants of a firm's annual growth rate.

In recent years, MNEs attracted increasing attention in the theoretical and empirical IO-literature. In particular, one strand within the empirical firm growth literature argues that firm growth dynamics differ between purely domestically oriented companies and subsidiaries of MNEs (see, Buckley *et al.*, 1984; Cantwell and Sanna-Randaccio, 1993; Bloningen and Tomlin, 2001; Pearce, 2006; Belderbos and Zou, 2007; Papanastassiou *et al.*, 2009; Oberhofer and Pfaffermayr, 2010).[5] Furthermore, exporting firms as well as MNEs are exposed to different domestic and non-domestic business type fluctuations. Consequently, this study tests whether internationally oriented firms (i.e. exporters and subsidiaries of MNEs) react differently to the respective business cycles.

With regard to the second strand of related literature, based on the seminal contribution of Caballero and Engel (1993), the heterogeneous (microeconomic) adjustment models explains (1) the probability of a reaction and (2) the extent of a reaction to a common external shock, as a function of the absolute difference between the desired and the actual state of a certain microeconomic unit.[6]

[5] Papanastassiou and Pearce (2009) provide an excellent up-to-date collection of research results concerning the development of MNEs. Thereby, Papanastassiou and Pearce (2009) put the focus on the strategic roles of MNE subsidiaries and stress the importance of R&D decentralization.

[6] Some extensions of the basic structure of the heterogeneous adjustment model, investigations of special policies and studies of lumpy investment behavior have been put forward by, for e.g. Caplin and Leahy (1997), Caballero and Engel (1999), Cooper *et al.* (1999) and Adda and Cooper (2000). Cooper (1998) surveys the heterogeneous (microeconomic) adjustment models and compares their policy implications with conclusions drawn from two other (large) strands of the theoretical business cycle literature (i.e. stochastic growth models and macroeconomic complementarities).

Following Caballero *et al.* (1997), the presence of adjustment costs leads to non-continuous adjustment of employment. Thereby, Caballero *et al.* (1997) call the difference between the desired and actual level of employment 'employment shortage' which is formally given by: $z_{it} = e^*_{it} - e_{i,t-1}$, where e_{it} denotes the firm level employment for each firm i at time t. In addition, the probability of employment adjustment is assumed to be increasing in the absolute value of z and the cross-sectional distribution of employment shortages is given by $f(z,t)$. Given this assumptions, a common shock (e.g. decline in demand for all goods) translates into heterogeneous reaction. Some firms for which $|z_i|$ is small will not adjust their firm size and consequently exhibit a zero employment growth rate. Other firms with a high $|z_i|$ will decide to adjust firm size and will close some part of the employment shortage given by an adjustment function $A(z,t)$. Consequently, at each point in time a firm's employment shortage, firstly, determines the probability of employment adjustment and, secondly, in case of adjustment the magnitude of the respective change in employment. Econometrically, heterogeneous (microeconomic) adjustment models support the use of a two-part model, where its first part examines the probability of adjustment and the second part focuses on the extent of the (non-zero) adjustment.

In comparison with the existing related empirical literature, this study focuses on a large sample of firms observed over only one European business cycle (2000–2003). Higson *et al.* (2002, 2004) analyze the impact of several business cycles on cross-sections of quoted firms in the United States and the United Kingdom. However, they are interested in the evolution of the long-run cross-sectional moments of the firm growth distribution over time, whereas this study analyzes the impact of short-run business type fluctuations on the growth performance of firm cohorts which share comparable characteristics. The study of Hart and Oulton (2001) uses a comparable methodology and analyzes a large sample of firms over 10 years. However, building on Hart and Oulton (2001) this study additionally utilizes explicit business cycle information and addresses the problem of non-reaction of firms.

III Data and Descriptive Statistics

We base the empirical analysis on data for manufacturing industries provided by several sources. Industry level value added to factor costs data are collected by the Austrian Institute of Economic Research (WIFO), but are based on Eurostat figures. The data are available at the NACE (revision 1.1) 3-digit level (NACE codes 151–366) for the EU 27. Exceptions are Bulgaria, Luxembourg and Romania. These figures were collected from 1985 to 2006 if available and from the late 1990s onwards for most Eastern European countries. The industry level data allow to construct annual (overall) European industry growth rates and country-specific total manufacturing value added to factor costs growth rates. In particular, for each year we aggregate the 3-digit industry value added data across all EU member countries to obtain overall European 3-digit industry production data. Similarly, we aggregate all 3-digit

industry figures within each country to measure a country's total manufacturing industries production. In a final step, we use these industry or country weighted aggregates for the calculation of the respective growth rates. Focusing on our European industry growth measure, due to the aggregation of annual value added to factor costs data across all countries, the resulting overall aggregates react more sensitively to production changes in large countries. To give one example, (within a given 3-digit industry) business type fluctuations in Germany will typically, more strongly, influence our European industry growth measure in comparison with sectoral variations in Austria. Evidently, within each country the same reasoning applies to our measure of total manufacturing industries growth.

Firm level data is provided by the AMADEUS database.[7] Balance sheet data and profit and loss accounts are gathered from the update 146 (November 2006) version of AMADEUS, whereas older versions of AMADEUS are used to identify subsidiaries of MNEs. Accordingly, we extract the subsidiary status of a particular firm in each year using corresponding annual updates of the AMADEUS database.[8] For this study the earliest available version of AMADEUS is from November 2001 and therefore limits the scope of the empirical investigation to the years from 2000 onwards. In addition, the number of usable observations in the November 2006 version decreases dramatically for the years 2005 and 2006. For these two reasons, a reliable empirical investigation is limited to the time span between 2000 and 2004. Within this time period, we observe 3 years (2000, 2001, 2004) with an average increase in European industry value added to factor costs and 2 years (2002, 2003) with negative Europe-wide industry growth rates. To isolate the effects of one single business cycle the analysis is based on the years 2000–2003. In addition, to assure a reasonable comparison of the effects of business type fluctuations on firm growth only firms, which are observed throughout the whole sample period are included.[9] Moreover, we drop obvious outliers and verify that our zero employment growth rates are not caused by data carry-overs from one to another year.[10] Finally, to define a reasonable control group for the subsidiaries of MNEs, our domestically oriented firms have to be fully independent. For this reason, we exclude all non-MNE subsidiary firms which, on their part, are shareholders of other firms because they would also be able to smooth demand fluctuations in their respective subsidiaries. Overall, this leads

[7] The Bureau van Dijk distributes the AMADEUS database, which (in its update from November 2006) includes financial statements, profit and loss accounts and information on companies' organizational structure of 8.8 million firms located in 40 European countries.

[8] For example, information from the AMADEUS version November 2001 (update 86) is used to identify subsidiaries of MNEs in the year 2000.

[9] In contrast to Boeri and Bellmann (1995) and Bhattacharjee *et al.* (2009), this study solely focuses on the impact of cyclical fluctuations on the performance of surviving firms. As the AMADEUS database only poorly reports firm exit, a reliable analysis of these firms is impossible. However, existing empirical evidence indicates a limited importance of business cycles for firm exit (Boeri and Bellmann, 1995; Bhattacharjee *et al.*, 2009).

[10] More precisely, we check whether within each firm, (operating) revenues vary from year to year and drop all firms with exactly the same amount of revenues in two consecutive years.

Table 1
Sample composition of growing and non-growing firms and average firm-specific firm growth rate, average European industry value added growth rate and average country-specific total manufacturing value added growth rates

Year	Total Obs.	Obs.: $g_i \neq 0$	Obs.: $g_i = 0$	Share: $g_i = 0$	$\bar{g}_i$	$\bar{g}_j$	$\bar{g}_c$
2000	86,454	57,004	29,450	0.3406	0.082	0.022	0.071
2001	86,454	56,378	30,076	0.3479	0.048	0.025	0.020
2002	86,454	54,687	31,767	0.3674	0.010	−0.008	0.021
2003	86,454	54,996	31,458	0.3639	−0.004	−0.007	0.016

Notes: g_i, g_j, g_c denote firm growth rate, European NACE 2-digit industry value added to factor costs growth rate and average country-specific total manufacturing value added to factor costs growth rate, respectively. The share of firms with $g_i = 0$ is measured as proportion of all 86,454 firms.

to a final sample size of 86,454 firms within 14 European countries which are observed in all 4 years.[11]

Table 1 summarizes the sample composition, the average firm growth rates, the average European industry value added to factor costs growth rates and average country-specific total manufacturing industries value added to factor costs growth rates for all 4 years. Thereby, consistent with the above described approach, firm growth is calculated using the first difference of employment levels. With only one exception the average firm growth rates exceed both – the average European industry value added to factor costs growth rates and the countries average total manufacturing value added to factor costs growth rates. Worth noting is the recession year 2003, where the average European industry growth rate and the average firm growth rate are slightly negative, whereas the country-specific total manufacturing growth rate is positive on average. Most interestingly, Table 1 depicts the number of firms which show non-zero growth rates, zero growth rates and the share of the firms with zero growth rates. The share of firms with no change in the number of employees in two subsequent years amounts to more than 36% of all observed firms, indicating that a non-negligible fraction of firms does not react to any type of business fluctuations.

To obtain a first descriptive evidence with regard to the impact of domestic and European business cycles on an individual firm's growth performance, Table 2 displays the results from a simple analysis of variance (ANOVA).[12] The ANOVA allows to split the variation in the annual firm growth rates into two parts, one which can be explained by the model and the second which is unexplained. More specifically, the model contains country and 3-digit industry dummy variables (main effects) and interaction terms between the main effects. The former (latter) capture country-specific (industry-specific) variation

[11] The list of countries include 2 new member states, namely Poland and Slovakia, and 12 countries which are part of the EU 15. Among the latter are Austria, Belgium, Finland, France, Germany, Great Britain, Greece, Italy, the Netherlands, Portugal, Spain and Sweden.

[12] Using AMADEUS database Goddard *et al.* (2009) provide a more comprehensive variance decomposition analysis with regard to profitability and growth of manufacturing firms located in 11 European countries.

Table 2
Analysis of variance of the firm growth rate

	Growth 2000			Growth 2001		
Source	Abs.	%	*p*-value	Abs.	%	*p*-value
Country effects	300.60	3.5	0.000	35.61	0.9	0.000
Industry effects	9.27	0.1	0.258	3.34	0.0	0.952
Country*Industry effects	86.73	1.0	0.145	102.99	2.5	0.000
Constant (Overall mean)	670.67	7.8	–	235.98	5.6	–
Model	1067.27	12.5	0.000	377.93	9.0	0.000
Residual	7494.25	87.5	–	3805.89	91.0	–
Total	8561.52	100.0	–	4183.81	100.0	–
	Growth 2002			Growth 2003		
Source	Abs.	%	*p*-value	Abs.	%	*p*-value
Country effects	6.1	0.2	0.000	2.29	0.1	0.000
Industry effects	3.52	0.1	0.081	4.31	0.1	0.039
Country*Industry effects	26.85	1.0	0.868	35.89	1.2	0.035
Constant (Overall mean)	27.19	1.0	–	19.12	0.6	–
Model	63.66	2.4	0.000	61.62	2.0	0.000
Residual	2566.75	1.0	–	2996.79	98.0	–
Total	2630.41	100.0	–	3058.42	100.0	–

Notes: A total of 86,454 observations for each year. *p*-values are based on F-tests, according to 13 d.f. (degrees of freedom) for Country Effects, 97 d.f. for Industry Effects and 942 d.f. for Country*Industry Effects.

in the observed firm growth rates. In general, Table 2 shows that the chosen dummy variable design explains only a relatively small fraction of the variation in the firm growth rates and the explanatory power becomes even worse for the recession years 2002 and 2003. The goodness-of-fit in terms of the standard R^2 is highest in the first year of the sample (12.5%), whereas in 2003 the model is only able to explain 2.0% of the variation in the firm growth rate. Moreover, only the country dummies statistically, significantly explain some parts of the variation in the firm growth rate throughout the whole sample period. Surprisingly, the industry effects are only (minor) statistically significant in 2002 and 2003. The interaction effects which allow for deviations from the main effects are only significant in the years 2001 and 2003 and, given the huge number of interaction terms (i.e. 942), only explain a very small fraction of the variation in the firm growth rate.

Therefore, with regard to the growth performance of firms in our sample the data surprisingly deliver a first indication of the limited importance of European industry fluctuations. The country of origin tends to be still more important for differences in firm growth rates across Europe. However, neither European industry effects nor country-specific effects seem to reasonably explain the variation in firm growth rates. Consequently, a more systematic analysis of the data is needed to draw final conclusions. Therefore, econometrically we set up a two-part model in the next section.

IV Empirical Specification and Estimation Strategy

We estimate the impact of business type fluctuations on firm growth at each point within the observed European business cycle. Subsequently, each annual cross-section of firms is separately investigated. This is consistent with Hart and Oulton (1998, 2001), who split the business cycle into several cross-sections. In contrast to econometric panel data methods, this approach allows to identify different effects at several stages of the business cycles. In addition, the very short time span in the data set renders dynamic panel estimation impossible. Unfortunately, this approach is unable to control for unobserved heterogeneity across firms. However, with regard to previous findings the inclusion of initial firm size and firm age controls for the important systematic determinants of differences in firm growth rates (Hart, 2000).

Moreover, following the previous theoretical considerations and the structure of the data (see Table 1) a careful treatment of non-reacting firms is required. The above mentioned heterogeneous adjustment literature suggest that firms, based on their actual and desired size, firstly, decide whether they are willing to adjust their firm size and secondly, choose the magnitude of adjustment. Econometrically, this lends support to the usage of a two-part model. Thereby, the first part describes the binary choice of reaction versus non-reaction to business cycle fluctuations for a particular firm i in period t:

$$y_{it}^{*} = \begin{cases} 0 & \text{for } g_{it} = 0 \\ 1 & \text{for } g_{it} \neq 0. \end{cases} \tag{1}$$

Based on equation (1) we parameterize the probability of $y_{it}^{*} = 1$ such that:

$$P(y_{it}^{*} = 1|\mathbf{z}_{it}) = P(g_{it} \neq 0|\mathbf{z}_{it}) = F(\mathbf{z}_{it}\gamma), \tag{2}$$

where $F(.)$ is the cumulative logistic function, γ is a vector of estimation coefficients and $\mathbf{z}_{it}$ contains explanatory variables of firm i at time t.

In contrast to many formulations of two-part models the dependent variable in our model is not restricted in any way.[13] Accordingly, the second part of the model which only governs non-zero outcomes of the annual firm growth rate g_{it} is modeled under the linearity assumption:

$$E(y_{it}|\mathbf{x}_{it}, y_{it}^{*} = 1) = \mathbf{x}_{it}\beta, \tag{3}$$

where β is another vector of parameters to be estimated with ordinary least squares (OLS) and $\mathbf{x}_{it}$ represents a different set of covariates. Finally, the conditional mean of a two-part model is given by:

[13] Typically, two-part models are used in health economics (see, e.g. Duan *et al*., 1983; Pohlmeier and Ulrich, 1995) or for fractional response variables (see, e.g. Oberhofer and Pfaffermayr, 2009; Ramalho and Vidigal da Silva, 2009; Ramalho *et al*., 2011), where the dependent variable is either restricted to R^{+} (e.g. demand for health care) or confined to the [0,1] interval (e.g. financial leverage).

$$E(y_{it}|\mathbf{x}_{it}) = P(y^*_{it} = 1|\mathbf{z}_{it})E(y_{it}|\mathbf{x}_{it}, y^*_{it} = 1) + P(y^*_{it} = 0|\mathbf{z}_{it})E(y_{it}|\mathbf{x}_{it}, y^*_{it} = 0). \quad (4)$$

As $E(y_{it}|\mathbf{x}_{it}, y^*_{it} = 0) = 0$, the conditional mean function simply reduces to the conditional mean of non-zero outcomes multiplied with the probability of a non-zero outcome. As just mentioned, the empirical specification of the two-part model contains two different sets of explanatory variables. More precisely, following related studies on determinants of job creation and job destruction, the first part of the model includes previous years firm size and firm age (Varejao and Portugal, 2007; Hölzl and Huber, 2009) and a firm's sales per employee in the previous year (Nilsen *et al.*, 2007). In addition, the inclusion of the ratio of a firm's previous years sales to industry minimum efficient scale (MES) (denoted as relative size) proxies the difference between a firm's actual and desired size, where MES is defined as the third quartile of the within 3-digit (Europe-wide) industry distribution of sales in the previous year.[14]

Following the above mentioned discussion on internationally oriented firms, we hypothesize that exporting firms and subsidiaries of MNEs react differently to business cycle fluctuations. With regard to MNEs, we use several different versions of AMADEUS database to construct a dummy variable which for each firm in each year takes on the value 1 if the firm is a subsidiary of a MNE and 0 if otherwise.[15] Information on a firm's exporter status can, theoretically, be gathered from the annual reports included in AMADEUS database. Unfortunately, AMADEUS only, very poorly, reports such information and, more problematically, no export information is collected for the majority of European countries. For this reason, our analysis of exporting firms is limited to only a subsample of European firms and therefore we separately present the empirical results for all countries and for those with non-missing export information.[16] Finally, we include contemporaneous European 3-digit industry value added to factor growth rates and a country's contemporaneous total manufacturing value added to factor costs growth rates, to examine whether European firms more likely react to the European business cycle or to domestic fluctuations.

Drawing from Gibrat's Law type of regressions, the second part of the model analysis the extent of a firm's annual employment growth rate for all firms with non-zero growth rates. Moreover, we are interested whether the magnitude of reaction to business cycles is heterogeneous across different

[14] For the calculation of MES, we also use firms which are not part of our final (balanced) sample. More precisely, the number of firms used for the calculation of the MES ranges from more than 360,000 in the year 1999 to approximately 530,000 firms in 2002.

[15] On average, subsidiaries of MNEs make up approximately 1% of all firms in the sample with the exception of the year 2001, where only half a percentage belongs to a MNE network. This feature of the data is well consistent with observations concerning more aggregated FDI data (see, e.g. Figure 1 in Mody, 2004). However, the firm level information shows an increase in the number of MNE subsidiaries already in 2002.

[16] For our sample of 14 countries, any non-missing export information is only available for firms in France, Great Britain, Greece and Sweden.

types of firms. For this reason, in addition to initial firm size, firm age, Europe-wide 3-digit industry growth, total manufacturing growth and the MNE (and/or exporter) dummy variable, x_{it} contains interaction terms of all firm-specific variables (firm size, firm age, MNE-exporter status) with both types of contemporaneous business cycles. To construct different firm cohorts, firm size and firm age are captured by dummy variables, based on the quartiles of the respective distributions in the previous year.[17] Consequently, the inclusion of a full set of interaction terms delivers a straight-forward testing procedure for the hypothesis of heterogeneous adjustment to business type fluctuations. Thereby, in contrast to heterogeneous (microeconomic) adjustment models, reaction to the business cycles is only modeled to be heterogeneous across firm cohorts, whereas within each cohort the reaction is assumed to be homogeneous.

V Estimation Results

As already mentioned, export information is systematically missing for all firms in the majority of EU member countries. For this reason, we are not able to provide a comprehensive analysis with regard to the reaction of exporting firms to domestic and Europe-wide business cycles. Consequently, we *inter alia* restrict our baseline analysis to the comparison of subsidiaries of MNEs with non-MNE subsidiary firms. Subsection V.1 discusses our baseline results. Nevertheless, in subsection V.2, we in addition investigate the role of exporting firms by only focusing on firms located in the four countries where export information is available.

Baseline results

Tables 3 and 4 summarize the results of the baseline two-part model, where Table 3, for each year, reports average marginal effects for the first part obtained from a standard logit model.[18] Table 4 shows the OLS results only considering firms with $g_{it} \neq 0$. In accordance with Moulton (1990), we calculate robust standard errors clustered by industry-country, which take correlation in the error terms within the industry and total manufacturing growth rate aggregates into account. For the second part, the smallest, youngest, non-MNE subsidiary firms build the reference group captured by the constant.

Interestingly, in goodness-of-fit terms the standard R^2 is considerably decreasing over the business cycle for the second part, whereas the first parts Pseudo-R^2 is increasing. This, in turn, indicates that in each year the first part of the model is likewise able to explain which firms adjust their firm size,

[17] Technically, the firm size and firm age distributions are split into their quartiles and four dummy variables are constructed, indicating whether a firm is located within the respective quartile of each distribution.

[18] As in non-linear models marginal effects of covariates are individual (firm) specific, we calculate average marginal effects using the approach suggested by Bartus (2005).

Table 3
Baseline estimation results: first part (logit model)

	2000	2001	2002	2003
Size	0.139***	0.162***	0.158***	0.151***
	(0.005)	(0.005)	(0.004)	(0.004)
Age	−0.045***	−0.039***	−0.040***	−0.050***
	(0.005)	(0.005)	(0.004)	(0.005)
Sales per employee	0.001***	0.001***	0.0003***	0.0002***
	(0.000)	(0.000)	(0.0000)	(0.0000)
Relative size	0.004	−0.008**	−0.007**	−0.006**
	(0.003)	(0.004)	(0.003)	(0.002)
MNE	−0.035	−0.065**	−0.011	−0.011
	(0.031)	(0.032)	(0.028)	(0.023)
European industry growth	0.063	−0.036	−0.105	−0.039
	(0.095)	(0.101)	(0.139)	(0.139)
Total manufacturing growth	0.758***	−0.568***	−1.706***	−2.140***
	(0.105)	(0.118)	(0.329)	(0.193)
Pseudo-R^2	0.1169	0.1283	0.1342	0.1532
N	86,454	86,454	86,454	86,454

Notes: Robust standard errors clustered by industry-country in parentheses. The table reports average marginal effects following Bartus (2005).
***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level.

whereas a Gibrat's Law type of regression is better able to explain the variation in the firm growth rate in recovery years.

Focusing on the first part results only, Table 3 indicates that firms which (ceteris paribus) are initially larger and younger, most probably change their firm size in each of the 4 years. In addition, firms with a higher level of per employee turnover and firms below the industry-specific MES more likely adjust firm size. This, in turn, indicates that firms are more (less) likely to adjust firm size if their actual size is below (above) their desired size. With the exception of 2001, subsidiaries of MNEs do not exhibit systematic differences in their adjustment probabilities. In general, our first part estimation results are well consistent with previous research on job creation and job destruction. For example, Hölzl and Huber (2009) report higher adjustment probabilities for larger and younger firms, whereas Nilsen *et al.* (2007) provide evidence for a positive impact of previous year's sales per employee on the probability of size adjustment.

With regard to the European industry cycle and domestic business fluctuations, it turns out that European firms do not react to the European industry cycle. The respective average marginal effects are rather small and insignificant for all four reported years. In contrast, over the business cycle, the country-specific total manufacturing value added to factor costs growth rates exhibit a significant and non-constant impact on the probability of employment adjustment. More precisely, firms in countries with higher total manufacturing growth rates are more likely to adjust their firm size in 2000 while in the remaining years higher total manufacturing growth rates reduce the probability

Table 4
Baseline estimation results: second part (OLS)

	2000	2001	2002	2003
Constant	0.288***	0.148***	0.059***	0.007
	(0.033)	(0.006)	(0.007)	(0.007)
Size 2	−0.199***	−0.050***	−0.022***	−0.006
	(0.031)	(0.008)	(0.007)	(0.006)
Size 3	−0.203***	−0.068***	−0.018***	0.002
	(0.033)	(0.007)	(0.007)	(0.006)
Size 4	−0.235***	−0.110***	−0.037***	0.003
	(0.035)	(0.009)	(0.007)	(0.007)
Age 2	−0.047***	−0.013**	−0.017***	−0.013***
	(0.010)	(0.006)	(0.004)	(0.004)
Age 3	−0.038***	−0.004	−0.020***	−0.019***
	(0.013)	(0.008)	(0.003)	(0.003)
Age 4	−0.068***	−0.017**	−0.038***	−0.032***
	(0.011)	(0.008)	(0.003)	(0.004)
MNE	0.042***	0.003	0.004	−0.007
	(0.014)	(0.013)	(0.007)	(0.008)
European industry growth	0.704*	−0.066	0.174*	0.084
	(0.396)	(0.083)	(0.096)	(0.188)
Total manufacturing growth	1.480***	0.331***	0.338*	0.677***
	(0.457)	(0.077)	(0.201)	(0.217)
Size 2* European industry growth	−0.573	0.018	0.011	0.092
	(0.437)	(0.091)	(0.091)	(0.160)
Size 3* European industry growth	−0.566	−0.057	−0.008	0.047
	(0.466)	(0.088)	(0.087)	(0.174)
Size 4* European industry growth	−0.599	0.025	−0.001	−0.012
	(0.482)	(0.111)	(0.096)	(0.178)
Age 2* European industry growth	0.109	−0.033	−0.157**	0.090
	(0.111)	(0.074)	(0.068)	(0.092)
Age 3* European industry growth	0.011	−0.004	−0.060	0.108
	(0.142)	(0.081)	(0.061)	(0.085)
Age 4* European industry growth	−0.025	0.065	−0.033	0.110
	(0.140)	(0.101)	(0.055)	(0.085)
MNE* European industry growth	−0.308**	0.103	−0.112	−0.003
	(0.136)	(0.205)	(0.106)	(0.174)
Size 2* total manufacturing growth	−1.497***	−0.473***	−0.644***	−0.309
	(0.469)	(0.102)	(0.190)	(0.196)
Size 3* total manufacturing growth	−1.654***	−0.577***	−0.737***	−0.372*
	(0.509)	(0.094)	(0.193)	(0.209)
Size 4* total manufacturing growth	−1.167**	−0.529***	−0.361*	−0.360*
	(0.536)	(0.094)	(0.201)	(0.212)
Age 2* total manufacturing growth	0.353**	0.182***	0.129*	−0.147
	(0.156)	(0.061)	(0.076)	(0.099)
Age 3* total manufacturing growth	0.338*	0.204**	0.017	−0.189**
	(0.192)	(0.083)	(0.084)	(0.083)
Age 4* total manufacturing growth	0.506**	0.348***	0.303***	−0.128
	(0.201)	(0.077)	(0.070)	(0.091)
MNE* total manufacturing growth	−0.560***	0.339	0.027	0.032
	(0.200)	(0.255)	(0.134)	(0.215)
R^2	0.1279	0.0261	0.0125	0.0073
N	57,004	56,378	54,687	54,996

Notes: Robust standard errors clustered by industry-country in parentheses.
***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level.

of employment adjustment. This result supports the heterogeneous adjustment models, which assume that the difference between the actual and desired firm size has to exceed a certain threshold to induce an adjustment.

Concentrating on the results obtained for the second part of the model, the OLS results concerning the main effects of the firm characteristics are consistent with standard results put forward by the empirical firm growth literature. Table 4 shows that the smallest, youngest, non-MNE subsidiary firms show the highest growth rates throughout the whole sample period with the exception of the year 2003, where the differences in growth rates across all different size classes are statistically insignificant. The age effects also indicate that young firms show higher growth rates than their older counterparts. Both results are well-known from Gibrat's Law type of regressions (see, e.g. Evans, 1987b; Variyam and Kraybill, 1992; Hart, 2000; Hart and Oulton, 2001; Cabral, 2007). With regard to subsidiaries of MNEs no general result can be obtained. In comparison with the reference group, multinationally oriented firms exhibit a larger main effect in the year 2000. However, taking the interaction effects with Europe-wide industry growth rates and countries' total manufacturing growth rates into account, the differences in growth rates between MNEs and domestically oriented firms might disappear.

Similar to the results obtained in the first part, the impact of the European industry business cycle seems to be limited. With the exception of the years 2000 and 2002, the 3-digit industry growth rate has no impact on the magnitude of the average growth rate of European firms. In addition, virtually all interaction effects of the European business cycle with different firm characteristic are insignificant.[19] Most interestingly, not even very large firms tend to be effected by the European industry business cycle.

Focusing, on the impact of fluctuations in domestic total manufacturing value added on firm growth, we are able to detect more systematic relationships. The main effect of domestic business cycles is positive and significant in all 4 years, indicating a positive impact on the growth rates of the reference group. Moreover, the interaction effects support the hypothesis of heterogeneity in the adjustment. Compared with the reference group, larger firms exhibit significantly lower growth rates. Conversely, the results with regard to firm age are inconclusive. In comparison to the reference group in the years 2001–2002 firm age positively interacts with the domestic business cycle, whereas in 2003 no systematic differences in the adjustment behavior between young and old firms can be detected.

To examine the sensitivity to business cycle fluctuations, we calculate conditional mean growth rates for five different firm cohorts over the entire obser-

[19] For this reason, we alternatively estimated the second part of our model, excluding the interaction effects of European 3-digit industry growth rates with firm size and firm age. Thereafter, the European business cycle in addition significantly explains variation in firm growth in 2003 while our other results are virtually unchanged. The corresponding results are available from the author upon request.

Table 5
Baseline results: conditional means for several firm cohorts and each year

	2000			2001		
	(1)	(2)	(3)	(1)	(2)	(3)
Size 1-Age 1 Firms (non-MNE)	0.467	0.407	0.192	0.428	0.152	0.065
Size 2-Age 2 Firms (non-MNE)	0.610	0.070	0.043	0.610	0.085	0.052
Size 3-Age 3 Firms (non-MNE)	0.726	0.062	0.045	0.731	0.072	0.052
Size 4-Age 4 Firms (non-MNE)	0.843	0.041	0.035	0.863	0.024	0.021
MNEs	0.915	0.043	0.040	0.822	0.050	0.038
	2002			2003		
	(1)	(2)	(3)	(1)	(2)	(3)
Size 1-Age 1 Firms (non-MNE)	0.405	0.067	0.027	0.410	0.025	0.008
Size 2-Age 2 Firms (non-MNE)	0.582	0.014	0.009	0.586	−0.009	−0.006
Size 3-Age 3 Firms (non-MNE)	0.712	0.010	0.008	0.718	−0.010	−0.008
Size 4-Age 4 Firms (non-MNE)	0.856	−0.016	−0.015	0.862	−0.024	−0.021
MNEs	0.847	0.008	0.006	0.847	−0.018	−0.016

Notes: Column (1) report the conditional probabilities for non-zero growth rates ($P(y_{it}^* = 1|\mathbf{x}_{it})$), whereas column (2) present the conditional mean growth rates for non-zero outcomes ($E(y_{it}|\mathbf{x}_{it}, y_{it}^* = 1)$) for the mentioned firm cohorts, respectively. In Column (3) the (overall) conditional mean growth rates are reported.

vational period.[20] The results are presented in Table 5. Columns (1) and (2) report conditional probabilities for non-zero growth rates (obtained from part one of the model) and the conditional mean growth rates for the firms with non-zero growth rates (i.e. predictions form the second part of the model). Column (3) display the conditional mean growth rates for all firms (with zero and non-zero growth rates) in the respective firm cohorts.[21]

The conditional means in Table 5 indicate that, on average, the smallest, youngest, non-MNE subsidiary firms exhibit the highest growth rates in all years. However, the relative volatility in the conditional average growth rate between recovery and recession years is largest for this cohort, suggesting a relatively pronounced sensitivity of small, young, non-MNE firms to business cycle movements. Subsidiaries of MNEs show slightly negative growth rates in 2003, but the MNE cohort is estimated to be the most stable group of firms. Interestingly, the conditional probability of a non-zero outcome monotonically increases with firm size and firm age. While only less than 47% of

[20] The definition of the firm groups follows our dummy variable design with regard to firm size, firm age and the MNE-status from the second part equation. Thereby, we utilize equation (4) for the calculation of each groups average values.

[21] For example, column (3) in the first row report the conditional means for the smallest, youngest, non-MNE subsidiary firms in the sample, which for each year are given by the combined effect of Constant + European industry growth + Total manufacturing growth from the OLS regression multiplied with the average probability of a non-zero outcome for the reference group from the logit model. Additional main effects and interaction terms enter the calculation of the conditional mean growth rates for the firms with non-zero growth rates for all other reported cohorts.

Table 6
The role of exporters: first part (logit model)

	2000	2001	2002	2003
Size	0.111***	0.163***	0.142***	0.126***
	(0.009)	(0.008)	(0.003)	(0.006)
Age	−0.011	−0.022***	−0.024***	−0.018***
	(0.008)	(0.006)	(0.004)	(0.005)
Sales per employee	0.0003***	0.0003***	0.0001***	0.0001**
	(0.0001)	(0.0001)	(0.0000)	(0.0000)
Relative size	0.027***	0.004	−0.001	0.001
	(0.006)	(0.005)	(0.002)	(0.003)
Exporters and MNEs	−0.088***	0.027	0.030	−0.028
	(0.044)	(0.052)	(0.045)	(0.033)
European industry growth	0.374***	−0.209	−0.076	0.157
	(0.137)	(0.194)	(0.097)	(0.198)
Total manufacturing growth	−1.316***	−1.451***	−5.487***	−2.632***
	(0.256)	(0.177)	(0.176)	(0.146)
Pseudo-R^2	0.1386	0.1702	0.2818	0.2369
N	36,577	36,577	36,577	36,577

Notes: Robust standard errors clustered by industry-country in parentheses. The table reports average marginal effects following Bartus (2005).
***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level.

the smallest, youngest, non-MNE subsidiary firms are expected to show non-zero growth rates more than 80% of the largest and oldest domestically oriented firms are intended to change their firm size in each year. Similarly, the adjustment probabilities of MNE subsidiaries are among the highest throughout. In addition, column (2) show that the sensitivity with respect to the growth performance of small, young, non-MNE subsidiary firms with non-zero employment growth is even more pronounced. For example, in the year 2000 firms with non-zero growth rates within the reference group are expected to exhibit a growth rate of about 40% while in 2002 the conditional mean growth rate for the same firms is estimated to be only 2.5%.

The role of exporters

As already stressed, in our sample of European firms any export information is only available for firms located in either, France, Great Britain, Greece or Sweden. Although, France and Great Britain are two large and influential economies, the firms located in those four countries only represent a small fraction of all firms located within the boundaries of the EU. However, the additional incorporation of exporting firms (at least) allows to verify the robustness of our main results. For this reason, we re-estimate our two-part model for the subsample of 36,577 firms located in the four mentioned countries, and jointly investigate the differing effects of business type fluctuations on subsidiaries of MNEs and/or exporting firms in comparison with only domestically oriented firms. Thereby, we group exporting firms and subsidiaries together as the vast majority of internationally oriented firms is using a

Table 7
The role of exporters: estimation results: second part (OLS)

	2000	2001	2002	2003
Constant	0.182***	0.119***	0.047***	−0.008
	(0.020)	(0.007)	(0.008)	(0.009)
Size 2	−0.090***	−0.053***	−0.027***	−0.001
	(0.014)	(0.007)	(0.007)	(0.008)
Size 3	−0.091***	−0.044***	−0.017**	0.015*
	(0.016)	(0.008)	(0.007)	(0.008)
Size 4	−0.099***	−0.056***	−0.034***	0.018**
	(0.017)	(0.008)	(0.007)	(0.008)
Age 2	−0.057***	−0.051***	−0.030***	−0.024***
	(0.012)	(0.005)	(0.005)	(0.006)
Age 3	−0.045***	−0.054***	−0.037***	−0.025***
	(0.013)	(0.005)	(0.005)	(0.005)
Age 4	−0.072***	−0.070***	−0.043***	−0.035***
	(0.012)	(0.005)	(0.005)	(0.005)
Exporters and MNEs	0.039*	−0.011	0.018*	0.022**
	(0.024)	(0.015)	(0.010)	(0.011)
European industry growth	0.365**	−0.043	0.201	0.056
	(0.185)	(0.096)	(0.131)	(0.233)
Total manufacturing growth	0.212	0.050	−0.013	−0.088
	(0.259)	(0.095)	(0.624)	(0.254)
Size 2* European industry growth	−0.279	0.062	−0.056	0.093
	(0.186)	(0.108)	(0.149)	(0.205)
Size 3* European industry growth	−0.246	0.078	−0.062	−0.053
	(0.202)	(0.106)	(0.130)	(0.221)
Size 4* European industry growth	−0.324	0.084	−0.038	−0.023
	(0.204)	(0.098)	(0.144)	(0.221)
Age 2* European industry growth	0.010	0.062	0.030	0.086
	(0.108)	(0.079)	(0.120)	(0.125)
Age 3* European industry growth	0.001	0.013	−0.047	0.153
	(0.098)	(0.066)	(0.102)	(0.101)
Age 4* European industry growth	−0.042	0.026	0.016	0.188**
	(0.102)	(0.078)	(0.088)	(0.089)
Exporters and MNEs* European industry growth	−0.300	−0.016	−0.501*	0.064
	(0.258)	(0.158)	(0.268)	(0.291)
Size 2* total manufacturing growth	−0.047	−0.146	0.094	0.476*
	(0.226)	(0.103)	(0.597)	(0.257)
Size 3* total manufacturing growth	0.084	−0.054	−0.039	0.502**
	(0.226)	(0.108)	(0.592)	(0.254)
Size 4* total manufacturing growth	−0.115	0.125	0.383	0.390
	(0.256)	(0.116)	(0.588)	(0.246)
Age 2* total manufacturing growth	−0.051	−0.004	0.634	−0.144
	(0.157)	(0.097)	(0.443)	(0.118)
Age 3* total manufacturing growth	−0.388**	−0.017	0.131	−0.212**
	(0.176)	(0.107)	(0.382)	(0.102)
Age 4* total manufacturing growth	−0.299*	0.043	0.000	−0.191*
	(0.180)	(0.096)	(0.403)	(0.102)
Exporters and MNEs* total manufacturing growth	−0.682	0.934*	6.450**	0.777**
	(0.490)	(0.477)	(3.230)	(0.306)
R^2	0.0530	0.0280	0.0130	0.0060
N	21,028	20,301	20,028	19,953

Notes: Robust standard errors clustered by industry-country in parentheses.
***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level.

Table 8
The role of exporters: conditional means for several firm cohorts and each year

	2000			2001		
	(1)	(2)	(3)	(1)	(2)	(3)
Size 1-Age 1 Firms (non-MNE)	0.363	0.203	0.074	0.337	0.116	0.039
Size 2-Age 2 Firms (non-MNE)	0.522	0.044	0.023	0.506	0.017	0.009
Size 3-Age 3 Firms (non-MNE)	0.663	0.044	0.029	0.625	0.022	0.014
Size 4-Age 4 Firms (non-MNE)	0.837	−0.002	0.031	0.841	−0.009	0.017
Exporters and MNEs	0.900	0.013	0.012	0.825	0.032	0.025
	2002			2003		
	(1)	(2)	(3)	(1)	(2)	(3)
Size 1-Age 1 Firms (non-MNE)	0.335	0.046	0.015	0.332	−0.010	−0.003
Size 2-Age 2 Firms (non-MNE)	0.513	0.006	−0.003	0.497	−0.028	−0.017
Size 3-Age 3 Firms (non-MNE)	0.653	−0.006	−0.005	0.650	−0.017	−0.014
Size 4-Age 4 Firms (non-MNE)	0.859	−0.030	−0.014	0.854	−0.030	−0.026
Exporters and MNEs	0.886	0.026	0.001	0.839	−0.018	−0.019

Notes: Column (1) report the conditional probabilities for non-zero growth rates ($P(y_{it}^* = 1|\mathbf{x}_{it})$), whereas column (2) present the conditional mean growth rates for non-zero outcomes ($E(y_{it}|\mathbf{x}_{it}, y_{it}^* = 1)$) for the mentioned firm cohorts, respectively. In Column (3) the (overall) conditional mean growth rates are reported.

combination of both strategies to serve foreign markets (see, e.g. Oberhofer and Pfaffermayr, 2012). Tables 6, 7 and 8 report our respective results.

To start with, Table 6 provides estimates for the firms' first part decision to adjust their firm size in each year. Evidently, our baseline results are robust to the additional consideration of exporting firms as well as to the use of only a subsample of firms. To briefly sum up the main results, larger, younger, more productive firms are more likely to adjust their firm size. In comparison with only domestically oriented firms, subsidiaries of MNEs as well as exporting firms do not exhibit significantly different adjustment probabilities, except in the year 2000. Finally, higher country-specific total manufacturing growth rates systematically reduce firm size adjustment probabilities, whereas EU industry growth rates only significantly and positively influence firm size adjustment probabilities, in the year 2000.

Similarly, Table 7 reports the estimation results for the second part equation, only focusing on firms with non-zero growth rates. Table 7 thereby, points to the relevance of firm size as well as firm age as the main determinants of the variation in firm growth. With regard to the impacts of domestic and European business cycles and the role of multinationality and exporting, we are not able to identify many systematic relationships. However, given the small number of countries included the former result comes not with a big surprise.

Finally, Table 8 provides estimates for conditional mean growth rates for the same firm cohorts as in our baseline analysis. Qualitatively, our baseline

results are supported because adjustment probabilities are again highest for the largest and oldest firms as well as for exporting firms and subsidiaries of MNEs. Contrary, the smallest and youngest non-exporting and non-MNE subsidiary firms exhibit the highest growth rates throughout but also most sensitively react to business fluctuations. To sum up, the explicit consideration of exporting firms does not qualitatively affect our baseline results.

VI Conclusions

Based on the empirical firm growth literature and on heterogeneous (microeconomic) adjustment models, this study empirically investigates the impact of European industry fluctuations and domestic business cycles on the growth performance of European firms. Following heterogeneous (microeconomic) adjustment models and given the structure of the data at hand (i.e. relative high share of zero growth rates) a careful treatment of non-reacting firms is required. In particular, a two-part model is proposed. In its first part this model examines the probability of a non-zero growth rate, whereas the second part analyzes the magnitude of the firm size adjustment.

In general, our results suggest that European industry fluctuations are not able to sufficiently explain variation in firm growth rates of European manufacturing firms. Instead, domestic total manufacturing business cycles tend to better predict the probability of a reaction and the extent of the (non-zero) adjustment. In addition, domestic demand fluctuations create detectable heterogeneity in the reaction among several different firm cohorts, whereas the adjustment to European industry recoveries and recessions tends to be homogeneous.

With regard to the different firm cohorts and consistent with standard results from the empirical firm growth literature, the smallest, youngest, only domestically oriented firms show the highest growth rates, indicating convergence in firm size (measured in terms of employment) within European industries. However, in relative terms, the growth rates of the smallest, youngest, only domestically oriented firms are most intensely affected by cyclical movements. In contrast, during the business cycle the firm size of MNE subsidiaries and exporting firms, tends to be relatively stable.

In terms of policy implications, the results of this study suggest that the majority of European firms are still much more affected by domestic business cycles than by Europe-wide trends in industry production. Consequently, the stabilization of business cycles in each individual member state still seems to be an important task for national governments and their fiscal policies. Moreover, our findings suggest that the vast majority of firms located within the boundaries of the EU only consider their respective domestic economies as their target markets and are therefore not affected by SMP policies. Consequently, with regard to the strategic behavior of European firms, the EU's efforts to establish one single market so far seem to be of only limited effectiveness. Thereby, however, one should bear in mind that European firms tend to be (relatively) small, which make them focusing on narrow target markets only. Overall, with our results at hand, EU's economic policy makers should

acknowledge the importance of decentralized fiscal policies and might think about the development of economic policies toward the creation of a larger number of large- and multi-market oriented firms.

However, as this empirical investigation uses data from a time period (2000–2003) of relatively moderate macroeconomic development, more pronounced results might be obtained using more severe cyclical movements. For this reason, as an outline for a research agenda, this topic should be reconsidered using firm and industry level data including the recent economic crisis.

Acknowledgements

I would like to thank two anonymous referees, the editor in charge (Andrew Hughes Hallett), Andrea Leiter, Michael Pfaffermayr, Matthias Stöckl and Hannes Winner, the participants of the research seminar at the Austrian Institute of Economic Research, the participants of the 36th annual conference of the European Association for Research in Industrial Economics (EARIE) 2009 in Ljubljana, the participants of the annual congress of the Spanish Economic Association 2009 in Valencia and the participants of the 4th FIW Research Conference International Economics 2010 in Vienna, for helpful comments and suggestions. I am indebted to the Austrian Institute of Economic Research (WIFO), and especially Dagmar Guttmann for providing the European industry level data. Financial support from the 'Oesterreichische Nationalbank' (OeNB, grant no. 12831) is gratefully acknowledged.

References

Adda, J. and Cooper, R. W. (2000). Balladurette and juppette: a discrete analysis of scrapping subsidies. *Journal of Political Economy*, **108**, pp. 778–806.

Audretsch, D. B., Klomp, L., Santarelli, E. and Thurik, A. (2004). Gibrat's law: are the services different. *Review of Industrial Organization*, **24**, pp. 301–24.

Aw, B. Y. and Lee, Y. (2008). Firm heterogeneity and location choice of Taiwanese multinationals. *Journal of International Economics*, **75**, pp. 167–79.

Bartus, T. (2005). Estimation of marginal effects using margeff. *Stata Journal*, **5**, pp. 309–29.

Belderbos, R. and Zou, J. (2007). On the growth of foreign affiliates: multinational plant networks, joint ventures, and flexibility. *Journal of International Business Studies*, **38**, pp. 1095–112.

Bellak, C. (2004). How domestic and foreign firms differ and why does it matter. *Journal of Economic Surveys*, **18**, pp. 483–514.

Bhattacharjee, A., Higson, C., Holly, S. and Kattuman, P. (2009). Macroeconomic instability and the business exit: determinants of failures and acquisitions of UK firms. *Economica*, **76**, pp. 299–318.

Bloningen, B. A. and Tomlin, K. (2001). Size and growth of Japanese plants in the United States. *International Journal of Industrial Organization*, **19**, pp. 931–53.

Boeri, T. and Bellmann, L. (1995). Post-entry behavior and the cycle: evidence from Germany. *International Journal of Industrial Organization*, **13**, pp. 483–500.

Buckley, P. J., Dunning, J. H. and Pearce, R. D. (1984). An analysis of the growth and profitability of the world largest firms, 1972 to 1977. *Kyklos*, **37**, pp. 3–26.

Caballero, R. J. and Engel, E. M. (1993). Microeconomic adjustment hazards and aggregate dynamics. *Quarterly Journal of Economics*, **108**, pp. 359–83.

Caballero, R. J. and Engel, E. M. (1999). Explaining investment dynamics in U.S. manufacturing: a generalized (S,s) approach. *Econometrica*, **67**, pp. 783–826.

Caballero, R. J., Engel, E. M. and Haltiwanger, J. (1997). Aggregate employment dynamics: building from microeconomic evidence. *American Economic Review*, **87**, pp. 115–37.
Cabral, L. M. (2007). Small firms in Portugal: a selective survey of stylized facts, economic analysis, and policy implications. *Portuguese Economic Journal*, **6**, pp. 65–88.
Cabral, L. M. and Mata, J. (2003). On the evolution of the firm size distribution: facts and theory. *American Economic Review*, **93**, pp. 1075–90.
Cantwell, J. A. and Sanna-Randaccio, F. (1993). Multinationality and firm growth. *Review of World Economics*, **129**, pp. 275–99.
Caplin, A. and Leahy, J. (1997). Aggregation and optimization with state-dependent pricing. *Econometrica*, **65**, pp. 601–25.
Coad, A. (2009). *The Growth of Firms: A Survey of Theories and Empirical Evidence*. Cheltenham, UK: Edward Elgar.
Cooper, R. W. (1998). Business cycles: theory, evidence and policy implications. *Scandinavian Journal of Economics*, **100**, pp. 213–37.
Cooper, R. W., Haltiwanger, J. C. and Power, L. (1999). Machine replacement and the business cycle: lumps and bumps. *American Economic Review*, **89**, pp. 921–46.
Duan, N., Manning, W. G., Morris, C. N. and Newhouse, J. P. (1983). A comparison of alternative models for the demand of medical care. *Journal of Business and Economic Statistics*, **1**, pp. 115–26.
Eurostat (2010). Short-term indicators. European Commission, Brussels (available at http://epp.eurostat.ec.europa.eu) (accessed date 27 March 2012).
Evans, D. S. (1987a). Tests of alternative theories of firm growth. *Journal of Political Economy*, **95**, pp. 657–74.
Evans, D. S. (1987b). The relationship between firm growth, size and age: estimates for 100 manufacturing industries. *Journal of Industrial Economics*, **35**, pp. 567–81.
Fazzari, S. M., Hubbard, R. G. and Petersen, B. C. (1988). Financing constraints and corporate investment. *Brookings Papers on Economic Activity*, **1988**, pp. 141–206.
Geroski, P. A. (2005). Understanding the implications of empirical work on corporate growth rates. *Managerial and Decision Economics*, **26**, pp. 129–38.
Geroski, P. and Gugler, K. (2004). Corporate growth convergence in Europe. *Oxford Economic Papers*, **56**, pp. 597–620.
Gibrat, R. (1931). *Les Inequalities Economiques*. Paris: Sirey.
Goddard, J., Tavakoli, M. and Wilson, J. O. (2009). Sources of variation in firm profitability and growth. *Journal of Business Research*, **62**, pp. 495–508.
Hamermesh, D. S. and Pfann, G. A. (1996). Adjustment costs in factor demand. *Journal of Economic Literature*, **34**, pp. 1264–92.
Hart, P. E. (2000). Theories of firms' growth and the generation of jobs. *Review of Industrial Organization*, **17**, pp. 229–48.
Hart, P. E. and Oulton, N. (1998). *Job generation in the UK corporate sector, 1986–95*. Discussion Paper 139. National Institute of Economic and Social Research.
Hart, P. E. and Oulton, N. (2001). Galtonian regression, company age and job generation 1986–95. *Scottish Journal of Political Economy*, **48**, pp. 82–98.
Higson, C., Holly, S. and Kattuman, P. (2002). The cross-sectional dynamics of the US business cycle: 1950–1999. *Journal of Economic Dynamics and Control*, **26**, pp. 1539–55.
Higson, C., Holly, S., Kattuman, P. and Platis, S. (2004). The business cycle, macroeconomic shocks and the cross-section: the growth of UK quoted companies. *Economica*, **71**, pp. 299–318.
Hölzl, W. and Huber, P. (2009). *An anatomy of firm level job creation rates over the business cycle*. WIFO Working Papers 348, Austrian Institute of Economic Research.
Jovanovic, B. (1982). Selection and evolution of industry. *Econometrica*, **50**, pp. 649–70.
Mody, A. (2004). Is FDI integrating the world economy? *The World Economy*, **27**, pp. 1195–222.
Moulton, B. R. (1990). An illustration of a pitfall in estimating the effects of aggregate variables on micro units. *The Review of Economics and Statistics*, **72**, pp. 334–8.

Nilsen, ∅. A., Salvanes, K. G. and Schiantarelli, F. (2007). Employment changes, the structure of adjustment costs, and plant size. *European Economic Review*, **51**, pp. 577–98.

Oberhofer, H. and Pfaffermayr, M. (2009). *Fractional response models - A replication exercise of Papke and Wooldridge (1996)*, Working Papers in Economics and Statistics 2009-02, University of Innsbruck.

Oberhofer, H. and Pfaffermayr, M. (2010). *Firm growth in multinational corporate groups*. Working Papers in Management and Economics 2010-7, University of Salzburg.

Oberhofer, H. and Pfaffermayr, M. (2012). FDI versus exports: multiple host countries and empirical evidence. *The World Economy*, **35**, pp. 316–30.

Papanastassiou, M. and Pearce, R. (eds.) (2009), *The Strategic Development of Multinationals: Subsidiaries and Innovation*. Basingstoke: Palgrave Macmillan.

Papanastassiou, M., Pearce, R. and Filippaios, F. (2009). Strategic internalization and the growth of the multinational firm. In M. Papanastassiou and R. Pearce (eds), *The Strategic Development of Multinationals: Subsidiaries and Innovation*. Basingstoke: Palgrave Macmillan, pp. 43–56.

Pearce, R. (2006). Globalization and development: an international business strategy approach. *Transnational Corporations*, **2006**, pp. 39–74.

Penrose, E. T. (1959). *The Theory of the Growth of the Firm*. New York: Blackwell Publishing.

Penrose, E. T. (2009). *The Theory of the Growth of the Firm*, 4th edn. Oxford: Oxford University Press.

Pohlmeier, W. and Ulrich, V. (1995). An econometric model of the two-part decisionmaking process in the demand for health care. *Journal of Human Resources*, **30**, pp. 339–61.

Ramalho, J. J. and Vidigal da Silva, J. (2009). A two-part fractional regression model for the financial leverage decisions of micro, small, medium and large firms. *Quantitative Finance*, **9**, pp. 621–36.

Ramalho, E. A., Ramalho, J. J. and Murteira, J. M. (2011). Alternative estimating and testing empirical strategies for fractional regression models. *Journal of Economic Surveys*, **25**, pp. 19–68.

Slater, M. (1980). The managerial limitation to the growth of firms. *Economic Journal*, **90**, pp. 520–8.

Sutton, J. (1997). Gibrat's legacy. *Journal of Economic Literature*, **35**, pp. 40–59.

Varejao, J. and Portugal, P. (2007). Employment dynamics and the structure of labor adjustment costs. *Journal of Labor Economics*, **25**, pp. 137–65.

Variyam, J. N. and Kraybill, D. S. (1992). Empirical evidence on determinants of firm growth. *Economics Letters*, **38**, pp. 31–6.

Date of receipt of final manuscript: 7 February 2012