

Schimke, Antje; Brenner, Thomas

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***Long-run Factors of Firm Growth –  
A Study of German Firms***

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. Then, 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). Two kinds of approaches might be distinguished. First, there are approaches that aim at identifying and analysing firm growth stages or firms' development paths (e.g. Delmar et.al. 2003). 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. Thereby, firm growth can be measured in terms of inputs, in terms of value and in terms of outputs (Garnsey et.al. 2006).

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. 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, and by sector and industry (e.g. Harhoff et. al 1998 and Bottazzi and Secchi 2006).

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. Uhlaner 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 specific 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), Kirchoff 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.

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) prove 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. 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.

In addition, some literature in the field focuses 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.

## **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.*

Below we test these three 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. 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 interpret that the mechanisms of growth are different in the service sector and, therefore, examine the manufacturing sector only. Second, our sample includes only micro, small and medium sized enterprises with less than 250 employees. In the case of larger firms growth is influenced strongly by mergers and acquisitions. 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*	Frequency	Percent [%] of Firms
micro	17	9.5
small	82	46.1
medium	79	44.4
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:

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

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 (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 (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 (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

Growth Paths	Number of Firms			
	Growth Rates per Year			
	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	42	69	101
ST_5	15	68	102	134
ST_4	28	103	131	164
DC_6	20	28	20	16
DC_5	39	23	11	6
DC_4	47	23	7	4
Mixed_6	130	99	59	43
Mixed_5	107	83	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: micro-sized enterprises (less than 10 employees), small-sized enterprises (more than 10 employees but less than 50 employees) and medium-sized enterprises (more than 50 employees but less than 250 employees). The average employment number reported during the observed time period in the Mannheimer Innovation Panel is used for this classification. The independent variable SIZE takes the value 1 for micro-sized enterprises, the value 2 for small-sized enterprises and the value 3 for medium-sized enterprises. The frequencies of the different size classes are given in Table 1.

#### *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. Again, we use the average over the reported values for the different years. This value is used as independent variable EXPO in the regressions. Table 4 gives an overview on the values that are found in our sample. 32 firms have not reported their export ratio.

Table 4: Export to turnover ratio (EXPO)

Exports to Turnover Ratio* (Percent)	Frequency	Percent [%] of Firms
0	14	7.8
1 - 5	39	21.9
6 - 25	43	24.2
26 - 50	33	18.5
51 - 100	17	9.6
Missing data	32	18.0
Total	178	100

\*categorisation of exports to sales ratio also used by Wijewardena, H. & Tibbits, G. (1999)

### *R&D expenditure (R&D)*

Firms report in the Mannheim Innovation Panel also the ration between their R&D expenditure and their total turnover. Again, we use the average value for the observed years. An overview on the resulting values is given in Table 5. Unfortunately, 43.3 percent of firms' information regarding the R&D expenditure is not useable, due to incomplete data.

Table 5: R&amp;D expenditure to turnover ratio (R&amp;D)

R&D-expenditure to Turnover Ratio (Percent)	Frequency	Percent [%] of Firms
0	27	15.2
1 – 10	62	34.8
11 – 50	7	3.9
51 - 100	5	2.8
Missing data	77	43.3
Total	178	100

### *Innovation projects (INV)*

The firms are also asked in the Mannheim Innovation Panel to report their expenditures for innovation projects, measured as the ratio of total expenditure to total turnover. Table 6 summarises these expenditures for innovation projects. Again, we have to deal with quite a number of missing values.

Table 6: Expenditures on innovation projects in relation to total turnover (INV)

INV-expenditure to Turnover Ratio (Percent)	Frequency	Percent [%] of Firms
0	11	6.2
1 - 10	56	31.5
11 - 25	21	11.8
25 - 50	11	6.2
51 - 100	2	1.1
Missing data	77	43.3
Total	178	100

### *Industry classification*

The Mannheim 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 7. We use 14 different classes of industries. For each industry a dummy is included in the regression analysis.

Table 7: 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
<b>Total</b>			<b>178</b>	<b>100</b>

\*NACE Codes Description

### 3.4 Regression approach

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  $\Pr(Y=1|X=x) = f(x'\beta)$ . In this manner, the most prominent link function is the logit function.

As independent variables all the above described variables are used. 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 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 results are reported in Tables 7 and 8. We discuss the results in the following separately for the different hypotheses that have been set up in Section 2.

**Table 7: Regression results (excluding INV)**

Growth Paths	Cut-off Point for Yearly Growth Rates	Regression Results			
		EXPO	R&D	SIZE	R <sup>2</sup>
GR_6	2.5%	-0.016	-0.198	0.026**	0.15
	5.0%	-0.026	-0.017	0.028**	0.16
	7.5%	-0.025	-0.063	0.020**	0.15
	10.0%	-0.037	-0.073	0.031**	0.19
GR_5	2.5%	-0.039*	0.062	0.023**	0.16
	5.0%	-0.062	-0.077	0.043**	0.19
	7.5%	-0.028	-0.460	0.044**	0.28
	10.0%	-0.017	-0.492	0.028**	0.21
GR_4	2.5%	-0.037**	-0.026	0.007	0.08
	5.0%	0.029	-0.104	0.001	0.09
	7.5%	0.018	-0.569	0.005	0.26
	10.0%	-	-	-	-
ST_6	2.5%	-	-	-	-
	5.0%	0.051**	0.059	0.022*	0.28
	7.5%	0.029*	0.117	0.019**	0.19
	10.0%	0.016	0.049	-0.003	0.09
ST_5	2.5%	0.022	-0.068	-0.001	0.11
	5.0%	0.041	0.180	0.006	0.14
	7.5%	0.016	0.038	0.002	0.12
	10.0%	0.011	-0.044	0.001	0.13
ST_4	2.5%	0.034*	-0.079	0.013	0.12
	5.0%	0.001	0.019	0.011	0.12
	7.5%	-0.002	0.152	0.012	0.12
	10.0%	-0.008	0.086	0.069	0.24
DC__6	2.5%	-0.028	1.259	-0.012	0.28
	5.0%	-0.025	-0.483	-0.016	0.22
	7.5%	-0.013	-0.161	-0.018	0.22
	10.0%	0.003	-0.583	0.006	0.14
DC_5	2.5%	-0.001	-0.176	-0.008	0.15
	5.0%	-	-	-	-
	7.5%	0.037	-0.240	-0.049	0.29
	10.0%	-	-	-	-
DC_4	2.5%	0.010	0.027	-0.010	0.09
	5.0%	0.020	0.143	-0.028	0.39
	7.5%	-	-	-	-
	10.0%	-	-	-	-
Mixed_6	2.5%	0.015	0.319	-0.017*	0.17
	5.0%	-0.007	0.053	-0.023	0.15
	7.5%	-0.009	0.048	-0.026	0.15
	10.0%	-0.010	0.069	-0.025*	0.12
Mixed_5	2.5%	0.009	0.149	-0.008	0.09
	5.0%	-0.031	-0.018	-0.020**	0.16
	7.5%	-0.015	0.043	-0.019*	0.16
	10.0%	-0.001	0.219**	-0.068*	0.25
Mixed_4	2.5%	0.001	0.024	0.000	0.09
	5.0%	-0.001	-0.077	-0.012	0.13
	7.5%	-0.013	-0.081	-0.017	0.09
	10.0%	-	-	-	-

standard errors in parentheses

\*\*\* p &lt; 0.01 \*\* p &lt; 0.05 \* p &lt; 0.1

**Table 8: Regression results (excluding R&D)**

Growth Paths	Cut-off Point for Yearly Growth Rates	Regression Results			
		EXPO	INV	SIZE	R <sup>2</sup>
GR_6	2.5%	0.018	-0.086	0.015	0.13
	5.0%	-0.034	-0.007	0.028**	0.13
	7.5%	-0.015	-0.000	0.015	0.13
	10.0%	-0.022	-0.042	0.021*	0.12
GR_5	2.5%	-0.003	-0.043	0.015	0.08
	5.0%	-0.005	-0.024	0.024**	0.14
	7.5%	-0.012	-0.034	0.028*	0.16
	10.0%	0.245	0.041	-0.030	0.22
GR_4	2.5%	-0.021	-0.007	-0.001	0.04
	5.0%	0.052	-0.030	-0.021	0.13
	7.5%	0.020	0.000	-0.001	0.14
	10.0%	-	-	-	-
ST_6	2.5%	-	-	-	-
	5.0%	0.166	-0.075	0.016	0.34
	7.5%	0.014	0.050	0.024**	0.18
	10.0%	0.004	0.002	0.008	0.12
ST_5	2.5%	0.017	-0.121	0.005	0.15
	5.0%	0.013	0.076	0.021**	0.22
	7.5%	0.003	0.035	0.014*	0.16
	10.0%	-0.009	-0.052	0.019*	0.18
ST_4	2.5%	0.025	-0.119	0.023*	0.25
	5.0%	0.029	0.064	0.025**	0.24
	7.5%	-0.004	0.048	0.024**	0.20
	10.0%	0.006	-0.020	0.090	0.27
DC_6	2.5%	-0.007	-1.000**	0.025	0.36
	5.0%	-0.033	-0.632**	0.015	0.31
	7.5%	0.016	-0.495**	-0.001	0.28
	10.0%	0.001	-0.082	0.003	0.11
DC_5	2.5%	0.003	-0.389**	0.009	0.22
	5.0%	0.016	-0.593**	-0.002	0.32
	7.5%	0.067	-0.719**	-0.041	0.37
	10.0%	-0.367	0.072	-0.060	0.48
DC_4	2.5%	0.024*	-0.082	-0.005	0.14
	5.0%	-0.015	0.012	0.001	0.19
	7.5%	0.034	-0.015	-0.029	0.35
	10.0%	-	-	-	-
Mixed_6	2.5%	-0.004	0.279**	-0.0247**	0.23
	5.0%	-0.109	0.042	-0.032**	0.26
	7.5%	-0.005	0.046	-0.035**	0.20
	10.0%	-0.005	0.081	-0.044**	0.20
Mixed_5	2.5%	-0.009	0.205**	-0.012	0.18
	5.0%	-0.007	0.046	-0.028**	0.21
	7.5%	-0.011	0.056	-0.033**	0.23
	10.0%	-0.051	0.161**	-0.069*	0.34
Mixed_4	2.5%	-0.015	0.091**	-0.001	0.11
	5.0%	-0.038	-0.045	-0.017	0.16
	7.5%	-0.018	-0.045	-0.028*	0.20
	10.0%	-	-	-	-

standard errors in parentheses

\*\*\* p &lt; 0.01 \*\* p &lt; 0.05 \* p &lt; 0.1

## 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 not confirmed by our results. We find for most categories that denote permanent growth (GR\_6, GR\_5 and GR\_4) a significantly positive coefficient for the size of firms. This means that larger firms are more likely to show permanent growth. The details of the results show two interesting aspects.

First, the results are less significant if the innovation effort (INV) is included in the model instead of R&D expenditures (R&D). Hence, part of the effect that larger 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 R&D variable, we clearly see a difference between the categories GR\_6 and GR\_5 compared to the category GR\_4. No significant relationship is found for the category GR\_4, while size is significantly related to the categories GR\_6 and GR\_5, independent of the definition of the cut-off point for the yearly growth rate. Hence, if we only consider firms that grow almost at all time steps, larger firms appear significantly more often. If we are less rigorous and include firms that also show phases of stagnation, larger firms are no longer over-represented in the category (GR\_4).

This helps us to understand why Hypothesis 1a is not 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 less likely to show growth in each time step. The regression results show us that smaller firms are much more likely to be found in the mixed categories (Mixed\_6, Mixed\_5 and Mixed\_4). 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. However, the results from the literature cannot 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 more likely to grow continuously. Small firms might grow faster but are more volatile.

The other part of 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 does not hold for the categories of continuous decline (DC\_6, DC\_5 and DC\_4). We do not find any significant relationship between belonging to these categories and the size of firms. Hence, the higher sustainability of development in larger firms only applies to growth and stagnation.

## 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 leads to no significant results for this variable except of in one regression. The only significant result is found for firms showing a mixed development path (Mixed\_5) if the 10%-cut-off point is used.

There are two possible explanations for the lack of significant results for R&D expenditures. First, R&D expenditures might, indeed, not be connected to any particular development path. Second, R&D expenditures might not be a sufficiently adequate measure for those kinds of innovation efforts that cause certain development paths. The latter explanation is supported by the fact that in most cases the sign of the coefficient for the variable R&D is the same as the sign for variable INV in the respective regression. Hence, we focus our interpretation on the findings for innovation projects.

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.

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 2: 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.

Significantly positive coefficients are found for the categories of mixed development paths. Hence, firms with high investments in innovation projects are not more likely to continuously grow but are more likely to show high fluctuations in the development. This means, that Hypothesis 2 is not confirmed. It has to be reformulated into stating that higher innovation efforts are connected to a smaller likelihood of continuous decline and more fluctuations 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 not confirmed by our empirical examination. If innovation projects (INV) are used as independent variable in the regression analysis, no significant results are obtained, except for one category. Therefore, we focus on the findings for the regressions in which R&D expenditures are used as independent variable.

In these regressions significant coefficients are found for the export share in the study of growth path (GR\_5 and GR\_4). However, the sign of the coefficients is opposite to what we expected in Hypothesis 3: 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.

A significantly positive relationship is found between the export share and the observation of continuous stagnation. We interpret this as statistical support for the assumption that exports leads to the stabilisation of business activities. This seems to hold especially if the cut-off point is defined very narrow (rather for cut-off points at 2.5 or 5.0 percent employment growth per year). A larger market seems to make firms less vulnerable to changes in the economic circumstances. This higher stability does also imply that we see less often permanent growth in such firms.

## 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 not 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 also more often permanent growth.

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 less 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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