Schimke, Antje; Brenner, Thomas

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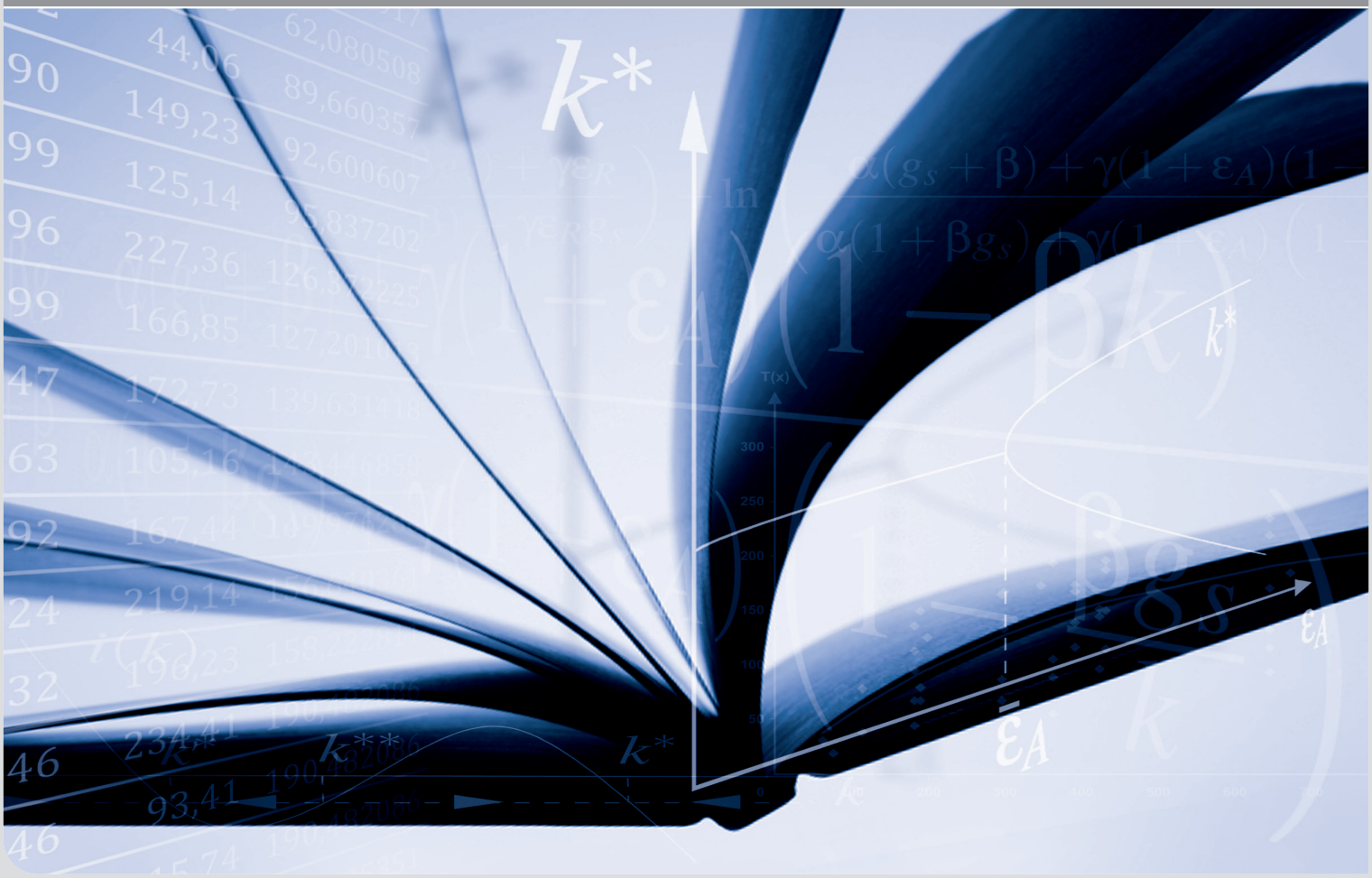

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Antje Schimke • Thomas Brenner

Abstract

This paper investigates whether the economic factors that are related to firm growth in the literature also determine the development path of firms. This means that we test which economic factors possess the ability to remain effective for a longer period of time. We examine three variables: firm size, innovation effort and export share. To this end, we use panel-data on 178 German manufacturing firms over the period from 1992 to 2007. We find that the determinants of permanent growth path are not the same as the determinants of firm growth at one point in time.

Keywords: Firm growth, firm growth paths, firm size, export, innovation effort

1 Introduction

Firm growth and its explanation is an important and well studied topic in the economic literature. A wide range of factors exist that are found to temporarily affect the growth of firms. However, the question of whether certain characteristics of firms imply that they grow more at a certain point in time is not the same as the question of whether certain firm characteristics imply that firms grow permanently. Knowledge about the issue whether certain firm characteristics imply an enduring firm growth is rare. Hence, whether most of the economic factors influencing firm growth remain effective and sustainable over time is unclear.

Understanding what causes firms to enter a permanent growth path is important in the context of economic competitiveness, structural change and growth, especially in the small business sector. Therefore, this paper aims to fill, at least, part of the gap that is identified above.

The existing literature on firm growth provides a wide range of theoretical and empirical findings on the influence of a number of factors and firm characteristics. Many studies have searched for significant relationships between various variables and growth (for an overview see Coad 2007, more details are presented in Section 2).

We start from this comprehensive knowledge about firm characteristics that cause growth, at least in the short run. We deduce from this knowledge expectations about the characteristics of firms that cause them to grow permanently. Therefore it might be interesting to take a more long-rum perspective, and see if it is possible to find some regularities in the growth processes. Hence, we test these expectations empirically.

The study is based on a sample of small and medium-sized manufacturing firms operating in Germany. The data is taken from the Mannheimer Innovation Panel, which allows us to follow 178 firms through the period from 1992 to 2007. Furthermore, the data base provides information about size, innovation activities and export shares of these firms. We classify the development paths of the firms and conduct regression analysis to identify the firm characteristics that come together with permanent growth.

The structure of the paper is as follows. Section 2 provides a review of literature in the domain of firm growth, which builds the starting point of the paper. The findings in the literature are used to deduce expectations for the empirical examination. Section 3 focuses on the methodology and sampling. It describes the data used and the methods applied. Section 4 discusses the results and draws conclusion on the determinants of development paths. In addition, it focuses on the robustness of the findings with respect to changes in the definition of development paths.

2 Background and hypotheses

A wide range of theories and empirical approaches exist that deal with firm growth (for an overview see Coad 2007). McKelvie and Wiklund 2010 summarize that there are three traditional kinds of research streams in the field of firm growth: Growth as an outcome, the outcome of growth and the growth process.

For this study, two kinds of approaches dealing with firm growth in terms of growth modes might be distinguished. Here, the theoretical discussion deals with stages of growth, paths of growth and rates of growth. First, there are approaches that aim at identifying and analysing firm growth stages and firms' development paths (e.g. Delmar et.al. 2003). Delmar et.al (2003) identifies different firm growth patterns that are related to firm age, size and industry affiliation. Additionally, they focus their analysis on the variation of measures of firm growth (e.g., relative, absolute sales growth, organic growth). Among them are approaches, such as Garnsey, Stam and Heffernan (2006), which focus on the sequence and

duration of growth phases during the life-cycle of firms. They analyse new firms' growth paths that are categorized by patterns of survival, continuousness of growth, turning points, reversals and cumulative growth. A few studies have focused their investigations on the importance of growth rates. Hence, the literature for the variation of growth rates and the conceptualization of growth is quite sparse.

Second, there are approaches that aim at identifying outside factors and firm characteristics that influence the growth of firms. Gibrat's Law, which states that firm growth is random, is considered falsified by most researchers nowadays (e.g., Lotti et.al 2009). Nevertheless, there seems to be an agreement that firm growth, especially in a short run, is much more random (e.g., Liu et.al. 1999). It is commonly assumed that there are some determinants which exert influence on firm growth. For example, Oliveira and Fortunato (2006) find that firms with higher foreign participation appear to grow faster than others. Other empirical studies examine whether firm growth can be explained by firm characteristics, such as size and age, sector and industry (e.g. Harhoff et. al 1998, Bottazzi and Secchi 2006) as well as the relation between strategic decision-making and firm performance (e.g., Baum 2003). Baum (2003) states that the speed of the entrepreneurs' decision-making (e.g. investments in R&D) predicts subsequent firm growth and profit.

Theoretical approaches address the topic from very different perspectives ranging from neoclassical theories of optimal size (Coase, 1937) and socio-economic point of view, in which the availability of resources and the competition for these resources are the core concepts of firm growth (e.g. van Stel et.al. 2007), to Penrose's theory (1959), which focuses on the internal learning-by-doing processes, and evolutionary concepts in which routines and the transition processes are important (Dosi and Nelson, 1994).

2.1 Knowledge about the determinants of firm growth

The existing research on factors that contribute to the growth of firms has focused on various variables. A bulk of studies concludes that firm growth is related to specific industries and firm size. Gallagher and Miller (1991) confirm that growing firms are overrepresented in some industries, especially in services, finance and distribution. Likewise, Davidsson and Delmar (2003) study commercially active firms in the private and non-governmental sector of Sweden and prove that high-growth firms are overrepresented in growing industries.

Researchers like Storey (1994), Kirchhoff et.al. (2002), Davidsson et.al. (2002) and Henrekson and Johansson (2008) conclude that firm size is one of most important factors for the determination of firm growth. Bigsten and Gebreeyesus (2007) find that the size of manufacturing firms is inversely related to their growth. Caves (1998) concludes that Gibrat's law holds for firms above a certain size threshold, whilst for smaller firms growth rates decrease with size. You (1995) surveyed the literature and arrived at a similar conclusion. Hart and Oulton (1996) study the relationship between size and growth and they find that the growth of firms is related to size.

A magnitude of the studies focuses on the impact of innovation on the growth prospects of firms (Almus and Nerlinger 1999, Coad and Rao 2006, Autio et.al. 2007). Based on these and further studies, innovation is acknowledged as one of the key drivers of firm performance and firm growth. Similarly, Del Monte and Papagni (2003) show that the growth rate of firms is positively correlated with research intensity. In line with this, Adamou and Sasidharan (2007) argue that R&D is an essential determinant of firm growth and find that an increase in R&D induces higher growth irrespective of the industry. By relating innovation efforts to sales growth for incumbent firms, Coad and Rao (2008) observe that innovation is of crucial importance to high-growth firms. Coad and Rao (2010) also find that firms are willing to increase their R&D activities after a positive growth shock. However, some studies have difficulties in identifying a significant impact of innovation efforts on firm growth. For example, Brouwer, Kleinknecht and Reijnen (1993) find that R&D expenditure has no

significant impact on the growth rates of firms. Corsino and Gabriele (2011) state that innovations in general do not affect firm growth significantly. In contrast, they find that incremental product innovations affect the revenue of certain business units.

In addition, a few studies in the field focus on the importance of exports. An article by Wijewardena and Corray (1995) presents weak statistical support for the hypothesis that greater export orientation leads to better growth performance in small industries. In this line, Wijewardena and Tibbits (1995) support the hypothesis that greater export orientation leads to better firm performance. A study by Bojnec and Xavier (2007) shows that export orientation reduces the firm exit. Another study by Liu and Hsu (2006), based on 280 Taiwan manufacturing firms, finds that the growth of firms is positively related to export. Using data on Austrian manufacturing firms, a paper by Pfaffermayr (2004) analyses the impact of the propensity to export on the growth performance of firms. The results show that foreign affiliate activity seems to preserve and even reinforce a firm's growth process. Obviously, the literature on exporting in relation to firm growth is quite sparse.

2.2 Expectations for the determinants of growth paths

A few studies have focused their examinations on the sequence and duration of the growth phases during the life course of panel-firms. A study by Garnsey, Stam and Heffernan (2006), based on 25 evolving firms operating in four different sectors, dealt with the categorization of these firms. This categorization was based on different features of new firms' growth paths. Similarly, Garnsey and Heffernan (2005) show that many different development paths exist and that the actual paths can be traced by a variety of growth measures at varying intervals.

In this paper we combine that literature on growth path with the literature on the determinants of firm growth. We examine whether the findings for the explanation of firm growth can be transferred to the explanations of firm's growth paths. Hence, the question is whether the determinants of growth are robust with respect to changing the perspective from a single growth step to a development path. To our knowledge the determinants of firm growth paths have not been comprehensively studied so far. The basic assumption is that growth determinants are robust to such a change in perspective. This would imply that we can transfer the findings on growth determinants in the literature to the explanation of development path. In the following we shortly discuss the implications of this assumption.

Above we have reported that the size of firms is a determinant of firm growth that is repeatedly confirmed in the literature. An inverse relationship is found. Hence, we can expect that growth paths are more frequently found among small firms. However, it is less clear in this case whether the results can be transferred to the medium-term perspective. Most fast growing firms are found among small firms. Hence, the average growth of small firms is higher. Whether this implies that we also find more permanently growing firms among the small firms is an open question. It might also be argued that large firms show a higher stability of their growth behaviour. We assume:

Hypothesis 1: (a) Permanently growing firms are more frequently found among small firms, (b) while large firms are more often characterised by a stable size.

Innovation activities are found in most of the literature to be another determinant of firm growth. Although there are studies that do not find a significant impact, we assume that innovation effort helps firms to grow and that this effect has a permanent character. Innovative firms should have a higher propensity to show continuously high growth rates. Therefore, we assume:

Hypothesis 2: Growth path are more likely to be found among firms that are characterised by high innovation efforts.

Finally, the literature reports a positive effect of the export share of firms on its growth rate. Again, it is plausible that this effect is of permanent nature. Firms that are highly export oriented should show continuously higher growth rates. Hence, we assume:

Hypothesis 3: Growth path are more likely to be found among firms that have high export shares.

A short discussion of determinants of short-run growth is given. Firm growth, in the short run, might be much more random as firm growth in a long run. Hence, the question is whether the determinants of firm growth are robust with respect to changing the perspective from a short-run growth (single step) to a long-run growth (development path). This makes it possible to see whether:

Hypothesis 4: The determinants of long-run growth and short-run growth are different.

Below we test these four hypotheses and the robustness of the confirmation or rejection of these hypotheses if the definition of growth paths is varied.

3 Methodology and data

3.1 Data source and studied firms

We use the Mannheimer Innovation Panel as data source. In this panel some more than 2.500 firms are questioned each year about their economic situation and processes. All firm characteristics that are relevant for our study are recorded in the Mannheimer Innovation Panel.

Nevertheless, we are not able to use the complete data set. The aim of our analysis is the identification of determinants for firms' growth paths. The growth paths are explained in section 3.2. Hence, data for several years is required. We consider the period from 1992 to 2007 and include in our analysis only firms that have participated in the questionnaire in each two-year period at least once.

Two additional conditions are applied that reduce the sample further. First, we restrict our analysis to the manufacturing sector (NACE-2-digit industries: 15 - 36). We examine the manufacturing sector, because no survey took place in the service sector in the years before 1995. This leads to a longer time study for the manufacturing sector. Second, our sample includes only small and medium sized enterprises with less than 250 employees. In the case of larger firms growth is influenced by mergers and acquisitions. We find that about 43 percent of the large firms are influenced by mergers. This means the turnover of large firms increased by 10 percent through mergers. Additionally, we find that about 40 percent of the large firms have been involved in a merger within the last three years. Therefore, we exclude these firms from the analysis.

Finally, the sample consists of 178 manufacturing firms. The size distribution of these firms is presented in Table 1. Most of the firms considered are small-sized and medium-sized firms.

Table 1: Firm size in terms of employment (SIZE)

Size*	**Cut-off points**	**Frequency**	**Percent [%] of Firms**
small	< =50 employees	99	**55.6**
medium	>50 – 250 employees	79	**44.4**
large	>250 employees	100 (excluded)	
Total		178	**100**

*SME definition of European Commission (2003)

3.2 Operationalisation of firms' development path

As presented above, there is a huge literature on firm growth. This literature provides clear concepts for the measurement of the growth of firms. According to Garnsey, Stam and Heffernan (2006) firm growth can be measured in terms of inputs (e.g. employees), in terms of value (e.g. assets) and in terms of outputs (e.g. sales). There is little agreement in the literature about what measure should be taken. Most common is the use of (relative/absolute) turnover growth rates or the number of employees.

In our case, numbers of employees tend to be the best choice. Employment data is less influenced by price effects, productivity effects, exchange rate effects and tax consideration. Furthermore, in our sample, employment data is less deteriorated by missing data. Therefore, we use the relative growth indicator on the basis of employment to measure firm growth:

$$RG_{t1t2} = (x_{t2} / x_{t1}) - 1.$$

However, we are not interested in growth as such, but in development paths. We want to analyse whether firms grow continuously and what characteristics these continuously growing firms share. Therefore, we have to classify firms according to their development path. The idea is to classify for each time step whether a firm grows, declines or stagnates. Continuously growing firms are those firms that grow in each time step. Therefore, we require a cut-off point that indicates the level at which firms are classified as being growing. In the empirical literature on firm growth, there is no explicit consensus of how to define such a cut-off point.

Studies measuring cut-off points of growth differ in terms of their definitions of growing firms, measurement of growth and the determination of the time period or time frame of study. Furthermore, they differ regarding the industries they observe, age and size of firms, methods and geographical coverage. This leads to a different identification of these firms in specific countries and sectors. In this paper, we employ the codes of the growth rates in reference to a paper by Garnsey, Stam and Heffernan (2006) that dealt with the categorization of new growing firms.

However, we do not restrict our analysis to one cut-off point. More information is gathered by repeating the analysis with different cut-off points. We use four different cut-off points: 2.5%, 5.0%, 7.5% and 10.0%. Hence, the different classes are defined as follows:

- One-step growth = employment growth at least 2.5%, 5.0%, 7.5% or 10.0% p.a.
- One-step stagnation = employment change less than 2.5%, 5.0%, 7.5% or 10.0 % p.a.
- One-step decline = employment decline at least 2.5%, 5.0%, 7.5% or 10.0% p.a.

This basic definition of growth, stagnation and decline for one time step is now used to define development paths. Similar to Garnsey, Stam and Heffernan (2006) we explore sample firms to identify trends in their paths of growth without losing important information on comparative patterns. In our sample we have data for the years 1992 to 2007. We aggregated the whole time span into 8 time periods: 1992-1993, 1994-1995, 1996-1997, 1998-1999, 2000-2001, 2002-2003, 2004-2005 and 2006-2007. In each time period we have, at least, one data set for all firms included in the analysis. Hence, we are able to classify each firm into the above three categories for each of the seven time-steps.

To examine these paths along these seven time steps we employ the following three main categories of development path: Growth (GR), Stagnation (ST) and Decline (DC). The three main categories comprise different variations of sub-categories and are shown in the following list:

Growth path (GR)

- GR_6: We say that a firm follows a strong growth path if it grew, at least, in six of the seven time steps and never experienced a period of decline.
- GR_5: Firms show an average growth path if they grew, at least, in five of the seven time steps and never experienced a period of decline.
- GR_4: We say that a firm follows a weak growth path if it grew, at least, in four of the seven time steps and never experienced a period of decline.

Stagnation path (ST)

- ST_6: We say that firms strongly stagnate if they stagnate, at least, in six of the seven time steps.
- ST_5: We say that firms show average stagnation if they stagnate, at least, in five of the seven time steps.
- ST_4: We say that firms weakly stagnate if they stagnate, at least, in four of the seven time steps.

Decline path (DC)

- DC_6: We say that a firm strongly declines if it declined, at least, in six of the seven time steps and never experienced a period of growth.
- DC_5: Firms show an average decline if they declined, at least, in five of the seven time steps and never experienced a period of growth.
- DC_4: We say that a firm weakly declines if it declined, at least, in four of the seven time steps and never experienced a period of growth.

Finally, we define for each set of categories (GR_6, ST_6, DC_6), (GR_5, ST_5, DC_5) and (GR_4, ST_4, DC_4) a category that contains all other firms. This category is called Mixed_6, Mixed_5 and Mixed_4, respectively. This implies that we have in total 12 categories. Furthermore, we defined four cut-off points: 2.5%, 5.0%, 7.5% and 10.0% per year. This implies that there are in total 48 categories. The numbers of firms categorized in these different categories are shown in Table 2.

Table 2: Absolute number of firms in the different development path categories

	Number of Firms			
	Growth Rates per Year			
Growth Paths	2.5%	5.0%	7.5%	10.0%
GR_6	25	29	30	18
GR_5	27	24	15	12
GR_4	46	22	10	2
ST_6	3	34	69	101
ST_5	15	59	102	134
ST_4	28	95	131	164
DC_6	20	24	20	16
DC_5	29	17	11	6
DC_4	47	17	7	4
Mixed_6	130	91	59	43
Mixed_5	107	78	50	26
Mixed_4	57	44	30	8

Each of these categories is used as dependent variable in one of the regressions conducted below, except of those categories in which the number of firms is too small.

3.3 Independent variables

In line with the hypotheses in Section 1, we use three independent variables for which we examine whether they are good predictors for the category in which a firm falls. These three independent variables are the size of the firm, the export rate, the R&D expenditures and the innovation activity. In addition we use industry assignment as a control variable because it is repeatedly reported in the literature that firms in different industries differ in their growth rates. However, it is beyond the scope of this paper to examine the differences between industries. Therefore, the results for the industry dummies are not discussed. Attention should be paid to the handling of missing values. These missing values are assumed to occur at-random. To run the logistic regressions, the statistic program has ignored and excluded the cases from relevant analysis. The default option of statistics is to exclude cases with missing values for any variable that is included in regression. We have changed this option so that the regression analysis does not exclude these cases completely from the regression. As a result, we might have a different number of cases for each variable. The data used and the definitions of these variables are described in the following:

Size of firms (SIZE)
We classified all firms into one of three size classes: small-sized enterprises (less than 50 employees) and medium-sized enterprises (more than 50 employees but less than 250 employees). The frequencies of the different size classes are given in Table 1. The independent variable SIZE shows the log form, because this produces a better fit than the apparently uses ratio-scaled variable. To control for firm size and to avoid endogeneity we use the log form of employment number reported in the first year of observation, in 1992.

Export ratio (EXPO)
In the Mannheimer Innovation Panel the firms report their export orientation in the form of the ratio between export and total turnover. First, we use the average over the reported values for the different years. This value is used as independent variable EXPO in the regressions. Second, we use the export expenditures for each year (*EXPO1992, EXPO1993 […] EXPO2007*).

R&D expenditure (R&D)
Firms report in the Mannheimer Innovation Panel also the ratio between their R&D expenditure and their total turnover. Again, we use the average value for the observed years and the single values (*R&D1992, R&D1993 […] R&D2007*).

Innovation projects (INV)
The firms are also asked in the Mannheimer Innovation Panel to report their expenditures for innovation projects, measured as the ratio of total expenditure to total turnover.

Industry classification
The Mannheimer Innovation Panel reports for each firm its industry classification. With a total number of 178 firms, there are only few firms in each class. Therefore, we aggregated the NACE-2-digit industries classification. Our aggregated industry classes are presented in Table 3.

Table 3: Type of industry

Description*	Code	Nace Code	Frequency	Percent [%]
Food, beverages, tobacco	1	15, 16	9	5.1
Textiles	2	17, 18	5	2.8
Leather articles	3	19	1	0.6
Wood products	4	20	2	1.1
Paper	5	21, 22	13	7.3
Petroleum products, nuclear fuel	6	23	1	0.6
Chemicals, man-made fibres	7	24	14	7.9
Rubber, plastic products	8	25	18	10.1
Non-metallic mineral products	9	26	10	5.6
Metals	10	27, 28	30	16.9
Machinery, equipment	11	29	28	15.7
Electrical and optical equipment	12	30 - 33	34	19.1
Transport equipment	13	34, 35	5	2.8
Furniture, consumer goods	14	36	8	4.5
Total			**178**	**100**

*NACE Codes Description

3.4 Regression approach

3.4.1 Short-run growth

We set up a regression approach with a linear model. The dependent variable is a continuous variable. It measures the relative growth of firms in terms of employment from one year to another, in the overall period 1992 to 2007 (e.g., 1992/1993, 1993/1994 […] 2006/2007). The regression framework follows a linear regression line that has an equation (1) of the form $Y = a + bX$.

$$GROWTH_j = a_0 + a_1 \cdot R\&D_j + a_2 \cdot EXPO_j \cdot \log(size_j) + \varepsilon$$

As independent variables we use the single value for *EXPO* and *R&D* as well as the log form of employment number *SIZE*. The analysis tries to explore exemplary the relationship between firm growth in the short run and their determinants. With this analysis we can see whether the determinants of short-run versus long-rung growth are different or not.

We set up estimations for short-run growth to compare with the results for the long-run growth.

3.4.2 Long-run growth

We apply a multiple regression with a logit model. The dependent variable is discrete, 0 or 1, denoting whether a firm shows the category of development path under consideration or not. The regression framework follows a discrete choice model specifying the probability that Y=1|X=x as dependent variable with Pr (Y=1|X=x) = f (x'β). In this manner, the most prominent link function is the logit function. The equation is as follows (2):

$$GROWTH_j = a_0 + a_1 \cdot INNO..._j + a_2 \cdot EXPO_j + a_3 \cdot \log(size_j) + a_{4-13} \cdot IndDummy_{1-13,j} + \varepsilon$$

As independent variables all the above described variables are used. *INNO* stands for the two different kinds of innovation activities such as R&D expenditures and expenditures for innovation projects. Employing different variations of development path categories, the analysis attempts to explore the prospective long term relationship between firm size, export orientation, R&D expenditure, innovation projects and firm growth. In the run-up to the regression analysis we found that the predictor variables R&D and INV are highly correlated, so that the statistical phenomenon of multicollinearity appears. To avoid multicollinearity between the variables R&D and INV we set up two different multiple regression models, in which each time one of the variables is excluded.

The coefficients of the logit model do not have a direct economic implication. Measures that are familiar to economists are marginal effects. After running the regression we generate the marginal effects and coefficients to draw some main conclusion on the strength of the effects on the probability that a firm grows, stagnates or declines.

4 Results and Interpretation

4.1 Regression Results

In total there several regression results conducted for the short-run growth. In regard to analysis for the long-run growth there are 48 development path categories defined above. For some categories the number of firms that are classified into these categories is so small that we did not conduct a regression analysis. For all other categories two regression are conducted: one including all independent variables except R&D and one including all independent variables except INV.

The regression results are reported in Tables 6, 7 and 8. We discuss the results in the following separately for the different hypotheses that have been set up in Section 2.

Table 6: Regression results for long-run growth (excluding INV)

Growth Paths	Cut-off Point for Yearly Growth Rates	Regression Results				
		EXPO	R&D	SIZE LOG	observation	R^2
GR_6	2.5%	-0.0126	-0.0259	-0.0758	45	0.04
	5.0%	-0.0299	0.3766*	-0.4435	45	0.14
	7.5%	-0.0352	0.0569	-0.384	50	0.09
	10.0%	-0.042	-0.1743	-0.5355	47	0.15
GR_5	2.5%	0.0371	0.0645	-0.1234	50	0.10
	5.0%	-0.0426	0.1892	-0.6842*	45	0.14
	7.5%	-0.0227	-0.0109	-0.2722	47	0.07
	10.0%	-0.0284	-0.3285	-0.5817	31	0.15
GR_4	2.5%	-0.0529**	0.0183	-0.5719	54	0.19
	5.0%	-0.0211	-0.048	-0.9330**	45	0.17
	7.5%	0.1107*	-0.1883	-2.6152**	38	0.43
	10.0%	-	-	-	-	-
ST_6	2.5%	-	-	-	-	-
	5.0%	0.0599	-2.5311*	4.1109**	45	0.58
	7.5%	0.0101	-0.0979	0.8888**	54	0.26
	10.0%	0.012	-0.0825	0.4527	61	0.11
ST_5	2.5%	0.0518	-2.0122	16.638	28	0.48
	5.0%	0.01383	0.3624	1.5123***	54	0.34
	7.5%	0.0022	-0.0237	0.5874*	59	0.13
	10.0%	0	-0.1047	0.8891**	54	0.16
ST_4	2.5%	0.0344	-1.6236	1.1844	45	0.34
	5.0%	-0.016	0.1492	0.6072*	52	0.14
	7.5%	-0.0247	0.3248	0.5278	55	0.15
	10.0%	-33.179	57.5944	-34.7493	15	0.91
DC__6	2.5%	-0.0436	-4.6239**	3.9222**	40	0.53
	5.0%	-0.0222	-1.0771	0.9433	39	0.24
	7.5%	0.0089	-0.7568	10.215	29	0.19
	10.0%	0.0035	-0.2290	0.5339	23	0.07
DC_5	2.5%	-0.0104	-2.0979**	3.2933**	49	0.42
	5.0%	-	-	-	-	-
	7.5%	0.0403	-0.5367	0.3636	24	0.22
	10.0%	-0.0109	-0.2420	-0.2820	20	0.21
DC_4	2.5%	0.0163	0.0208	0.3386	52	0.14
	5.0%	0.0302	0.0721	-0.569	32	0.23
	7.5%	0.0318	-0.1012	-0.5647	20	0.17
	10.0%	-	-	-	-	-
Mixed_6	2.5%	0.0142	0.3936	-0.5316	56	0.15
	5.0%	0.0075	-0.0144	-0.5098	56	0.12
	7.5%	0.0079	0.0389	-0.6338**	61	0.12
	10.0%	0.0064	0.122	-0.5748	59	0.13
Mixed_5	2.5%	0.0097	0.2717	-0.7191**	56	0.16
	5.0%	0.008	-0.1039	-0.5266	56	0.11
	7.5%	0.003	0.0487	-0.6136*	59	0.14
	10.0%	0.0167	0.1795	-1.3703**	29	0.29
Mixed_4	2.5%	-0.0016	0.0007	-0.0835	50	0.09
	5.0%	0.0161	-0.1620	0.4295	36	0.22
	7.5%	-0.0115	-0.3483	0.1975	48	0.11
	10.0%	-	-	-	-	-

standard errors in parentheses

*** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$

Table 7: Regression results for long-run growth (excluding R&D)

Growth Paths	Cut-off Point for Yearly Growth Rates	Regression Results				
		EXPO	INV	SIZE LOG	observation	R^2
GR_6	2.5%	0.0228	-0.0109	-0.4491	42	0.08
	5.0%	-0.0251	0.0899	-0.4902	42	0.15
	7.5%	-0.026	0.0438	-0.6714*	46	0.17
	10.0%	-0.031	-0.0232	-0.9731**	42	0.24
GR_5	2.5%	0.0058	0.0190	-0.5297	47	0.12
	5.0%	-0.0277	0.0575	-0.7355*	42	0.17
	7.5%	0.003	0.0264	-0.7829*	42	0.13
	10.0%	0.0329	-0.1327	-1.8432*	26	0.34
GR_4	2.5%	-0.0480*	0.0004	-0.7059**	56	0.27
	5.0%	0.1065*	-0.3262	-2.7155**	42	0.46
	7.5%	0.1955*	-0.3000	-3.4892**	36	0.55
	10.0%	-	-	-	-	-
ST_6	2.5%	-	-	-	-	-
	5.0%	0.0349	-0.5785	3.0319*	42	0.46
	7.5%	-0.0302	0.1147	1.3469***	52	0.27
	10.0%	-0.0068	0.0169	0.6158*	59	0.11
ST_5	2.5%	0.0834	-0.8459	0.2428	27	0.47
	5.0%	-0.0102	0.2740*	2.0208***	52	0.42
	7.5%	-0.0198	0.049	0.9548***	59	0.2
	10.0%	-0.0246	-0.0158	1.1467***	53	0.18
ST_4	2.5%	0.0239	-0.3866	0.8219	38	0.28
	5.0%	-0.0575**	0.1771*	1.1342**	47	0.27
	7.5%	-0.0357	0.1887*	0.8588**	54	0.21
	10.0%	-19.416	1.075.805	150.844	16	0.92
DC_6	2.5%	-0.0343	-1.0540**	17.802	37	0.46
	5.0%	-0.0115	0.0584	0.5551	40	0.13
	7.5%	0.0643*	-1.0642**	1.5222*	39	0.43
	10.0%	0.0083	-0.1362	0.4947	33	0.17
DC_5	2.5%	0.0072	-0.8110**	2.1799**	45	0.43
	5.0%	0.0625	-1.0676*	-0.2162	35	0.41
	7.5%	0.0332	-0.7255*	0.2176	35	0.32
	10.0%	-0.0089	-0.1155	-0.2505	21	0.17
DC_4	2.5%	0.0406**	-0.0345	0.3737	53	0.18
	5.0%	0.0384	-0.0015	-0.0788	44	0.18
	7.5%	0.0239	-0.1013	-0.4018	21	0.1
	10.0%	-	-	-	-	-
Mixed_6	2.5%	0.0002	0.1470	-0.1527	55	0.08
	5.0%	0.0009	-0.0832	-0.4979	55	0.11
	7.5%	0.0161	-0.01142	-0.6594*	59	0.14
	10.0%	0.0134	0.0223	-0.5483	59	0.13
Mixed_5	2.5%	-0.1245	0.1389	-0.3876	55	0.13
	5.0%	0.0131	-0.1012	-0.7147**	55	0.14
	7.5%	0.0117	-0.0007	-0.7334**	59	0.18
	10.0%	0.0345	0.0605	-1.2184*	30	0.28
Mixed_4	2.5%	-0.0391	0.0725	0.1424	59	0.11
	5.0%	0.0043	-0.0885	-0.0600	36	0.18
	7.5%	-0.0014	-0.2004	-0.1568	47	0.17
	10.0%	-	-	-	-	-

standard errors in parentheses

*** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$

Table 8: Regression results for short-run growth

Relative Employment growth in a short-run from 1992-2007 (one year step)					
variable	**(1) 92/93**	**(2) 93/94**	**(3) 94/95**	**(4) 95/96**	**(5) 96/97**
			same year:		
EXPO	-0.0528	0.0360	-0.0269	0.2170	0.1300
R&D	0.2231	0.2856	-0.1986	-0.5110	0.1647
SIZE(log)	-0.0144	-0.0248	0.0057	-0.0114	-0.0258
observation/R^2	93/0.2	92/0.20	84/0.25	63/0.25	70/0.2
			one year before:		
EXPO	-	0.0316	-0.0629	-0.0257	-0.0057
R&D	-	0.3466	-0.2508	-0.1759	0.7273
SIZE(log)	-	-0.0258	-0.0256	0.0037	-0.0203
observation/R^2	-	90/0.2	85/0.3	72/0.25	60/0.2
			two years before:		
EXPO	-	-	0.0071	0.1611	-0.0010
R&D	-	-	-0.2417	-0.2764	0.7939
SIZE(log)	-	-	-0.0280	-0.0144	-0.0266
observation/R^2	-	-	91/0.3	77/0.2	73/0.2
variable	**(6) 97/98**	**(7) 98/99**	**(8) 99/00**	**(9) 00/01**	**(10) 01/02**
			same year:		
EXPO	0.1642	-0.2237*	-0.0853	-0.0551	0.0714
R&D	-0.0998	0.0619	0.1318	-0.4123	-0.4278
SIZE(log)	0.0469*	0.0308	-0.0176	0.0108	0.0359*
observation/R^2	64/0.2	65/0.3	76/0.2	51/0.1	81/0.3
			one year before:		
EXPO	-0.0394	-0.2190*	0.0897	-0.0894	-0.0395
R&D	0.6984	0.2377	1.2732***	-0.2579	-0.8360
SIZE(log)	0.0238	0.0332	-0.0345	0.0089	0.0158
observation/R^2	78/0.1	61/0.3	59/0.3	71/0.1	51/0.2
			two years before:		
EXPO	-0.0457	0.0340	0.1180	-0.0740	-0.2220*
R&D	0.0838	1.2040**	0.7072	1.1345**	-0.4793
SIZE(log)	0.0118	-0.0470**	-0.0311	0.0262	0.0354
observation/R^2	71/0.2	78/0.3	55/0.2	58/0.3	71/0.3
variable	**(11) 02/03**	**(12) 03/04**	**(13) 04/05**	**(14) 05/06**	**(15) 06/07**
			same year:		
EXPO	-0.2501	0.1008	0.0190	0.0669	-0.1541
R&D	-0.5674	0.6738	0.6913	0.5698	2.2513**
SIZE(log)	0.0102	-0.1300***	0.0023	-0.0060	0.0624**
observation/R^2	69/0.1	56/0.4	75/0.3	83/0.1	64/0.3
			one year before:		
EXPO	-0.3360	-0.2305**	0.1630	0.0371	-0.0774
R&D	0.2760	0.1915	-0.0791	1.0784*	11286.0000
SIZE(log)	0.0053	-0.1024***	-0.0369	0.0051	0.0416*
observation/R^2	61/0.1	66/0.4	52/0.3	67/0.2	82/0.2
			two years before:		
EXPO	0.0882	0.1760	-0.0728	0.0240	0.0172
R&D	-0.6967	-0.2664	2.6104**	0.6650	-0.3714
SIZE(log)	-0.0226	-0.0875***	0.0134	-0.0018	0.0154
observation/R^2	42/0.2	58/0.5	72/0.4	48/0.1	73/0.25

4.2 Firm size (Hypothesis 1)

We have concluded above from the findings in the literature that small firms should be expected to grow permanently more often (Hypothesis 1a), while large firms should be expected to show more often stagnation (Hypothesis 1b).

The former claim (Hypothesis 1a) is confirmed by our results. We find for most categories that denote permanent growth (GR_6, GR_5 and GR_4) a significantly negative coefficient for the size of firms. This means that larger firms are less likely to show permanent growth, while smaller firms are more likely to show growth paths. The details of the results show two interesting aspects.

First, the results are less significant if the R&D expenditure (R&D) is included in the model instead of expenditures for innovation projects (INV). Hence, part of the effect that smaller firms seem to be more likely to growth permanently seems to be explainable by a higher innovation effort.

Second, if we look at the more significant results of the regression with the INV variable, we slightly see a difference between the growth categories. For GR_6 and GR_5 no significant relationship is found for the cut-off points at 2.5 and 5.0 percent employment growth per year, while size is significantly related to cut-off points at 5.0 to 10.0 percent employment growth per year. Hence, if we only consider firms that grow almost at all time steps, smaller firms appear significantly more often. If we are less rigorous and include firms that also show phases of stagnation, smaller firms are strongly over-represented in the growth path (GR_4) with cut-off points at 2.5 to 7.5 percent employment growth per year.

This helps us to understand why Hypothesis 1a is partially confirmed. Other studies show that smaller firms grow on average faster than larger firms. However, these studies look at one time step. If we extend the perspective to a longer period, smaller firms are more likely to show growth in several time steps. The regression results also show that smaller firms are much more likely to be found in the mixed categories (Mixed_6 and Mixed_5). Smaller firms are more influenced by economic fluctuation (e.g. price effects, productivity effects). Hence, smaller firms exhibit greater up- and downturns in their life cycles.

The literature states that firm size is one of the most important factors for the determination of firm growth (see, e.g., Wijewardena, H. & Tibbits, G. 1999). We also find a strong relationship between firm size and permanent growth. Thus, the results from the literature can be transferred to our research question. While the literature finds that small firms make a larger contribution to net employment growth (Davidsson et.al 2002, Henrekson & Johansson 2008 and Halabisky et.al. 2006), we find that larger firms are less likely to grow continuously. Small firms might grow faster but are more volatile.

The other part or Hypothesis 1 (part b) is confirmed by our analysis. Although this finding is not always significant, we find evidence for the claim that larger firms are more likely to show continuous stagnation. Larger firms seem indeed to be less vulnerable to changes in the circumstances. We might conclude that large firms are more often found in all categories of permanent development. However, this holds for the categories of continuous decline (DC_6 and DC_5). We find significant positive relationships between belonging to these categories (rather a cut-off point at 2.5 percent employment decline per year) and the size of firms. Hence, the higher sustainability of development in larger firms only applies to stagnation and decline.

4.3 Innovation efforts (Hypothesis 2)

In the literature innovations are usually seen as a determinant of growth. Empirical research on firm growth confirms this belief. Therefore, Hypothesis 2 states that firms with higher innovation efforts should also be more likely to show permanent growth.

In our analysis we use two measures for innovation efforts: R&D expenditures (R&D) and innovation projects (INV). Both cannot be used in the same regression analysis due to multicollinearity problems. Therefore, we use two regressions, including one of these measures each time. We expect similar results for the two measures because they measure approximately the same. This is not the case: the results are quite different.

Using the R&D expenditures (R&D) as independent variable we find significant results for this variable. A positive significant coefficient is found for firms showing a growth path (GR_6) if the 5%-cut-off point is used. This means, firms with high investments in R&D are more likely to show permanent growth. This holds especially for the strong growth path (GR_6) that grew, at least, in six of the seven time steps and never experienced a period of decline.

We find a significantly negative coefficient for the category of a stagnation path (ST_6). Thus, investments in R&D seem to help firms to avoid strong growth stagnation. This means the firms stagnate, at least, in six of the seven time steps.

Additionally, we find strong and highly significant coefficients for the shrinking categories (DC_6, DC_5) with a cut-off point of 2.5 percent. Therefore, firms with high R&D expenditures are less likely to be continuously declining.

The expectation was that firms with many innovation projects (high values of INV) are more likely to show continuous growth. This is not confirmed by the empirical analysis: For none of the growth path (GR_6, GR_5 and GR_4) any significant result is obtained.

Significantly positive coefficients are found for the categories of stagnating development paths (ST_5, ST_4). This holds for the cut-off points at 5.0 to 7.5 percent. Hence, firms with high investments in innovation projects are not more likely to continuously grow but are more likely to show stable development.

The coefficients of INV for the shrinking categories (DC_6, DC_5) produce significant results with a negative sign. This holds for the cut-off points at 2.5 to 7.5 percent. We interpret this as a statistical support for an alternative formulation of Hypothesis 3: Firms with high expenditures for innovation projects (INV) are less likely to be continuously declining. This holds especially for a very permanent decline (five or six out of seven time steps). The finding does not hold for very strong decline (more than 10%). Hence, investments in innovation projects seem to help firms to avoid continuous small and medium decline.

To sum up, Hypothesis 2 is partially confirmed by our results. Whilst firms with high R&D expenditures are more likely to show a permanent growth path, for firms with investments in innovation projects the hypothesis has to be reformulated into: Higher innovation efforts are connected to a smaller likelihood of continuous decline and more continuous stagnation in the development of the firm.

4.4 Export share (Hypothesis 3)

Above we hypothesized that higher export shares lead to a higher probability of continuous growth (Hypothesis 3). This is partially confirmed by our empirical examination. If innovation projects (INV) are used as independent variable in the regression analysis, we find significant results for different categories. Additionally, we focus on the findings for the regressions in which R&D expenditures are used as independent variable. These regressions produce significant results for one category.

In both regressions significant coefficients are found for the export share in the study of growth path (GR_4) for a cut-off point at 2.5 percent employment growth per year. However, the sign of the coefficients is opposite to what we expected in Hypothesis 4: A high export share makes permanent growth less likely. This contradicts the findings in the literature that a high export rate leads to high firm growth (Pfaffermayr 2004 and Wijewardena & Tibbits 1999). Again, we have to take into consideration that we do not

analyse firm growth in one time step but development paths. Therefore, to understand the results, we have to check the other results. In the case of growth paths (GR_4) with cut-off points from 5.0 to 7.5 percent the relationship between exporting and firm growth turns into a significant positive relationship. This means, higher export shares lead to higher probability of a weak growth path (grew, at least, in four of the seven time steps and never experienced a period of decline).

Using the R&D variable as independent variable, the results are no longer significant. Therefore, we focus our interpretation on the results for innovation projects (INV). A significantly negative relationship is found between the export share and the observation of continuous stagnation (ST_4). This holds for the cut-off point of 5.0 percent. Thus, exports seem to help firms to avoid weak growth stagnation. This means, the firms stagnate, at least, in four of the seven time steps.

If we look at the results for the decline path (DC_4), we find a significantly positive coefficient. We interpret this as statistical support for the assumption that firms high on exports are less likely to be continuously declining. This seems to hold especially if the cut-off point is defined very narrow (rather for cut-off points at 2.5 percent employment growth per year). The finding does not hold for strong decline (more than 5.0 percent). Hence, exporting seems to help firms to avoid continuous micro and small decline.

4.5 Short-run growth (Hypothesis 4)

In the literature you can find comprehensive knowledge about firm characteristics that cause growth, at least in the short run. In the process of our analyses as well as to , a short discussion of short-run growth versus long-run growth is given. This makes it possible to see whether the determinants of short-run growth and long-run growth are really different. To compare the results, we set up the following hypothesis 4 that state that the determinants of long-run growth and short-run growth are different (see Table 8).

First, we find significant coefficients for the independent variable EXPO (marked in red). These coefficients are always with a negative sign. While we find a positive relationships between exporting and long-run growth (see Table 7), the results for short-run growth show a negative relationship between exporting and growth. In the case of exporting, the determinants of single steps of development and the determinants of development paths are quite different.

Second, using the R&D expenditure as independent variable, we always find strongly significant coefficients with a positive sign (marked in green). This might lead to the assumption that R&D expenditures have a positive impact on firms' growth. While investments in R&D in any one year strongly affect the growth in the subsequent year, the impact of R&D in a long-run turns into a negative relationship between innovation effort and firm growth.

To sum up, hypothesis 4 is confirmed by our results. To our knowledge the determinants of firm growth paths and firm growth in single steps are different. This would imply that we cannot transfer the findings on growth determinants in a short-run to the explanation of development paths.

5 Conclusions

In this paper we analyse whether the factors that are found to be related to firm growth in the literature are also related to continuous growth of firms in the medium run. The literature usually examines whether certain characteristics are related to a higher average growth rate. We study whether these characteristics are also related to the probability of permanent growth. Hence, this paper moves the perspective from average growth to the

structure of development paths. We find that changing the perspective also changes the results of the empirical analysis tremendously.

While smaller firm sizes come together with higher average growth rates, smaller firms are more likely to grow permanently. To the contrary, smaller firms are less likely to grow in several successive time steps. They show higher fluctuations in the development than larger firms. Larger firms, in contrast, show more often a stable firm size and stable growth path.

Differences between the two perspectives on firm growth are also found for innovation efforts. While in the literature a positive impact of innovation activities on firm growth is repeatedly reported, we do not find that innovative firms do more frequently show sustainable growth. However, we find that innovative firms are less likely to decline continuously. Furthermore, they are more likely to show fluctuations in the development with growth and decline phases.

Similar differences are found for the export shares. Again, the literature reports that higher export shares are related to higher average growth rates, while we find that firms with high export shares are likely to show continuous growth. Considering the medium run development of firms, high export shares come along with a more stable development, meaning that such firms are more likely to show continuous stagnation.

To sum up our findings, we conclude that high average growth rates and development path with permanent growth are very different things. If we want to understand how firms enter a positive or negative development track, determinants of average growth do not help. The characteristics of firms that imply certain development paths are different from those that explain average growth. So far studies on firms' development paths are rare; so that there is great potential for further studies on what determines how firms develop. This study is only a first step in this direction.

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