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Firm performance after high growth: evidence for an absolute measure of growth

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Abstract

Do high-growth firms continue to create jobs after the high-growth period or is high-growth a one-time event? Does the answer to this question depend on the definition of high growth? This paper analyzes data from Amadeus on Bulgarian firms for three consecutive 3-year periods (2001-2004, 2004-2007, and 2007-2010). Previously, high growth has been defined in terms of relative growth or composite measures such as recommended by Eurostat-OECD. We additionally apply an absolute measure of growth, i. e. the actual change in headcount. Using a two-part model with separate equations for survival and growth, we moreover specifically account for the impact of firm exits on aggregate effects. We find that definitions are central for outcomes. In terms of relative and Eurostat-OECD high growth our results for Bulgarian firms largely confirm what has been found for high-income countries: surviving relative high-growth firms are characterized by negative future growth rates. High growth firms defined according to Eurostat-OECD continue to grow positively after high growth. If growth is measured in absolute terms, then high growth firms only continue to create more jobs than non-high growth firms as far as surviving firms are concerned. Taking firm exits into account, absolute high-growth firms are outperformed by average firms due to the job losses of large exiting high-growth firms – with one notable exception: absolute high-growth firms of initially small size (10-49 employees) continue to grow faster than other firms even if exits are accounted for and indeed seem a worthwhile target for policies promoting high-growth entrepreneurship.

Keywords: high-growth firms, growth measures, employment, persistence, entrepreneurship policy

JEL Classification Number: L26, J23, C18, D22, P23

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1 INTRODUCTION

High-growth firms have attracted significant attention from policymakers. The European Union for example explicitly mentions the support of high-growth, innovative enterprises as an objective in its Europe 2020 strategy (EU, 2010). Likewise, most OECD countries have adopted targeted policies for highly growing entrepreneurial firms (see Autio et al., 2007; Mason and Brown, 2013; OECD, 2013).[1]

The support of high growth firms is typically motivated by the fact that a large share of new jobs is created by a small number of firms with high growth while most other firms do not grow (Birch and Medoff, 1994; Brüderl and Preisendörfer, 2000; Davidsson and Henrekson, 2002; Delmar et al., 2003; Littunen and Tohmo, 2003; Halabisky et al., 2006; Acs and Mueller, 2008). An influential report from NESTA (2009) for example showed that 6% of all existing firms in the United Kingdom generated 50% of all new jobs during 2002–2008. In a similar vein, Daunfeldt and Halvarsson (2015) found that 6% of

[1] Questioning the ability of governments to support high-growth firms is beyond the scope of this study. See Autio and Rannikko (2016) for a recent discussion on the role of governments in 'picking winners'.

firms in Sweden contributed to 42% of new jobs during 2005–2008. Based on a review of the existing evidence, Henrekson and Johansson (2010) confirmed that about 4% of firms are responsible for more than 50% of job creation.

Despite the increasing focus on high growth firms, important information is still missing. While their central role for job creation is well-established as far as the short-term is concerned, knowledge on the long-term contribution of high-growth firms after the high-growth event is so far inconclusive (see Table 1). This should be of great concern to policymakers who support high-growth firms to spur employment. Any evidence limited to the period of high growth is of little importance if firm growth is purely random or, even worse, if high-growth firms display a disappointing performance after having achieved high-growth (Coad et al., 2014).

Another central and under-investigated issue is whether policies should target firms that (will) experience high growth in absolute or relative terms as firm growth seems to depend very much on definitions (Almus, 2002, Shepherd and Wiklund, 2009; Weinzimmer et al., 1998). Daunfeldt et al. (2014) for example found that high-growth firms defined as the 1% fastest growing firms over a 3-year period in terms of relative change in employment have a very low probability (1.49%) of remaining high-growth firms in the next period, whereas almost one-third (31.67%) of the fastest growers in absolute terms will remain high-growth firms. The main difference between absolute and relative growth is fairly obvious. High-growth firms selected according to relative growth tend to be much smaller than those that are fast growing in absolute terms. Although this is a well-known problem and often reported in method sections (Davidsson and Delmar, 2006), it is usually ignored thereafter when results are discussed or compared to other studies. Rather surprisingly, no study has so far attempted to estimate the long-term growth performance for firms defined according to absolute high-growth. The existing literature so far exclusively focuses on a relative definition of high-growth (Capasso et al., 2013; Coad, 2007; Coad and Hölzl, 2009; Daunfeldt and Halvarsson, 2015; Parker et al., 2010), composite indices similar to relative measures such as the one recommended by Eurostat-OECD (Hölzl, 2013; Satterthwaite and Hamilton, 2016) or by Birch and Medoff (1994) (Senderovitz et al., 2016) and in rare cases a combination of relative and absolute growth (Acs, 2013; Hölzl, 2013). The absence of a study on the long-term performance of high growth firms defined in terms of absolute change in employees is even more striking as one should assume that the absolute increase or decrease in headcount matters from a labor market perspective.

The existing evidence on the development of high-growth firms furthermore exclusively builds on data from high-income countries (Austria, Belgium, Denmark, France, the Netherlands, New Zealand, Sweden, United Kingdom and United States). At the same time, a growing body of evidence shows large differences in job creation and destruction processes across countries (Ayyagari et al., 2014; Bravo-Biosca et al., 2013; Criscuolo et al., 2014). The validity of results from high-income countries therefore yet needs to be tested for different economic settings. Middle-income countries in Eastern Europe provide a particularly interesting case study for research on firm growth. The transition to a market-led economy in the 1990s typically resulted in the emergence of new small firms, a decline of old inefficient ones and large aggregate productivity gains (Hutchinson and Xavier, 2006). Apart from first evidence on the determinants of high-growth (e.g. cross-country studies by Cuaresma et al., 2014 or Mateev and Anastasov, 2010 and for Kosova by Hoxha and Capelleras, 2010), the dynamics of high growth have not been studied in this context.

This paper contributes to the literature on entrepreneurship and firm growth. In a novel way, it investigates the contribution of high-growth firms to job creation after their high-growth event by comparing three different definitions of high growth – absolute, relative and the composite measure recommended by OECD. Using firm-level data from Amadeus on 369,283 private firms in Bulgaria for three consecutive 3-year periods (2001-2004, 2004-2007, and 2007-2010) it analyzes the growth performance of high-growth firms three and six years after their period of high growth. The research question should be of high relevance to policymakers. If high-growth events are followed by subsequent decline, this fundamentally questions the strategy to target high-growth firms in order to promote sustainable employment levels. If in addition the long-term growth performance of high-growth firms is largely deter-

mined by the measurement of growth, then a much larger emphasis needs to be put on the criteria for selecting high growth firms.

Methodologically we combine non-parametric and parametric methods. Next to comparing the three definitions of high-growth in terms of transition probabilities between different growth states (exit, decline, stagnation, growth, high-growth) from one 3-year period (t) to the next (t+3) or upper next (t+6), we model future growth rates by means of a two-part model. Following Huber et al. (2017) our model consists of probit regressions for firm survival and exit on the hand and linear regressions for growth of surviving and exiting firms on the other hand. The choice of a two-part model is motivated by the fact that empirical studies on firm growth show that the main determinants for growth such as firm size affect exiting and surviving firms in a very different way (Caves, 1998, Evans, 1987, Dunne and Hughes, 1994 or Sutton, 1997). Smaller firms for example are usually less likely to survive, but conditional on survival they exhibit higher growth rates compared to larger firms. In this regard, the two-part model allows for a decomposition of the specific contributions of firm exit and survival to the persistence of growth for each different set of high-growth firms compared to non-high growth firms.

The main result of our work largely puts into question the method applied by previous studies to define high growth exclusively in relative terms. Our findings rather suggest that it is central for results if growth is measured in absolute or relative ways. High-growth firms defined in relative terms are least likely to repeat high growth (0.71%) compared to absolute HGFs (28.52%) and OECD HGFs (11.47%) and most likely to exit (27.16% for relative, 6.71% for absolute and 7.76% for OECD HGFs). If only surviving firms are taken into account, then absolute high-growth firms show the biggest potential for job creation in coming periods followed by OECD HGFs, while relative HGFs are outperformed by average firms. At the same time, our findings demonstrate that taking firm exits into account considerably influences results. Analyses on high growth should consequently not be limited to surviving firms. Exit rates for high-growth firms are lower than for non-high growth firms. At the same time, high-growth firms which do exit are of much larger firm size than non-high-growth firms. This is particularly the case for an absolute definition of high growth which selects larger firms. Overall, the growth performance of absolute high-growth firms after the high-growth event is therefore negative. OECD and relative HGFs on the other hand perform better than non-HGFs even after high growth. What does this imply for high-growth policies? We argue that policymakers are interested in actual change of headcount reflected by an absolute definition of high growth. The impact of high growth entrepreneurship policies on long-term employment therefore seems very much open to doubt in light of the negative performance of absolute HGFs after high growth compared to other firms. There remains however one notable exception: initially small high-growth firms (10-49 employees) continue to outperform non-high-growth firms of the same size in the long-run and could be a target for policymakers.

This paper is organized as follows. Section 2 reviews the literature and relates our contributions to previous work. Section 3 describes the data and definitions and reports descriptive statistics. Section 4 discusses the methodology. Section 5 presents results from the transition probability matrices as well as from the two part model before Section 6 discusses these results and concludes.

2 LITERATURE ON HIGH-GROWTH FIRMS

The debate about which firms create jobs was sparked by the empirical findings of Birch (1981, 1987) that small firms generated most new jobs in the U.S. economy. Birch's findings constituted a shift from the previous paradigm that large firms create most jobs and were highly controversial (e.g. Davis et al., 1996b). The interest in high-growth firms originates from this research as further investigations showed that most small firms did not grow, and only a minority of high growth firms (labelled 'gazelles' by Birch and Medoff, 1994) were responsible for job creation (Brüderl and Preisendörfer, 2000;

Davidsson and Henrekson, 2002; Delmar et al., 2003; Littunen and Tohmo, 2003; Schreyer, 2000; Storey, 1994).[2]

As a result, interest in small firms per se has declined while interest in the characteristics and determinants of high-growth firms has increased (Coad et al., 2014). A series of seminal studies have for example investigated whether high-growth firms are small (Delmar et al., 2003; Weinzimmer et al., 1998), young (Delmar et al., 2003; Haltiwanger et al., 2013), belong to an enterprise group (Delmar et al., 2003), are family-owned (Bjuggren et al., 2013), originate from a certain industry (Bos and Stam, 2013; Halabisky et al., 2006; Acs and Mueller, 2008; Mason and Brown, 2013), region (Acs and Mueller, 2008) or country (Schreyer, 2000; Bravo-Biosca et al., 2013). Taken together the following stylized facts emerged: high-growth firms tend to be younger than non-high-growth firms, they are not necessarily small but of all sizes, and they also tend to be in all sectors and not only high-tech (Moreno and Coad, 2015).

While the characteristics of high-growth firms have been well studied by now, the issue of regularity (or irregularity) of high-growth over time still deserves further consideration. A first indication on the persistence of high-growth is given by the numerous studies dealing with Gibrat's law (see Caves, 1998; Geroski, 1995 and Sutton, 1997 for reviews of early studies). Gibrat's law of proportionate effect (Gibrat, 1931) is one of the earliest attempts to explain firm growth and states that initial firm size and growth should be independent. In that regard, Gibrat's law requires that growth rates are random and firm growth cannot be persistent. In general, little support has been found for this hypothesis. The earlier studies investigating whether firm growth rates were correlated over time found that the process of firm growth was characterized by positive autocorrelation (e. g. Chesher, 1979; Ijiri and Simon, 1964; Singh and Whittington, 1975). More recent studies rather found negative autocorrelation of growth over time and a negative relationship between size and growth (e.g. Bottazzi et al., 2011; Goddard et al., 2002; Oliveira and Fortunato, 2006).

As far as growth dynamics of high-growth firms rather than the average firm is concerned, the evidentiary base is summarized in Table 1. Empirical findings provide an ambiguous picture with regard to the long-term economic contribution of high-growth firms. This is the case for both overall growth rates as well as disaggregated growth by firm size. Acs (2013) showed that surviving high-growth firms in the U.S. exhibited moderate growth rates in the next period and growth was higher for smaller firms. Capasso et al. (2013) in contrast demonstrated that among their sample of high-growth firms in the Netherlands there were two coexisting subsets, a bigger one showing high negative annual autocorrelation and a smaller one showing high positive annual autocorrelation. The coexistence of bouncing firms that alternately strongly grow or strongly decline with persistent growers was most pronounced among micro firms. Coad (2007) and Coad and Hölzl (2009) found negative annual autocorrelation for growing firms in France and Austria. Once they disaggregated across size classes they found that only high-growth micro firms were prone to dramatic negative autocorrelation of annual growth rates, whilst larger firms were characterized by positive autocorrelation. In a similar manner, Daunfeldt and Halvarsson (2015) found that previous HGFs in Sweden have negative growth in the next period. The disaggregation of results for different firm sizes showed that growth was particularly negative for medium and large firms (-0.226) compared to small (-0.201) and micro firms (-0.077). Hölzl (2013) instead showed for Austrian firms that growth remained positive 3 and 9 years after the high-growth period and that again smaller firms had higher growth rates than large firms. Parker et al. (2010) showed that past high-growth among medium-sized firms in the Netherlands could not explain future growth. High growth was only positively related to future growth when interacted with management strategies such as the distribution of shares to the workforce. Satterthwaite and Hamilton (2016) found for New Zealand that high-growth firms had death rates up to four times greater than other firms but that surviving HGFs continued to grow moderately. Senderovitz et al. (2016) finally demonstrated a positive relationship between previous high-growth and profitability (return on equity) in the next period.

[2] In addition, high-growth firms have been found to create important spillovers to the wider economy by acting as a role model for potential entrepreneurs or leading to more innovation and export orientation (Krasniqi and Desai, 2016).

Table 1: Summary of previous studies on growth persistence of high-growth firms

Study	Country	Period	Growth Measure				Growth Indicator	Process of Growth[a]	Growth Period	Exitsb	Results[c]
			Absolute	Relative	Composite						
					OECD	Other					
Acs, 2013	United States	1998-2006				x	Employees, Sales	T	4-year	yes	+
Capasso et al., 2013	Netherlands	1994-2004		x			Employees	O/A	1-year	no	-
Coad, 2007	France	1996-2002		x			Employees, Sales	T	1-year	no	-
Coad and Hölzl, 2009	Austria	1975-2004		x			Employees	T	1-year	no	-
Daunfeldt and Halvarsson, 2015	Sweden	1997-2008		x			Employees	T	3-year	no	-
Hölzl, 2013	Austria	1985-2007			x	x	Employees	T	3-year	yes	+
Parker et al., 2010	UK	1992-2001		x			Sales	O/A	4-year	yes	0
Satterthwaite and Hamilton, 2016	New Zealand	2005-2014			x		Employees	O	3-year	yes	+
Senderovitz et al., 2016	Denmark	2004-2010				x	Employees	O	4-years	no	+

[a] T total, O organic, A acquired

[b] Study accounts for firm exits

[c] Overall growth rates after high-growth period: + positive growth, - negative growth, 0 insignificant

Additional studies by Dillen et al. (2014) for Northern Belgium and Gabrielsson et al. (2014) for the Scania region in Sweden were limited to investigate the repetition of the high-growth status. Not surprisingly, they found that it is very unlikely to repeat high-growth over (multiple) consecutive periods of time. In particular for larger firms, it is obviously very difficult to continue growing at a very rapid pace for several periods. We believe it is also unnecessary from a policy perspective where support to high-growth firms seems to be justified as long as they at least achieve to preserve their previously attained high levels of employment and do not start declining. Nevertheless, findings that high-growth rarely persists have motivated labels such as 'one-hit wonders' (Daunfeldt and Halvarsson, 2015) or 'one-shots' (Dillen et al., 2014) for high-growth firms.

A largely unresolved issue in the literature is furthermore the definition of high-growth. No general agreement has so far been reached. Researchers even still use different expressions when referring to firms with high growth such as gazelles (Birch, 1987), fast-growing firms (Almus, 2002 or Brüderl and Preisendörfer, 2000), high-impact firms (Acs, 2013) or high-growth firms (Delmar et al., 2003). At the same time, definitions seem to matter very much for results. With regard to the indicator of high-growth, the number of employees is most commonly used in the literature (see Table 1). Daunfeldt et al. (2014) compared employment to other growth indicators such as sales and productivity. While the correlation between employment and sales was high, it was low between employment and productivity. They therefore conclude that policies promoting high growth in employment may come at the cost of reduced productivity growth.[3]

Most important for our research objective is, that different measures of growth (relative or absolute formulas) select different sets of high-growth firms. Davidsson and Delmar (2006) exemplify the issue as follows: If firm A has started with 1 employee and has 6 employees after three years, its growth is 600% or 5 employees. At the same time, if firm B has started with 10 employees and has after the same period 15 employees, its growth is 50% or 5 employees. Both will have the same absolute growth, but the former will have achieved a substantially higher relative growth (600% compared to 50%). In that regard, it is another central insight from Table 1 that none of the existing studies on the persistence of growth uses an absolute measure for defining high-growth. About half of the studies applied a relative measure to define high-growth. Capasso et al. (2013), Coad (2007) and Coad and Hölzl (2009) all measured growth as annual log difference in employment (and sales). High-growth firms were then defined as the 10% fastest growing quantile of firms according to relative growth. In a similar manner, Parker et al. (2010) identified the 10% fastest growing firms in terms of relative annual sales growth as high growth firms. In addition, Daunfeldt and Halvarsson (2015) defined high growth firms as the 1% of firms with the highest log difference in employment over a 3-year period. The other half used different composite measures. Hölzl (2013) and Satterthwaite and Hamilton (2016) applied the recently very common definition recommended by Eurostat-OECD (2007): firms with at least 10 employees in the start-year and annualized employment growth exceeding 20% during a 3-year period. The OECD definition is very similar to other relative growth measures except for the firm size threshold[4] and a time-invariant minimum growth rate and is increasingly adapted as the standard in the literature (see also Anyadike-Danes et al., 2015; Bravo-Biosca et al., 2013). Hölzl (2009) additionally applied a modified version of the so-called Birch index which combines absolute with relative growth rates. He introduced a size threshold of 10 employees and a minimum growth rate over three years of 25% similar to the Eurostat-OECD definition. Acs (2013) used another variant of the Birch index and defined high-growth firms as enterprises whose sales have at least doubled over a 4-year period and whose product of absolute and relative change in employment is at least 2. Senderovitz et al. (2016) finally utilized a relative definition with size thresholds as originally applied for gazelles by Birch and Medoff (1994). High-growth firms were defined as those which have experienced a doubling of sales over a 4-year period, had sales larger than 1 million Danish Kroner and had positive equity.

[3] The negative relationship between profit and growth in employees or sales does however not seem to hold for firms with extraordinary high growth (500-31,000 percent over 5 years) as Markman and Gartner (2002) show.

[4] Similarity to studies with a relative measure is particularly strong in the case of Coad (2007) who is employing a dataset limited to firms with 20+ employees as well as Parker et al. (2010) who focus on firms that have grown to medium-size (sales between £ 5 - 100 million) until the end of the high-growth period.

3 DATA, DEFINITIONS AND DESCRIPTIVES

3.1 DATA

We use information from the firm-level dataset Amadeus, a widely used commercial database maintained by Bureau van Dijk (see, Bianchini et al., 2016 or Cuaresma et al., 2014 for other studies on high-growth using Amadeus). Amadeus contains information for registered companies in Europe across all sectors of activity. We have access to data for Bulgaria covering the time period 2001-2010. We consider all private firms. Public companies (section L of the European NACE Revision 1.1 classification system) have been eliminated from the sample. The present study furthermore contains only firms with information on the number of employees.[5] Employment is a point-in-time measure reflecting the number of workers on a firm's payroll at December 31st of a given year as reported to the social security services of Bulgaria. Additional information available in the dataset includes sector of activity (at the level of 4-digit NACE codes), geographic location (4-digit postal codes), legal form, and foreign ownership. Our final sample covers 369,283 observations for three 3 year periods (2001-2004, 2004-2007, and 2007-2010).

As presented in Table A1 of the appendix, summary statistics for firm size and sector in our sample are comparable to data reported by the National Statistical Institute (NSI) for Bulgarian enterprises. The information is not identical because the Amadeus data available for the first years of our observation period does not contain the full universe of Bulgarian firms. While in the period 2001-2003 our dataset contains about a third of all Bulgarian firms, coverage increases to around half of firms for 2004-2005 and includes virtually all firms (around 97-99%) from 2006 onwards. As the share in total firms increases over time distributions in terms of size and sector become more similar between the data reported by NSI and Amadeus. The firms included in earlier years tend to be of bigger size than those reported by NSI which is also reflected in the sectoral distribution (e.g. a slightly higher share of typically larger manufacturing firms and lower share of smaller firms in trade). Undoubtedly, it would always be preferable to have full coverage of firms throughout the entire period observed. Given the advantages of our dataset presented next, we however consider the similarity of our dataset to the universe of Bulgarian firms sufficient enough for the purposes of our study.

The main advantage of the dataset is that it captures not only medium and large firms, but also micro firms. The minimum firm size in our sample is one employee, indicating self-employment as the firm owner is counted as an employee. The data therefore allows addressing the question whether different definitions of high-growth including those biased towards very small firms influence the persistence of growth. Another advantage of the dataset is that it enables us to account for firm exit. We do not need to confine our analysis to surviving firms, but are able to analyze the contribution of firm exit to aggregate employment growth. As every firm in our dataset is allocated a unique identification number which normally does not change, we can follow firms over time. Technically, the number of employees for exiting firms in our sample is indicated by a zero value from the year onwards in which a firm appears in the dataset for the last time, i. e. when it last reports having employees or being self-employed. Since the number of employees also includes firm owners, we can rule out any cases where firms continue to exist as owner-only firms. To further limit the number of possibly falsely defined exits due to missing data entries, we restrict our sample of exits to firms which do not reappear in our dataset in any of the subsequently available years. Moreover, firms are only regarded as exits if they do not report any information on sales[6] either. Firms with 1,000 or more employees in the last year reported (around 0.4% of total exits) are furthermore excluded from our classification of exit. We chose this rather large firm size as cut-off point based on the experience from West Germany by Fackler et al. (2013) that establishments with more than 100 employees still accounted for 0.7-1.1% of

[5] Employment data was imputed for up to two missing values between two existing ones based on the fact that the number of employees showed high serial correlation of above 0.8. A missing value was replaced by the average value of the two known ones.

[6] Note that information on sales is only available for a limited number of firms and could therefore not be further exploited in our empirical strategy.

exits between 1975 and 2006. In our final sample, 0.2% of exiting firms are of large size with more than 250 (and less than 1,000) employees before exit, while 93.7% are micro-sized with less than 10 employees in the year before exit. In general, the resulting exit rates for our sample of firms (3-year cumulative unconditional exit rates of 32% as presented in section 5.1) correspond very much to the average annual exit rate of 11% between 2004 and 2010 officially reported by Eurostat.[7]

At the same time, the following issues regarding the database are worth being highlighted: first, Amadeus reports poor information on firm age for its Bulgarian data. Consequently, we cannot control for age in our analysis although prominent studies show that firm age has an important influence on high firm growth (e.g. Decker et al., 2016). Second, to account for market entry is much more difficult than to account for firm exit. Since the coverage of firms in our dataset increases over time, it is not clear whether a firm newly enters the dataset due to firm birth or due to an increased coverage. For that reason we excluded all firm entries from our analysis. Since our intended comparison of high-growth firms to non-high-growth firms existing during the same time period is per definition limited to incumbent firms, we do not consider the lack of information on firm entries as a major drawback to our research design. Thirdly, our data provides information on the firm level as identified by a unique firm number. A firm can consist of several establishments at different physical locations which are again made up of different divisions or departments. We are unable to account for job flows at the intra-firm level between establishments or departments although employment dynamics within firms could definitely provide further interesting insights (see e. g. McKelvie and Wiklund, 2010). Fourth, all growth measures compared in this paper capture total firm growth, regardless of whether the increase in employment is the result of organic (internal) growth or acquired (external) growth due to acquisitions or mergers. Similarly, job destruction captures both jobs lost by firms that dismiss employees and spin-offs which create new independent firms without reducing the total number of employees. Another potential scenario in this regard which is not captured includes the transfer of domestic jobs to offshore firm sites. In order to test for the sensitivity of our results to job losses of such kind, we will compare exit rates of domestically-owned firms to those of foreign-owned ones which should be particularly likely to shift operations from one country to another. Results are reported in section 5.4.

A job in this study means an employment position filled by a worker or owner of a firm. Since our data does not distinguish between part-time and full-time employment, both types count equally as a single job. At the same time, Bulgaria is characterized by the lowest share in part-time employment (ranging between 1.5-3% for the period under investigation 2001-2010) among 48 countries surveyed by OECD.[8] We therefore have good reason to believe that job creation in our study is almost entirely caused by the creation of additional full-time positions rather than an increase in part-time employment. Job creation is finally defined as the difference between gross job creation and gross job destruction by surviving and exiting firms. Jobs created by newly entering firms during a studied period are not accounted for by our measure of job creation.

We draw for the first time on data from a middle-income country in contrast to the existing research on the persistence of high-growth. Bulgaria seems to provide a typical case study hereof. It is classified as an average upper middle income country by the World Bank (gross national income per capita in 2015 of USD 7,220).[9] According to the Human Development Index by the United Nations[10] which also considers social dimensions of development, Bulgaria ranks 59 out of 188 countries in 2014. In terms of the regulatory environment for starting and operating a firm, Bulgaria achieves rank 7 out of 51 up-

[7] http://ec.europa.eu/eurostat/web/structural-business-statistics/entrepreneurship/business-demography (accessed 23 Nov 2017).

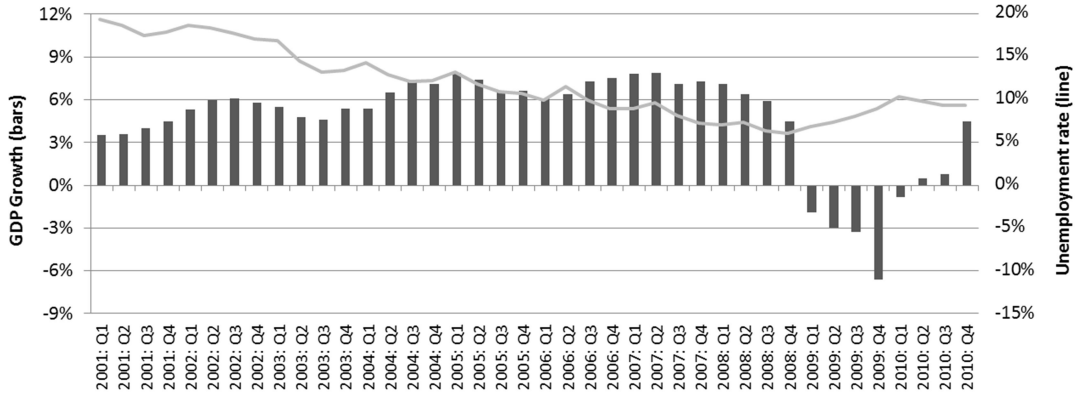
[8] https://data.oecd.org/emp/part-time-employment-rate.htm (accessed 30 Oct 2017): Part-time employment defined as both employees and self-employed who usually work less than 30 hours per week in their main job. Part-time continues to be a rare type of employment in Bulgaria with a relative share of only 1.59% in 2016.

[9] https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups (accessed 1 Nov 2016): For 2017 upper middle income countries range between a GNI per capita of USD 4,036-12.475.

[10] http://hdr.undp.org/en/composite/HDI (accessed 1 Nov 2016): HDI is the geometric mean of normalized indices for gross national income per capita, life expectancy and years of schooling.

per middle income countries in the Doing Business Ranking 2017 by World Bank[11] and ranks 9 out of 25 countries in the Eastern Europe and Central Asia region. The Doing Business report also investigates (but does not rank) aspects of labor market regulation which might be important for the growth patterns of firms. If redundancy rules for example were very restrictive in Bulgaria, firms might find it more difficult than in other countries to adapt their level of employees and might therefore refrain from growing rapidly. Again, Bulgaria shows similar framework conditions as other middle-income countries. Both the notice period as well as severance pay for redundancy dismissal for example amount to 1 month as in many other middle income countries.

Figure 1: GDP growth from previous year and unemployment rate for Bulgaria, 2001-2010



Source: NSI Bulgaria[12]

The macroeconomic environment during the studied three 3 year periods (2001-2004, 2004-2007, and 2007-2010) is illustrated in Figure 1. It shows that our observation period both comprises periods of economic growth as well as a period of economic downturn following the global financial crisis. The bars in Figure 1 indicate quarterly GDP rates of change compared to the corresponding quarter of the previous year, while the line indicates the unemployment rate. After constant GDP growth at around 6-7% and steadily declining unemployment levels, GDP shrank in 2009 by up to -7% and unemployment sharply rose to up to 10%.

3.2 DEFINITIONS

It is the central objective of this paper to understand how different methods of measuring high growth impact results. Other important issues in defining high growth firms include the indicator of growth, the process of growth, and the period studied (see Delmar et al., 2003; Coad et al., 2014).

As indicator for growth we use the number of employees which is also applied by most other studies indicated in Table 1. Using employees as size indicator additionally has the advantage that firms born in the start year of a growth period (t-3) do not need to be excluded from the sample, because employment is measured as a point-in-time value at the end of a given year and does not accumulate over a year as sales does. With regard to the process of growth, the literature usually distinguishes between organic, acquired and total growth. As discussed above we lack information on acquisitions or spin-offs and therefore focus on total growth as many other studies do.

As far as the growth period is concerned, we use 3-year periods to calculate growth rates in line with the definition of high-growth by Eurostat-OECD (2007) and as also applied by many studies using other definitions (see Table 1). Choosing longer periods such as 3 years has the advantage that short-

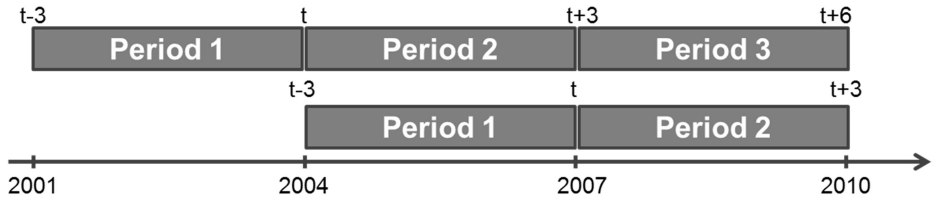
[11] http://www.doingbusiness.org/rankings: The 2017 ranking comprises the categories starting a business, dealing with construction permits, getting electricity, registering property, getting credit, protecting minority investors, paying taxes, trading across borders, enforcing contracts and resolving insolvency. For labor market regulations see http://www.doingbusiness.org/data/ExploreTopics/labor-market-regulation (accessed 1 Nov 2016).

[12] http://www.nsi.bg/en/content/5504/gdp-production-approach-%E2%80%93-total-economy (accessed 29 Nov 2016)

term fluctuations in employment due to transitory shocks[13] or measurement errors are less often falsely interpreted as high growth. A question related to transitory growth is whether high-growth firms should be defined on the basis of sustained growth. Should only continuous growth in each year of a 3-year period count as high-growth? Or should extraordinary growth in one year together with no growth in the other two years qualify as high-growth as well?[14] We think it is appropriate to define high-growth firms based on the total number of jobs created over a 3-year period and that the year-by-year pattern of how these jobs were created should not matter.

In order to analyze how high growth firms in one period develop in coming periods, we divide our sample into three 3-year periods (2001-2004, 2004-2007 and 2007-2010) as illustrated in Figure 2. Our analysis of future growth rates in t+3 consequently comprises two periods 2 (2004-2007 and 2007-2010) whereas the analysis of future growth in t+6 is only based on a single period 3 (2007-2010). Since the period 2007-2010 is furthermore characterized by the beginning of the great recession, results for t+6 need to be interpreted with adequate caution. Bartz and Winkler (2016) e.g. recently confirmed that the great recession was detrimental to entrepreneurship. Results for t+3 on the other hand which are derived by pooling both a period with very favorable economic conditions (2004-2007) and a period with unfavorable conditions (2007-2010) are expected to be less influenced on average by the macroeconomic environment.

Figure 2: Growth periods studied



To measure growth, there broadly exist three different methods: (i) absolute growth measures, (ii) relative growth measures, and (iii) composite measures. We compare definitions of high growth according to each of the three methods.

Firstly, we define high growth in absolute terms. Absolute growth refers to raw changes in size between two points in time. High growth firms in absolute terms are then defined as a certain share of firms that display the highest absolute growth during a particular period. As already emphasized earlier, this paper is the first attempt to apply an absolute measure for analyzing the growth persistence of high-growth firms. We define growth in absolute terms for firm *i* at time *t* as

$$g_{i,t} = E_{i,t} - E_{i,t-3}, \quad (1)$$

where $E_{i,t}$ is the number of employees in firm *i* during year *t* at the end of the 3-year period and $E_{i,t-3}$ is firm size at the beginning of the 3-year period. After cleaning for outliers with a 3-year increase of more than 1,000 employees (0.005% of observations), high growth firms in absolute terms (absolute HGF) are defined as the 1% of firms with the highest growth in employment over a 3-year period. This corresponds to a minimum growth rate of 26 employees necessary for being defined as absolute HGF.

Secondly, we apply a relative definition of growth. It is most common in the literature on firm growth to define high growth firms in a relative way (e.g. as percentage change or log-differences). We follow recommendations by Törnqvist et al. (1985) to use log differences to measure relative change and define relative growth as

$$g_{i,t} = \ln(E_{i,t}/E_{i,t-3}), \quad (2)$$

[13] See Haltiwanger et al. (2013) and Davis et al. (1996a) for a detailed discussion of transitory shocks and how they cause regression-to-the-mean-effects when studying the relationship of firm size and growth.
[14] In our sample 53% of high-growth firms show continuous growth in each year of the 3-year period.

To increase comparability with absolute high growth firms, we again choose to use 1% of firms as a cut-off point for being a high growth firm in relative terms (relative HGF). This corresponds to a minimum logarithmic growth rate of 1.94 for relative HGFs.

Since previous studies have also used larger shares we considered additional cut-off points as shown in Table 2. A 5% cut-off would correspond to a minimum increase over a 3 year period by 5 employees for being an absolute HGF and by logarithmic growth of 1.1 for being a relative HGF. Applying a 10% cut-off would include firms that grew only slightly by 2 employees or logarithmic growth of 0.7. Because the required minimum absolute growth falls off significantly after the 1% definition, we follow Bjuggren et al. (2013) and Daunfeldt and Halvarsson (2015) who also found that choosing a larger cut-off point than 1% might include firms that exhibited only small growth during the observed period.

Table 2: Required minimum growth in employees over 3-year period for HGFs with 1%, 5% and 10% cut-off points, pooled for all periods

Threshold	Absolute	Relative (Δ log)
1%	26	1.9
5%	5	1.1
10%	2	0.7

As discussed above, a relative measure will favor growth of small firms, whereas an absolute measure will favor larger firms. To reduce the impact of firm size on the growth indicator, composite measures have become popular for defining firm growth. We will therefore apply as a third definition of high growth the one recommended by Eurostat-OECD (2007). We call the firms selected by this definition OECD HGFs. They are defined as firms that achieve an annualized growth rate of at least 20% during a 3-year period and have a size of at least 10 employees at the beginning of the period. The OECD requirement for high growth can be written as follows:

$$\left(\frac{E_{i,t}}{E_{i,t-3}}\right)^{\frac{1}{3}} - 1 \geq 0.2 \qquad if\ E_{i,t-3} \geq 10 \tag{3}$$

We again eliminate outliers leading to a very small reduction of 0.002% of observations. In practice, an average annualized growth of 20% over three years would be equal to 72.8% growth over a 3-year period. The size requirement of $E_{i,t-3} \geq 10$ is used to mitigate the bias of relative growth rates towards micro-sized firms. A disadvantage of using a definition for HGFs based on a particular minimum growth rate on the other hand is its time-variance with regard to macroeconomic conditions. During periods of a favorable macro-economic environment a much larger number of firms will be able to achieve the required 3-year growth of 72.8% than during recessionary periods. More in general, the OECD definition can be considered as a time-variant version of a relative growth measure with thresholds for growth and size. Since the percentage growth rates of the OECD definition are easier to interpret than the log differences of the relative definition, we will utilize average annualized percentage growth rates as relative growth measure in most of the following analyses.

As we are also interested in heterogeneous growth trajectories for different firm sizes, the whole sample is divided into four sub-samples according to the Eurostat[15] definition for size classes: micro firms (<10 employees), small firms (10–49 employees), medium-sized firms (50-249 employees) and large firms (>249 employees) all measured at the beginning of a 3-year period at time *t-3*.

Alternatively, we could have allocated firms to size classes based on the average firm size over a period (i. e. the average size at *t-3* and *t*). This approach is meant to reduce typical biases inherent to sorting growing entities into size classes (see Davis et al., 1996b for a detailed discussion). These biases are of particular relevance for studies which focus on the contribution of different size classes to overall job creation. If firms migrate between size classes from one year to the next and the overall

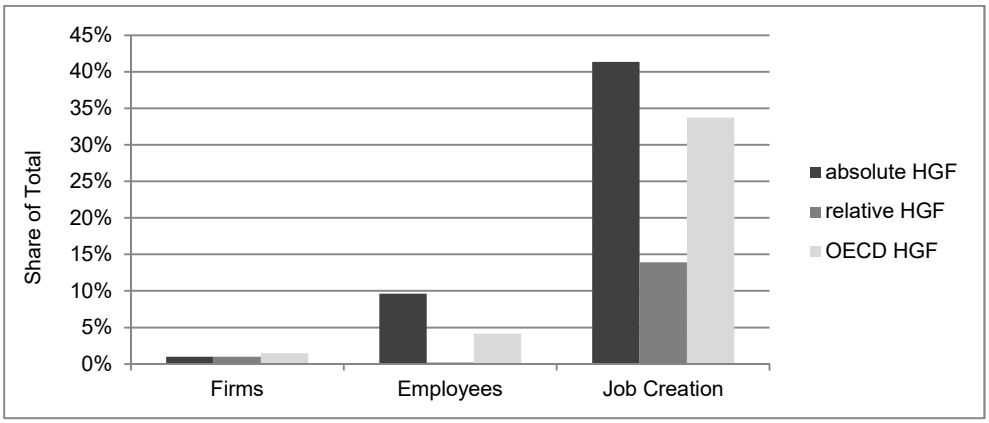
[15] http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Enterprise_size (accessed 2 Nov 2016).

firm size distribution changes accordingly, it might be misleading to establish claims about the contribution of a particular size class based on initial firm size. Our research interest is of a different kind. We focus on the impact of an absolute definition of high growth on the long-term performance of firms compared to other definitions. Even though these definitions are very much characterized by selecting different firms in terms of size (classes) at t-3, the selected firms subsequently do not migrate from one definition to the other. By focusing on average firm size over a 3-year period or on firm size at the end of a period (t) we would therefore rather take out the effects which we want to investigate (see also our discussion regarding firm size as explanatory variable in section 4).

3.3 Descriptive Statistics

First interesting findings emerge from a simple descriptive comparison of average Bulgarian firms and the three different definitions of HGFs. In total, the dataset used for the regression analysis covers 369,283 observations pooled over the three 3-year periods 2001-2004, 2004-2007, and 2007-2010. Included are all incumbent firms which exist from the first to the last year of the first 3-year period (period 1 in Figure 2). The three different samples of high-growth firms are of comparable magnitude: 3,660 absolute HGFs, 3,658 relative HGFs (each representing 1.0% of firms), and 5,398 OECD HGFs (representing 1.5% of firms). The number of firms which are classified as high-growth according to all three definitions is small with only 140 firms. In terms of satisfying two out of the three definitions, the overlap is highest for absolute and OECD HGFs with 1,762 firms in common and lowest for OECD and relative HGFs with only 156 firms in common. Absolute and relative HGFs have 812 firms in common.

Figure 3: Share of HGFs in total firms, employees and gross job creation, by definition of high growth



Note: Pooled average values for periods 2001-2004, 2004-2007, and 2007-2010. Firms corresponds to total number of surviving firms over a 3-year period; Employees corresponds to the aggregate employment of surviving firms at the beginning of a 3-year period (t-3); Job creation corresponds to jobs created by surviving firms with positive growth over a 3-year period.

To start with, Figure 3 reveals the importance of high-growth firms for the Bulgarian labor market. It reports the share of high-growth firms in the total number of surviving firms per 3-year period, their share in total employment, and their contribution to gross job creation. Across all three definitions, high-growth firms account for a very small number of firms and initial employment, but make a disproportionate contribution to job creation. Nevertheless, their contribution varies largely according to their definition. Focusing on absolute and OECD HGFs indeed reveals the widely acclaimed vital role of high-growth firms for job creation. Absolute HGFs constitute 1.0% of firms, 9.6% employees and are responsible for 41.3% of job creation. OECD HGFs have a share of 1.5% in total firms, 4.1% in total employees and 33.7% in newly created jobs. The comparison of OECD HGFs to firms with 10+ employees (in line with the size threshold of the OECD definition) is shown in Figure A1 of the appendix for each 3-year period separately. Overall, the comparison to firms with 10+ employees results in a share of 8% in firms, 5% in employees and 56% in job creation for OECD firms. This largely corresponds to what has been found for high-income countries. Bravo-Biosca et al. (2013) for example showed a contribution by OECD HGFs of 25-64% to gross job creation for 11 OECD countries in the

period 2002-2005. Relative HGFs on the other hand, display a much smaller contribution to new jobs of only 13.9% and Figure 3 already prompts to question if relative HGFs should indeed be supported by entrepreneurship policies.

Table 3: Descriptive Statistics, pooled periods 2001-2004, 2004-2007, 2007-2010

	All firms	**HGFs absolute**	**HGFs relative**	**HGFs OECD**
	Mean			
Firm size in t-3 (S.D.)	11.827 (70.198)	114.726 (237.780)	2.688 (6.720)	33.407 (52.281)
	Percentages			
Size class (t-3)				
Micro (1-9 employees)	82.27	21.97	95.74	-
Small (10-49 employees)	13.84	31.17	3.91	85.40
Medium (50-249 employees)	3.32	36.20	0.36	13.54
Large (>249 employees)	0.57	10.66	-	1.06
Sector (t-3) [a]				
Agriculture, hunting, forestry	3.16	2.70	4.24	3.19
Fishing	0.05	0.08	-	0.09
Mining and quarrying	0.13	0.60	0.19	0.22
Manufacturing	12.36	27.95	16.57	22.16
Electricity, gas and water supply	0.16	0.66	0.33	0.22
Construction	6.05	13.17	12.58	14.17
Wholesale and retail trade	43.16	24.32	31.57	33.09
Hotels and restaurants	6.10	4.73	8.58	4.21
Transportation, communications	6.00	5.38	5.86	5.50
Financial intermediation	1.29	2.36	1.97	2.06
Real estate, business activities	12.11	10.85	10.83	10.04
Education	0.60	0.19	0.55	0.17
Health and social work	4.18	2.54	1.69	1.69
Other services activities	4.64	4.37	4.95	3.20
Region (t-3) [b]				
North West	8.36	5.66	7.11	5.74
North Central	10.33	9.18	9.40	9.30
North East	13.82	12.51	13.31	12.82
South East	12.15	8.99	10.63	9.34
South West	37.10	46.53	42.10	44.85
South Central	18.24	17.13	17.44	17.95
Legal form (t-3)				
Partnership	1.56	0.68	0.55	1.57
Limited liability company	43.14	71.86	77.26	72.55
Joint-stock company	3.72	21.80	7.98	11.17
Sole proprietorship	48.06	3.69	12.08	12.80
Other [c]	3.52	1.97	2.13	1.91
Foreign Ownership (t-3) [d]				
Domestic	60.74	52.88	53.87	54.91
Foreign	39.26	47.12	46.13	45.09
Number of observations	369,283	3,660	3,658	5,398

a Sector according to first level (section) of the NACE Rev. 1.1 classification system

b Statistical regions (NUTS Level 2) as defined by the Bulgarian National Statistical Institute (accessed 24 May 2016: http://www.nsi.bg/en/content/12993/basic-page/classification-territorial-units-statistics-bulgaria-nuts)

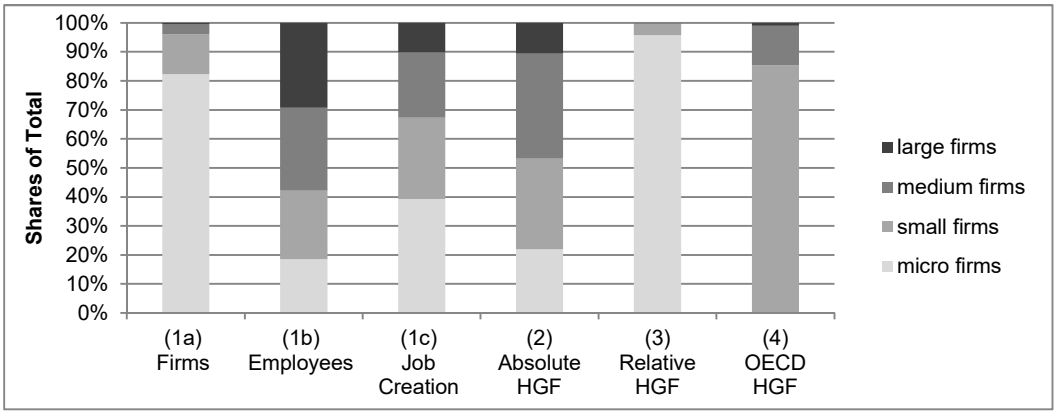
c Includes state-owned and municipal enterprises, associations and co-operations

d Sample of firms with available information. Availability varies between 8-25% among sub-samples

The summary descriptive statistics presented in Table 3 are based on average values for the three considered 3-year periods. Table 3 demonstrates that high-growth firms are different from the average firm in our sample, but even more so that the three sets of HGFs again differ very much from each other. We first consider the differences in firm size. Table 3 shows that the average firm had 11.827 employees at the beginning of a 3-year period (*t-3*). Firm sizes for HGFs vary substantially according to their definition. HGFs measured as the 1% of firms with the highest absolute increase in employees and thus biased towards larger firms, had on average 114.726 employees in *t-3*. In big contrast, rela-

tive HGFs defined as the 1% of firms with the highest log growth exhibit a strong bias towards smaller firms with 2.688 employees on average. HGFs defined according to OECD are positioned in between these two extremes in terms of average firm size at the beginning of the high growth period with 33.407 employees. The classification of firms into four different size classes reveals more details on the firm size biases inherent to the different definition of high-growth. Absolute HGFs contain a much smaller share of micro-sized businesses with less than 10 employees (21.97%) compared to the total sample of firms (82.27%). Relative HGFs on the other hand are almost entirely composed of micro firms (95.74%), while OECD HGFs do not include any micro firms by definition. For small, medium and large firm size classes the differences are similar. Whereas the shares for absolute HGFs are more or less evenly distributed among the four size classes, relative HGFs do not include any large firms and OECD HGFs are very much made up from small firms.

Figure 4: Contribution of firm size classes to firms, employees, job creation and types of HGFs



Note: Pooled average values for periods 2001-2004, 2004-2007, and 2007-2010. Firms corresponds to total number of surviving firms over a 3-year period; Employees corresponds to the aggregate employment of surviving firms at the beginning of a 3-year period (t-3); Job creation corresponds to jobs created by surviving firms with positive growth over a three 3-year period. Firm sizes classes are defined as micro firms (<10 employees), small firms (10–49 employees), medium-sized firms (50-249 employees) and large firms (>249 employees) at the beginning of a period (t-3).

Figure 4 illustrates the contribution of firm size classes to the labor market for all surviving sample firms on the one hand (bars 1a-c) as well as for the three differently defined types of high-growth firms (bars 2-4) on the other hand. Among all surviving firms, micro-sized firms constitute a very large share of firms (82%) as shown in bar (1a). In terms of employment as indicated in bar (1b) the role of micro-businesses is less prominent with 19% and below the contribution of other firm size classes. Regarding overall job creation depicted in bar (1c), micro-firms contribute with a share of 39%. This is almost identical to what Daunfeldt et al. (2015) found for Sweden where about 40% of new jobs were created by micro-firms during 2005-2008. Small firms in our sample contribute 28% to total job creation, medium-sized firms 23% and larger firms 10%. Focusing now on how different firm size classes contribute to each set of HGFs in bars 2-4, the distribution for absolute HGFs (bar 2) is very similar to that of average firms in terms of employees (1b) and job creation (1c). The situation is totally different for relative HGFs (3). As micro-firms entirely dominate the set of relative HGFs, it most closely represents the distribution of average firms in terms of total number of firms (1a). OECD HGFs (4) display a similar small firm bias as relative HGFs however towards small- instead of micro-sized firms due to the size-threshold of 10+ employees. At the same time, Figure 4 reveals that by using a size-threshold for micro firms the OECD definition ignores 39% of total job creation. Overall, comparing the contribution of firm size classes to the labor market shows that the size class distribution for absolute HGFs reflects quite accurately the relevant categories for policymakers, i.e. employees and job creation. Relative HGFs with an imminent bias towards very small firms instead only correspond well to firm size shares in terms of number of firms which seems less relevant from a labor market perspective. A definition according to OECD offsets the emphasis on micro-sized firms at the price of ignoring a considerable share of overall job creation.

Descriptive Statistics in Table 3 furthermore show that high growth firms are represented in all sectors of economic activity although they occur up to twice as often as average firms in the manufacturing and construction sector. On the other hand, HGFs are under-represented among the sectors wholesale and retail trade, education as well as health and social work. Geographically, HGFs exist in all regions of Bulgaria, but occur more often in the economically most developed South Western region around the capital city Sofija and less often in the least developed North Western region. The distribution of legal forms among HGFs compared to average firms differs considerably. There seems to exist a correlation between legal forms and growth. High-growth firms are much more often limited liability companies where all owners are protected from financial liability. Sole proprietorship is more uncommon for HGFs compared to average firms. Finally, as far as descriptives on foreign ownership are concerned, the variation among HGFs is small and they are in general more often foreign-owned than average firms.

Additionally, we present descriptive information on firms' growth rates over a single period. To compare growth rates between the sets of HGFs (absolute, relative and OECD) we employ absolute change and relative annualized percentage change over a 3-year period. Table 4 shows results for both growth measures. Considering all surviving firms results in negative annual growth of -0.540 employees in absolute terms while measured in terms of relative growth they exhibit small positive growth (1.4%). By definition, high growth firms exhibit very high growth rates and, as expected, variation among the different definitions is again large. Which type of HGF grows most depends on the growth measure used. Not surprisingly, absolute HGFs perform best in terms of absolute growth (90.616 employees more) and relative HGFs in terms of relative growth (134.7% annually).

Table 4: Descriptive statistics of firms' growth rates, pooled

	Obs.	Absolute growth (S.D.)	Relative growth (S.D.)
All surviving firms	369,283	-0.640 (28.012)	0.014 (0.266)
High Growth firms			
Absolute	3,660	90.616 (102.673)	0.662 (0.823)
Relative	3,658	30.542 (59.728)	1.347 (0.655)
OECD	5,398	50.139 (78.735)	0.354 (0.185)

Note: Pooled average values for periods 2001-2004, 2004-2007, and 2007-2010. Firm entries are not included. Absolute growth defined as $E_{i,t} - E_{i,t-3}$. Relative growth defined as $\left(E_{i,t}/E_{i,t-3}\right)^{\frac{1}{3}} - 1$.

4 METHODOLOGY

Methodologically we combine non-parametric and parametric methods. To provide a first impression of the dynamics of firm growth over time, we follow Capasso et al. (2013), Daunfeldt and Halvarsson (2015) and Hölzl (2013) and report estimated transition probability matrices. Firms are divided into five growth brackets including one for high-growth. Transition probability matrices then show the estimated probabilities that a firm in a given growth bracket in period *t* will be located in that or another growth bracket in the next period *t + 3* for each of the three definitions of high growth.

We then model future growth rates for high-growth firms and control firms by means of a two part model which consists of probit regressions for firm survival and exit on the one hand and linear regressions for growth of surviving and exiting firms on the other hand. In a third stage, the resulting conditional means from the two-part model for the two groups of high-growth firms and non-high-growth firms are used for a decomposition analysis of the aggregate growth performance for each definition of high-growth.

The choice of a two-part model in order to estimate future growth rates of HGFs is motivated by the fact that we do not only want to take surviving firms into account, but also firm exits. One-part models for job creation rates at the firm level pool over exiting and surviving firms and therefore restrict the parameters of explanatory variables to have an equal impact on both type of firms. Empirical studies

on the dynamics of firm growth however find that the main determinants for growth affect exiting firms in a very different way compared to surviving firms (e.g. Sutton, 1997; Caves, 1998). Firm size, in particular, has a very different impact on growth of survivors and exits. Smaller firms are less likely to survive, but conditional on survival they exhibit higher growth rates compared to larger firms (Dunne and Hughes, 1994; Haltiwanger et al., 2013). Our findings in section 5.3 will moreover point into the same direction. For this reason, we follow Huber et al. (2017) and Hölzl (2013) who suggest to explicitly separate exiting from surviving firms by employing two distinct equations. The two-part model furthermore allows for a decomposition of the specific contributions of firm exit and survival to the persistence of growth for each different set of high-growth firms.

We start with predicting the probability that a firm survives conditional on firm- and industry-specific characteristics. Formally, the 1st part of the two-part model describes the binary response of survival versus exit:

$$y_{i,t+\tau} = \begin{cases} 1 & \text{for } E_{i,t+\tau} \neq 0 \ (survival) \\ 0 & \text{for } E_{i,t+\tau} = 0 \ (exit) \end{cases} \quad (4)$$

where the dependent variable $y_{i,t+\tau}$ denotes the probability to survive at time *t+τ* for a firm *i* that has existed throughout the first 3-year period (from *t-3* to *t*). *τ* is the time after the first 3-year period with τ = (3,6). $E_{i,t+\tau}$ is the number of employees at time *t+τ*. $E_{i,t+\tau}$ is greater than zero for firms which survive until the end of the next (*t+3*) or upper-next (*t+6*) period and therefore continue to report employees, while it equals zero in case of a firm exit.

The probit model for survival is then given as follows:

$$P(y_{i,t+\tau} = 1|\boldsymbol{x_i}) = P(survival|\boldsymbol{x_i}) = \Phi(\boldsymbol{x'}_i \boldsymbol{\beta}) = \Phi(\beta_0 + \beta_1 HGF + \beta_2 size + \beta_3 industry_{code} + \beta_4 location + \beta_5 legal + \beta_6 foreign + \beta_7 industry_{size} + \beta_8 industry_{gro} \quad) \quad (5a)$$

where P denotes the probability for survival. Φ is the cumulative distribution function (CDF) of the standard normal distribution which ensures that the estimated response probabilities are strictly between zero and one for all values of x_i and β. x_i is the set of explanatory variables, and β are the parameters estimated by maximum likelihood.

As explanatory variables we first use an indicator variable *HGF* that takes the value 1 if the firm was a high-growth firm (absolute, relative, OECD) at time *t* and 0 otherwise. *Size* controls for firm size using ten dummy variables for size categories (1-4, 5-9, 10-14, 15-19, 20-24, 25-49, 50–99, 100-249, 250-499 and ≥ 500 employees). We choose size categories rather than the absolute number of employees in order to allow for more flexibility in case of potential non-linear relationships between size and the dependent variable. Additional firm-specific variables include *industry code* at the 2-digit NACE level comprising 59 different industries. *Location* controls for the 28 districts a firm can be located in, *legal* includes five different types of legal form (partnership, limited liability company, joint-stock company, sole proprietorship and other), and *foreign* is a dummy variable for foreign versus domestic ownership.[16] All of these explanatory variables are measured at t-3. In a similar manner as discussed earlier with regard to the classification of growing firms into size categories in section 3.2, we considered it more appropriate to condition on time *t-3* rather than time *t*. Controlling for differences at the end of the high-growth period in *t* would identify the influence of any unobserved characteristics related to the process of high-growth (e.g. management strategies developed throughout the period of high-growth). Our main research question instead asks whether the public support of (potential) high-growth firms is justifiable with regard to their long-term growth performance – depending on different definitions of high-growth. For our purposes, measuring an explanatory variable on time t after high growth has occurred would therefore be a bad control.

[16] The availability of further firm-specific variables in our dataset such as sales, profit or assets is very limited for micro and small firms, because only medium-sized and large firms are obliged to file accounts. Results for controlling for financials are therefore very similar to those presented for medium and large firms in section 5.3.

As industry-specific explanatory variables we moreover use *industry size* at the 4-digit NACE level in terms of mean employment for other firms in the same sector at time t-3. This variable controls for the fact that larger industries may reduce competitive pressures. The second industry control variable is mean *industry growth* for other firms in the same 4-digit NACE industry from time t-3 to time t in terms of relative percentage change over a three-year period. To control for industry growth is important because it is associated with changes in the intensity of competitive pressure. Positive (negative) industry growth relaxes (increases) competitive pressure and affects firm survival and firm growth.

Based on the estimated probability of survival from equation (5a), the probability of exit can simply be derived as the residual

$$P(exit) = P\left(y_{i,\,t+\tau} = 0|\boldsymbol{x_i}\right) = 1 - P(survival|\boldsymbol{x_i}) \qquad (5b)$$

In the 2nd part of the two-part model, we then study growth rates in coming periods by means of an ordinary least squares (OLS) model. For surviving firms we estimate the following regression:

$$E\left(g_{i,t+\tau}|\boldsymbol{x_i}, survival\right) = E\left(g_{i,t+\tau}|\boldsymbol{x_i}, survival\right) = \boldsymbol{x_i\beta} = \beta_0 + \beta_1 HGF + \beta_2 size + \beta_3 industry_{code} + \beta_4 location + \beta_5 legal + \beta_6 foreign + \beta_7 industry_{size} + \beta_8 industry_{growth} + \varepsilon_i, \quad if\ y_{i,t+\tau} = 1 \qquad (6a)$$

where the dependent variable $g_{i,t+\tau}$ denotes growth in the number of employees of firm *i* from time *t* (end of the first 3-year period) to *t+τ*. As *τ* is again the time after the first 3-year period with τ = (3,6), *t+τ* therefore indicates the last year of the next or upper-next 3-year period. x_i is the same set of explanatory variables used in the 1st part of the two-part model, whereas the parameters β are now estimated with OLS.[17] ε_i is the remaining error term.

In the same way as for surviving firms, we additionally estimate $g_{i,t+\tau}$ for exiting firms as:

$$E\left(g_{i,t+\tau}|\boldsymbol{x_i}, exit\right) = \beta_0 + \beta_1 HGF + \beta_2 size + \beta_3 industry_{code} + \beta_4 location + \beta_5 legal + \beta_6 foreign + \beta_7 industry_{size} + \beta_8 industry_{growth} + \varepsilon_i, \quad if\ y_{i,t+\tau} = 0 \qquad (6b)$$

This step is only necessary in the case of absolute growth. For relative growth when $E\left(g_{i,t+\tau}|\boldsymbol{x_i}, exit\right)$ = -1, i. e. the relative growth rate for exits is always -100%, eq. (6b) does not need to be estimated.

Finally, in the third stage of our econometric model, we make use of the regression results from the two-part model to decompose aggregate growth into different components. We use the conditional mean function to calculate predictions (conditional means) from the 1st (probit) and 2nd (OLS) stage of two-part model for the two groups of high-growth firms on the one hand and non-high-growth firms on the other hand.

The aggregate growth effects are given for the group of high-growth firms by

$$E\left(y_{i,t+\tau}|x_i, HGFx_{i,t}\right) = P(surival|x_i)\ E\left(g_{i,t+\tau}|x_i, survival\right) + P(exit|x_i)E\left(g_{i,t+\tau}|x_i, exit\right), \qquad (7a)$$

and for non-high-growth firms by

$$E\left(y_{i,t+\tau}|x_i, non\ HGFx_{i,t}\right) = P(surival|x_i)\ E\left(g_{i,t+\tau}|x_i, survival\right) + P(exit|x_i)E\left(g_{i,t+\tau}|x_i, exit\right) \qquad (7b)$$

where for each equation separately we multiply the conditional mean probability of survival as estimated from eq. (5a) with the conditional mean growth rates of surviving firms in coming period(s) as esti-

[17] One could argue that standard OLS estimation might lead to inconsistent results as the regressor *size* includes the lagged dependent variable. This would indeed be a problem if we were trying to identify whether the very fact that a firm is a HGF changes its probability to be a HGF in the next period ('true' state dependence) or if instead it is mainly permanent factors inherent to the firm and unobserved by the researcher that are behind the persistent nature of high growth ('spurious' state dependence, see also Kaiser and Kongsted, 2008). As we do not attempt to distinguish between the types of state dependence a standard OLS estimator seems sufficient.

mated from eq. (6a) and add to it the product of the conditional mean probability of exits as estimated from eq. (5b) and the conditional mean growth rates for exits as estimated from eq. (6b).

By taking the differences of the two groups of HGFs and non-HGFs for each component of eq. (7a) and (7b), that is:

$$E(y_{i,t+\tau}|x_i) = E(y_{i,t+\tau}|x_i, HGFx_{i,t}) - E(y_{i,t+\tau}|x_i, non\ HGFx_{i,t}) \quad (8)$$

we are eventually able to compare the overall future growth performance of HGFs to non-HGFs. In particular, we can investigate whether the future growth rates differ depending on the definition of high growth and how firm survival and exit contribute to potential differences.

5 RESULTS

5.1 TRANSITION PROBABILITY MATRICES

The reported transition probability matrices in Tables 5 a-c provide a first impression of how firms in a given period *t* (columns) develop in the next period *t+3* (rows) in terms of growth. Firms are divided into five growth brackets: firm exits during a 3-year period are included in the growth bracket $g_{i,t+\tau}^{(0)}$, declining firms with negative growth are included in $g_{i,t+\tau}^{(1)}$, stagnating firms with zero growth in $g_{i,t+\tau}^{(2)}$, and growing (but not high-growth) firms in $g_{i,t+\tau}^{(3)}$. High-growth firms are grouped in bracket $g_{i,t+\tau}^{(4)}$. We perform this step for each definition of high growth separately. The set of firms in growth brackets $g_{i,t+\tau}^{(0)}$ (exiting firms), $g_{i,t+\tau}^{(1)}$ (firms with negative growth) and $g_{i,t+\tau}^{(2)}$(firms with zero growth) is identical irrespective of how high growth is defined. Firms in growth bracket $g_{i,t+\tau}^{(4)}$(high-growth firms) obviously differ according to the definition of high growth. Consequently, also firms in growth bracket $g_{i,t+\tau}^{(3)}$ which constitutes the residual of firms with positive growth, but not high-growth differ slightly across the three definitions of high growth. The rows in Tables 5 a-c all add up to 100% each.

Starting with the first column in Tables 5a-c, about a third of all firms (31.73%) exit in the next 3-year period ($g_{i,t+3}^{(0)}$). Already declining ($g_{i,t}^{(1)}$) or stagnating firms ($g_{i,t}^{(2)}$) at the end of the first period are most likely to exit in the next period. About another third of firms (29.84%) as shown in the second column experiences negative growth ($g_{i,t+3}^{(1)}$). Firms with zero growth ($g_{i,t}^{(2)}$) are very likely to either continue stagnating (35.32%), but even more so to exit (45.18%). Out of the firms with positive growth in one period ($g_{i,t}^{(3)}$) about a third continues to grow, but they are even more likely to decline (about 40%) or to exit (about 21%).

By focusing on firms exhibiting high growth ($g_{i,t+\tau}^{(4)}$), Tables 5a-c very much add to the fact that the definition of high growth plays a decisive role for the economic contribution of high growth firms. In terms of repeating high growth in the next period, 28.52% of absolute HGFs are able to do so. Relative HGFs in contrast show with 0.71% a probability to repeat high-growth as low as for any other firm in the sample. OECD HGFs have a probability of 11.47% to repeat high-growth. These largely differing probabilities are in line with findings from previous studies. Daunfeldt and Halvarsson (2015) for example also find a probability of about 1% to repeat relative high growth rates in the next 3-year period. Hölzl (2013) shows that OECD HGFs have a probability to repeat high-growth of 7.6% in the next period, while HGFs defined according to the Birch index (with an additional component of absolute growth) exhibit a probability of 28.7% to repeat high growth. Weinblat (2017) arrives at a very similar average probability of 23.5% to repeat high growth according to the Birch index for nine different European countries. Daunfeldt et al. (2014) show that absolute HGFs repeat high growth with a probability of 31.67%, relative HGFs with 1.49% and HGFs defined according to Birch have a probability of 21.32%. The existence of large variations in the probability to repeat high growth among the differently defined HGFs at the same time contributes to building a strong case for thoroughly choosing the

measure of growth, in particular for considering a definition of high growth in absolute terms. By exclusively employing a relative measure for high growth Daunfeldt and Halvarsson (2015) for example arrive at the conclusion that HGFs are essentially 'one-hit wonders'. Transition probabilities for high growth firms measured in an absolute way or according to OECD on the other hand would lead to a different result.

Table 5a: Transition probabilities for growth brackets from t to t+3, absolute HGFs

	$g_{i,t+3}^{(0)}$ exit	$g_{i,t+3}^{(1)}$ negative growth	$g_{i,t+3}^{(2)}$ zero growth	$g_{i,t+3}^{(3)}$ positive growth	$g_{i,t+3}^{(4)}$ high growth firms (absolute)	Total
$g_{i,t}^{(1)}$	35.20	30.97	12.86	20.45	0.53	100
$g_{i,t}^{(2)}$	45.18	8.59	35.32	10.86	0.05	100
$g_{i,t}^{(3)}$	20.87	40.04	6.27	31.31	1.51	100
$g_{i,t}^{(4)}$ = HGF (absolute)	**6.71**	**52.13**	**0.22**	**12.42**	**28.52**	100
Total	31.73	29.84	15.00	22.36	1.06	100

Table 5b: Transition probabilities for growth brackets from t to t+3, relative HGFs

	$g_{i,t+3}^{(0)}$ exit	$g_{i,t+3}^{(1)}$ negative growth	$g_{i,t+3}^{(2)}$ zero growth	$g_{i,t+3}^{(3)}$ positive growth	$g_{i,t+3}^{(4)}$ high growth firms (relative)	Total
$g_{i,t}^{(1)}$	35.20	30.97	12.86	20.44	0.54	100
$g_{i,t}^{(2)}$	45.18	8.59	35.32	10.55	0.36	100
$g_{i,t}^{(3)}$	20.32	40.43	6.22	32.66	0.37	100
$g_{i,t}^{(4)}$ = HGF (relative)	**27.16**	**37.63**	**2.07**	**32.43**	**0.71**	100
Total	31.73	29.84	15.00	22.98	0.44	100

Table 5c: Transition probabilities for growth brackets from t to t+3, OECD HGFs

	$g_{i,t+3}^{(0)}$ exit	$g_{i,t+3}^{(1)}$ negative growth	$g_{i,t+3}^{(2)}$ zero growth	$g_{i,t+3}^{(3)}$ positive growth	$g_{i,t+3}^{(4)}$ high growth firms (OECD)	Total
$g_{i,t}^{(1)}$	35.20	30.97	12.86	20.42	0.56	100
$g_{i,t}^{(2)}$	45.18	8.59	35.32	10.84	0.07	100
$g_{i,t}^{(3)}$	21.46	39.90	6.44	29.26	2.93	100
$g_{i,t}^{(4)}$ = HGF (OECD)	**7.76**	**46.36**	**1.83**	**32.58**	**11.47**	100
Total	31.73	29.84	15.00	21.85	1.58	100

Note: Pooled average values for periods 2001-2004, 2004-2007, and 2007-2010. Transition probabilities are calculated using frequencies. Columns denote state at time t at the end of the first three-year period; rows denote state at time t+3 at the end of the next 3-year period. Growth brackets are defined based on annualized percentage change $g_{i,t+3}$ as follows: $g_{i,t+\tau}^{(0)}$ = -1 (exit), -1<$g_{i,t+\tau}^{(1)}$<0 (negative growth), $g_{i,t+\tau}^{(2)}$ = 0 (zero growth), $g_{i,t+\tau}^{(3)}$>0 (positive growth), and $g_{i,t+\tau}^{(4)}$= HGF. The definition of growth brackets based on absolute growth or log-differences does not alter results.

Additionally, Tables 5a-c suggest that it is worthwhile not to limit ones research interest to the repetition of the high-growth status in coming periods. The high probability of absolute HGFs to repeat high growth seems to happen at the price of a lower probability to exhibit (non-high) positive growth or to sustain the achieved level of employment. Adding up the probabilities for sustaining previous employment levels ($g_{i,t+3}^{(2)}$), growing positively ($g_{i,t+3}^{(3)}$) as well as highly growing ($g_{i,t+3}^{(4)}$) provides a different impression than solely focusing on the repetition of high-growth. In fact, absolute HGFs (41.16%) and relative HGFs (35.21%) then have a closer probability not to decline or to exit in the next period, while OECD HGFs perform best with a probability of 45.88%. In a similar vein, adding up exiting ($g_{i,t+3}^{(0)}$) and declining high growth firms ($g_{i,t+3}^{(1)}$) results in the lowest probability of decline for OECD HGFs (54.12%), followed by absolute HGFs (58.84%) and relative HGFs (64.79%). One could argue that declining HGFs have the chance to again recover in following periods and are therefore fundamentally

different from firm exits. This line of argumentation is supported for example by Capasso et al. (2013) who detected a high 'rebound effect' for high-growing firms experiencing alternately highly positive and highly negative growth rates. If we therefore disentangle exit from decline, then a definition of high-growth in relative terms again appears least favorable as 27.16% of relative HGFs exit compared to only 7.76% OECD HGFs and 6.71% for absolute HGFs.

We also assessed transition probabilities between the state at the end of a period (*t*) and the state two periods later (*t+6*). Since our dataset only comprises three consecutive 3-year periods this effectively means comparing the state of a firm at the end of 2001-2004 to the state at the end of 2007-2010. Results are reported in Tables A2a-c of the appendix. In essence, results for two periods later are similar to what is shown in Tables 5a-c. Absolute HGFs exhibit the highest probability to repeat high-growth two periods later (14.31%), whereas only 0.80% of relative HGFs and 2.42% of OECD HGFs are able to. Aggregating probabilities for stagnation, positive and high-growth two periods later shows that absolute HGFs (20.56%) have a lower probability not to decline or exit than relative HGFs (25.94%) and OECD HGFs (25.14%). Exit rates on the other hand are again highest for relative HGFs (20.36%) followed by OECD HGFs (12.73%) and absolute HGFs (9.88%), which is again partially offset by an inverse ranking in terms of declining growth (53.69% of relative HGFs, 62.13% of OECD HGFs and 69.56% of absolute HGFs).

The variations in transition probabilities between differently defined HGFs are very substantial. Absolute HGFs largely outperform the other samples of HGFs in terms of repeating high growth as well as exit. Relative HGFs perform particularly poor compared to the other definitions of high growth. Taking a broader view on what constitutes a positive future growth performance however produces a more nuanced picture. Considering all high-growth firms which at least do not decline or exit in the coming period, OECD HGFs perform best followed by absolute HGFs. Relative HGFs again exhibit the lowest probability for positive future growth.

5.2 Main Regression Results

We start with showing growth estimates from OLS (2nd part of 2-part model) for surviving firms in more detail based on the specification given in equation (6a). This is done with the intention to increase comparability of our results to those previous studies which focus on surviving firms. Tables 6a-c compare results for growth of previous high-growth firms to control firms in t+3 and t+6 for the three definitions of high-growth. Each table utilizes a different measure of growth as outcome variable $y_{i,t+T}$.

Table 6a reports results for absolute growth as defined in eq. (1). We control for the firm- and industry specific covariates as described. The coefficient of the high-growth indicator variable (HGF) shows the effect on firm growth for high-growth firms compared to non-high-growth firms. It takes the value of 1 if a firm has been a HGF and 0 otherwise. For the period t+3 after the high-growth event we find that high-growth firms continue to significantly contribute to the labor market in the next period. The contribution to the absolute number of jobs compared to non-HGFs is largest for absolute HGFs (16.283 more jobs), followed by OECD (7.181) and relative HGFs (5.848). While results in t+3 are positive for all three groups of surviving HGFs, the picture looks very different for growth two periods after the high-growth event in t+6. All types of HGFs destroy more jobs than non-HGFs in t+6. The results are most negative for absolute HGFs (-48.993), whereas relative and OECD HGFs shrink by -12.472 and -15.925 employees respectively. The coefficients for other control variables on the other hand are very similar for t+3 and t+6.

Since the regression sample for growth in t+3 is derived by pooling the two base periods 2001-2004 and 2004-2007, while the sample for growth in t+6 consists only of one base period 2001-2004, sample sizes are different and the job losses in t+6 cannot be directly subtracted from job gains in t+3. To this end, Table A3 in the appendix presents regression results in terms of absolute growth for identical sub-samples in t+3 and t+6. It shows that job gains in t+3 are not fully offset by job losses in t+6. In other words, the overall contribution to gross job creation by surviving high growth firms is positive even two periods after the high-growth event during the economic crisis. Absolute growth in employ-

ees after two periods is again highest for absolute HGFs with 33.843 jobs more than non-HGFs. Relative HGFs and OECD HGFs create 12.658 and 14.118 jobs respectively more than non-HGFs.

Table 6a: Absolute growth of surviving HGFs (absolute, relative, OECD), t+3 and t+6

$y_{i,t+\tau}$ = Absolute growth	τ=3			τ=6		
	(1)	(2)	(3)	(4)	(5)	(6)
Covariates	Absolute	Relative	OECD	Absolute	Relative	OECD
HGF	16.283***	5.848***	7.181***	-48.993***	-12.472***	-15.925***
	(4.678)	(2.234)	(1.489)	(8.617)	(4.584)	(2.663)
Size (ref: 25-49)						
1-4	4.195***	3.527***	4.522***	4.227***	5.693***	3.282***
employees	(0.928)	(0.972)	(0.922)	(1.364)	(1.489)	(1.297)
5-9	3.775***	3.223***	4.030***	3.620***	4.672***	3.032***
employees	(0.765)	(0. 794)	(0. 760)	(1.332)	(1.399)	(1.288)
10-14	3.522***	3.062***	2.837***	3.051***	3.848***	4.589***
employees	(0.607)	(0. 624)	(0. 633)	(0.946)	(0. 977)	(1.014)
15-19	2.974***	2.614***	2.444***	2.293**	2.711***	3.397***
employees	(0.591)	(0. 607)	(0. 611)	(0.921)	(0. 959)	(0.987)
20-24	2.083***	1.791***	1.703***	0.696	1.025	1.351
employees	(0.576)	(0. 584)	(0. 584)	(1.160)	(1.198)	(1.189)
50-99	-5.619***	-4.565***	-4.571***	-4.959***	-6.672***	-6.934***
employees	(1.189)	(1.237)	(1.235)	(1.901)	(2.018)	(2.008)
100-249	-14.050***	-12.233***	-11.995***	- 12.005***	-14.686***	-15.559***
employees	(2.326)	(2.440)	(2.449)	(4.006)	(4.204)	(4.253)
250-499	-53.264***	-50.502***	-50.149***	-41.881***	-45.550***	-46.779***
employees	(6.270)	(6.441)	(6.457)	(10.082)	(10.427)	(10.497)
500+	-153.408***	-150.466***	-150.043***	-122.798***	-126.624***	-128.104***
employees	(16.299)	(16.345)	(16.346)	(16.928)	(16.981)	(16.990)
Industry size	yes	yes	yes	yes	yes	yes
Industry growth	yes	yes	yes	yes	yes	yes
Industry code	yes	yes	yes	yes	yes	yes
Location	yes	yes	yes	yes	yes	yes
Legal form	yes	yes	yes	yes	yes	yes
Foreign owned	yes	yes	yes	yes	yes	yes
Observations	95,756	95,756	95,756	28,691	28,691	28,691
# HGF	1,292	1,022	3,434	447	399	1,371
R^2	0.129	0.127	0.128	0.165	0.149	0.153

Notes: Robust standard errors in parentheses. Constant not reported. ***p-value < 0.01, ** p-value < 0.05, * p-value <0.1.
Growth measured as $y_{i,t+\tau} = E_{i,t+\tau} - E_{i,t+\tau-3}$

The contribution of each group of HGFs changes when using relative growth as dependent variable. Table 6b shows regression results for measuring growth in terms of relative log-differences as used in equation (2) for defining relative HGFs. Table 6c indicates the annualized percentage change as used in equation (3) for defining OECD HGFs. When measuring future growth in a relative way, the effect of being a high growth firm again results in a positive contribution to jobs in the next period t+3 for absolute HGFs (0.100 log growth and 3.6 annual percentage growth over a 3-year period) and even more so for OECD HGFs (0.116 log growth or annually 3.9%). For relative HGFs however growth rates become considerably negative in t+3 (-0.337 log growth and -7.0% annually) compared to non-HGFs. In t+6 again all types of HGFs reduce their number of employees compared to non-HGFs.

Our results relate closely to what has been found by the previous studies listed in Table 1. The studies by Capasso et al. (2013), Coad (2007), Coad and Hölzl (2009), Daunfeldt and Halvarsson (2015) and Parker et al. (2010) which all define and measure high growth in relative terms similar to our definition in equation (2) find negative (or insignificant in the case of Parker et al., 2010) future growth rates just as we do in Tables 6b and 6c for relative HGFs. Acs (2013), Hölzl (2013), Satterthwaite and Hamilton (2016) and Senderovitz et al. (2016) who define growth according to OECD or other composite measures that incorporate components of absolute growth detect positive future growth rates as we do for absolute and OECD HGFs in Tables 6b and 6c .With regard to results for absolute growth as presented in Table 6a, our study is the first of its kind and we are not aware of any evidence to compare our results to.

Table 6b: Relative log growth of surviving HGFs (absolute, relative, OECD), t+3 and t+6

$y_{i,t+\tau}$ = relative log growth	τ=3			τ=6		
	(1)	(3)	(3)	(4)	(5)	(6)
Covariates	Absolute	Relative	OECD	Absolute	Relative	OECD
HGF	0.100***	-0.337***	0.116***	-0.286***	-0.343***	-0.138***
	(0.032)	(0.037)	(0.016)	(0.059)	(0.053)	(0.027)
Size (ref: 25-49)						
1-4	0.390***	0.396***	0.401***	0.259***	0.279***	0.248***
employees	(0.012)	(0.012)	(0.012)	(0.020)	(0.020)	(0.020)
5-9	0.197***	0.198***	0.206***	0.153***	0.163***	0.145***
employees	(0.013)	(0.013)	(0.013)	(0.021)	(0.021)	(0.021)
10-14	0.111***	0.110***	0.104***	0.092***	0.099***	0.103***
employees	(0.014)	(0.014)	(0.014)	(0.023)	(0.023)	(0.023)
15-19	0.081***	0.080***	0.076***	0.027	0.030	0.035
employees	(0.017)	(0.017)	(0.016)	(0.027)	(0.027)	(0.027)
20-24	0.061***	0.061***	0.058***	0.059**	0.062**	0.064**
employees	(0.019)	(0.019)	(0.019)	(0.030)	(0.030)	(0.030)
50-99	-0.098***	-0.093***	-0.091***	-0.036	-0.049*	-0.049*
employees	(0.020)	(0.020)	(0.020)	(0.029)	(0.029)	(0.029)
100-249	-0.114***	-0.107***	-0.098***	-0.091***	-0.110***	-0.114***
employees	(0.023)	(0.022)	(0.022)	(0.031)	(0.031)	(0.031)
250-499	-0.263***	-0.253***	-0.239***	-0.176***	-0.204***	-0.209***
employees	(0.047)	(0.046)	(0.046)	(0.065)	(0.064)	(0.064)
500+	-0.189***	-0.181***	-0.163***	-0.123	-0.155**	-0.160**
employees	(0.053)	(0.052)	(0.052)	(0.076)	(0.075)	(0.075)
Industry size	yes	yes	yes	yes	yes	yes
Industry growth	yes	yes	yes	yes	yes	yes
Industry code	yes	yes	yes	yes	yes	yes
Location	yes	yes	yes	yes	yes	yes
Legal form	yes	yes	yes	yes	yes	yes
Foreign owned	yes	yes	yes	yes	yes	yes
Observations	95,756	95,756	95,756	28,691	28,691	28,691
# HGF	1,292	1,022	3,434	447	399	1,371
R^2	0.062	0.064	0.063	0.060	0.061	0.059

See Notes Table 6a. Growth measured as $y_{i,t+\tau} = \ln(E_{i,t+\tau}/E_{i,t+\tau-3})$.

Table 6c: Annualized percentage growth of surviving HGFs (absolute, relative, OECD), t+3 and t+6

$y_{i,t+\tau}$ = annualized percentage growth	τ=3			τ=6		
	(1)	(3)	(3)	(4)	(5)	(6)
Covariates	Absolute	Relative	OECD	Absolute	Relative	OECD
HGF	0.036***	-0.070***	0.039***	-0.059***	-0.084***	-0.034***
	(0.007)	(0.010)	(0.004)	(0.012)	(0.013)	(0.006)
Size (ref: 25-49)						
1-4	0.115***	0.116***	0.119***	0.074***	0.079***	0.071***
employees	(0.003)	(0.003)	(0.003)	(0.006)	(0.006)	(0.006)
5-9	0.056***	0.055***	0.059***	0.041***	0.043***	0.039***
employees	(0.003)	(0.003)	(0.003)	(0.006)	(0.006)	(0.006)
10-14	0.032***	0.031***	0.029***	0.023***	0.024***	0.026***
employees	(0.004)	(0.004)	(0.004)	(0.006)	(0.006)	(0.006)
15-19	0.022***	0.022***	0.021***	0.008	0.009	0.010
employees	(0.005)	(0.005)	(0.005)	(0.007)	(0.007)	(0.007)
20-24	0.019***	0.019***	0.018***	0.016*	0.017**	0.017**
employees	(0.005)	(0.005)	(0.005)	(0.009)	(0.009)	(0.009)
50-99	-0.022***	-0.020***	-0.019***	-0.013*	-0.016**	-0.016**
employees	(0.005)	(0.005)	(0.005)	(0.007)	(0.007)	(0.007)
100-249	-0.029***	-0.026***	-0.023***	-0.022***	-0.027***	-0.027***
employees	(0.005)	(0.005)	(0.005)	(0.008)	(0.008)	(0.008)
250-499	-0.061***	-0.057***	-0.053***	-0.035***	-0.041***	-0.043***
employees	(0.009)	(0.009)	(0.009)	(0.015)	(0.015)	(0.015)
500+	-0.050***	-0.046***	-0.041***	-0.026	-0.033*	-0.034*
employees	(0.012)	(0.012)	(0.012)	(0.018)	(0.018)	(0.018)
Industry size	yes	yes	yes	yes	yes	yes
Industry growth	yes	yes	yes	yes	yes	yes
Industry code	yes	yes	yes	yes	yes	yes

Location	yes	yes	yes	yes	yes	yes
Legal form	yes	yes	yes	yes	yes	yes
Foreign owned	yes	yes	yes	yes	yes	yes
Observations	95,756	95,756	95,756	28,691	28,691	28,691
# HGF	1,292	1,022	3,434	447	399	1,371
R^2	0.054	0.055	0.055	0.051	0.052	0.051

See Notes Table 6a. Growth measured as $y_{i,t+\tau} = \left(\frac{E_{i,t+\tau}}{E_{i,t-3+\tau}}\right)^{\frac{1}{3}} - 1$.

The emerging findings from the regression of future growth rates for surviving firms are therefore two-fold. First of all and in line with insights from descriptive statistics and transition matrices, results are very much affected by how high-growth is defined. Our results largely confirm findings by previous studies: surviving relative HGFs show negative future growth rates, while OECD HGFs and absolute HGFs continue to grow. Secondly, there is a large difference in the contribution of HGFs compared to non-HGFs for the medium (t+3) versus long-term view (t+6). While – with the notable exception of relative HGFs – HGFs exhibit a positive economic contribution in terms of jobs over the period following high-growth (t+3), their performance is negative two periods later (t+6). We again need to add as caveat that the analysis for t+6 is based on a single period, i.e. the performance of firms from period 2001-2004 to period 2007-2010 which was very much characterized by the economic downturn from 2008 onwards. Nevertheless, job gains by HGFs in t+3 are not off-set by job losses in t+6. In total, overall job creation is still positive two periods after the high-growth event. The decomposition of the aggregate effect for each group of HGFs and non-HGFs in this section as well as the disaggregation for firm sizes in section 0 will shed more light on these first findings for surviving firms.

To decompose the effect, we use the conditional mean function to calculate predictions for HGFs on the one hand and non-HGFs on the other hand from the probit regressions for survival and exit of firms (1st stage of two-part model) as well as OLS estimations for growth rates of surviving and exiting firms respectively (2nd stage of two-part model). Table 7a presents the decomposition of results for growth measured in absolute terms. As relative growth measure in Table 7b we use annualized percentage change as firm exits are indicated by a zero where logarithms are undefined for. In addition, results for surviving firms are very similar for percentage change as well as log differences. Tables 7a-b each include three sections of results: those for HGFs, for non-HGFs as well as for differences between the two groups. Each section then reports the conditional probability of survival in column (1a), the conditional probability of exit in column (1b), the conditional mean growth rate for surviving firms in column (2a), the conditional mean growth rate for exits in column (2b) and column (3) finally reports the overall conditional mean growth rates for surviving and exiting firms derived by multiplying columns (1a) and (2a) and adding the product of columns (1b) and (2b).

Column (2a) on the right hand side of Table 7a shows differences in absolute growth rates between HGFs and non-HGFs for surviving firms identical to those in Table 6a. The very last column (3) in Table 7a on the other hand reports the overall growth for both surviving and exiting HGFs compared to non-HGFs based on eq. (8). It shows that results change profoundly when exits are taken into account. The positive economic contribution of HGFs in t+3 as shown in Tables 6a-c for surviving firms becomes negative for all types of HGFs with most jobs destroyed by absolute HGFs. The negative results in t+6 for survivors (column 2a) remain largely unchanged when exits are included (column 3). In stark contrast, overall results for relative growth as outcome variable in column (3) of Table 7b turn positive for all types of HGFs - both for t+3 and t+6 - compared to the perspective on survivors only in column (2a). What causes the opposite impact of firm exits on results depending on how growth is measured? The rates of decline for exiting firms as shown in columns (2b) seem pivotal for an explanation. Even though exit rates are lower for HGFs compared to non-HGFs, HGFs which do exit are of much larger firm size than non-HGFs (as HGFs on average are of larger size than non-HGFs). Exiting HGFs therefore reduce overall growth rates to a much larger extent than exiting non-HGFs. This is particularly the case for absolute HGFs, since an absolute definition of high growth is biased towards larger firms. Exiting firms among absolute HGFs consequently tend to be particularly large.

Table 7a Decomposition of conditional mean growth by definition of HGFs, absolute growth

Absolute growth		HGFs					Non-HGFs					Differences				
Definition	t+τ	(1a) Survival rate	(1b) Exit rate	(2a) Growth survivors	(2b) Growth exits	(3) Total mean growth	(1a)	(1b)	(2a)	(2b)	(3)	(1a)	(1b)	(2a) *as 1st row of Table 6a*	(2b)	(3)
Absolute HGFs	τ =3	0.765	0.235	14.206	-193.318	-34.583	0.682	0.318	-2.077	-4.580	-2.873	0.083	-0.083	16.283	-188.74	**-31.710**
Relative HGFs	τ =3	0.743	0.257	3.928[1]	-24.983	-3.490	0.682	0.318	-1.920	-4.802	-2.836	0.061	-0.061	5.848	-20.18	**-0.654**
OECD HGFs	τ =3	0.817	0.183	5.066	-60.160	-6.900	0.680	0.320	-2.115	-4.614	-2.914	0.136	-0.136	7.181	-55.55	**-3.986**
Absolute HGFs	τ =6	0.716	0.284	-54.142	-43.365[0]	-51.080	0.582	0.418	-5.149	-1.968	-3.821	0.133	-0.133	-48.993	-41.40	**-47.259**
Relative HGFs	τ =6	0.812	0.188	-18.211	-22.199	-18.962	0.581	0.419	-5.739	-1.967	-4.157	0.231	-0.231	-12.472	-20.23	**-14.805**
OECD HGFs	τ =6	0.740	0.260	-21.076	-13.224	-19.034	0.579	0.421	-5.151	-1.957	-3.807	0.161	-0.161	-15.925	-11.27	**-15.227**

Notes: Column (1a) reports the conditional probability of survival, column (1b) the conditional probability of exit. Column (2a) represents the conditional mean growth for surviving firms, column (2b) the conditional mean growth for exits. Column (3) reports the overall conditional mean growth for surviving and exiting firms. Differences are calculated by subtracting each of the columns 1a-3 for non-HGFs from those of HGFs. Values in column (2a) in right panel 'differences' are equivalent to coefficients for HGF in Tables 6a-c. [0] Statistically not significant, [1] significant at the 10% level, [2] significant at the 5% level, all other values significant at the 1% level.

Absolute growth is measured as $y_{i,t+\tau} = E_{i,t+\tau} - E_{i,t+\tau-3}$

Table 7b Decomposition of conditional mean growth by definition of HGFs, relative growth

Annualized percentage growth		HGFs					Non-HGFs					Differences				
Definition	t+τ	(1a) Survival rate	(1b) Exit rate	(2a) Growth survivors	(2b) Growth exits	(3) Total mean growth	(1a)	(1b)	(2a)	(2b)	(3)	(1a)	(1b)	(2a) *as 1st row of Table 6c*	(2b)	(3)
Absolute HGFs	τ =3	0.765	0.235	0.015[2]	-1	-0.223	0.682	0.318	-0.021	-1	-0.332	0.083	-0.083	0.036	0.000	**0.109**
Relative HGFs	τ =3	0.743	0.257	-0.090	-1	-0.323	0.682	0.318	-0.020	-1	-0.331	0.061	-0.061	-0.070	0.000	**0.008**
OECD HGFs	τ =3	0.817	0.183	0.017	-1	-0.170	0.680	0.320	-0.022	-1	-0.334	0.136	-0.136	0.039	0.000	**0.165**
Absolute HGFs	τ =6	0.716	0.284	-0.116	-1	-0.367	0.582	0.418	-0.057	-1	-0.451	0.133	-0.133	-0.059	0.000	**0.084**
Relative HGFs	τ =6	0.812	0.188	-0.141	-1	-0.302	0.581	0.419	-0.056	-1	-0.452	0.231	-0.231	-0.084	0.000	**0.150**
OECD HGFs	τ =6	0.740	0.260	-0.090	-1	-0.326	0.579	0.421	-0.056	-1	-0.453	0.161	-0.161	-0.034	0.000	**0.127**

See notes Table 7a.

Relative annualized percentage growth over a 3-year period is measured as $y_{i,t+\tau} = \left(\frac{E_{i,t+\tau}}{E_{i,t-3+\tau}}\right)^{\frac{1}{3}} - 1$

During the recessionary context in t+6 the differences between surviving and exiting firms are much smaller as most firms shrink anyway. In contrast to an absolute growth measure, the negative effects of larger firm sizes among exits of HGFs are not accounted for when using relative rates of change with a minimum value for firm exits of -1 as shown in Table 7b. Instead, the differences in exit rates (1b) for HGFs (lower) and non-HGFs (higher) determine overall results and contribute to positive aggregate effects in columns (3) for HGFs in both t+3 and t+6.

To sum up, it appears important to take firm exits into account when analyzing the performance of high-growth firms in coming periods. Limiting the analysis to surviving firms omits the opportunity for important findings. If accounting for firm exits influences overall growth rates in a positive or negative manner again depends on the way how growth is measured. Absolute growth attributes a higher importance to firm exits from larger firms. This is why in particular an absolute definition of high-growth firms which is biased towards larger firms performs worse when future growth is also measured in an absolute manner. Measuring future growth in a relative way on the other hand ignores the influence of firm size among exits and turns results positive for all types of HGFs.

5.3 RESULTS BY FIRM SIZE

In this section we examine the previous results for micro, small, medium and large firms separately. We use the four firm size classes as defined in section 3.2: micro firms (<10 employees), small firms (10–49 employees), medium-sized firms (50-249 employees) and large firms (>249 employees) all measured at the beginning of the first 3-year period at time *t-3.* The focus is on absolute growth which – as argued throughout this paper – we assume to be of most relevance from a policy perspective. Tables 8 a-c accordingly disaggregate results for conditional absolute growth as shown in Table 7a for different firm size classes. For a disaggregation of relative growth rates by firm size classes see Tables A4a-c in the appendix.

We consider columns (1a) and (2a) in Tables 8 a-c first. The emerging findings are closely related to our econometric strategy presented in section 4 and largely support our choice for a two-part model. We motivated the use of a two-part model by the fact that firm size – among other factors influencing firm dynamics – has a different impact on firm survival on the one hand and on growth of survivors on the other hand. We therefore argued in favor of two separate equations for the decision to survive and for growth rates of survivors. Column (1a) indicates the conditional probability of survival. It seems to hold for both a perspective on t+3 as well as on t+6 that the rate of survival increases with firm size. The increasing probability to survive is more pronounced for non-HGFs, but the differences exist for HGFs as well: micro-sized firms are less likely to survive than small firms, which again survive less often than medium-sized. As far as large firms are concerned the probability to survive is generally higher than for medium-sized firms with the only exception of absolute HGFs where large firms survive less often than medium-sized firms. In contrast, column (2a) clearly shows that conditional on survival growth rates decrease with firm size. While for example surviving micro-sized absolute HGFs in Table 8a grow by 33.193 employees in the period following high-growth (t+3), small absolute HGFs only grow by 14.118 employees. Medium-sized absolute HGFs decrease by -12.850 over the same time period and large absolute HGFs decrease by -98.152 employees. As a cautionary note, some results for conditional mean growth rates for surviving (and exiting) HGFs lack statistical significance. This could be triggered by small sample sizes. At the same time, coefficients for firm size dummies in the OLS regressions on growth of surviving firms in Tables 6a-c very much confirm the general trend that smaller firms grow faster than larger firms. For the group of non-HGFs we find a similar relationship between size and growth - although it seems more appropriate to reformulate the trend insofar as that the rate of decline increases (rather than that the rate of growth decrease) when firm size increases.

Table 8a Decomposition of conditional mean growth (absolute growth) by firm size classes for absolute HGFs

Absolute growth		HGFs Absolute				Non-HGFs				Differences				Share	
Firm size class	t+τ	(1a) Survival rate	(2a) Growth survivors	(2b) Growth exits	(3) Total growth	(1a)	(2a)	(2b)	(3)	(1a)	(2a)	(2b)	(3)	HGF	Non-HGF
Micro	τ =3	0.742	33.193	-118.438	-5.940	0.632	0.463	-2.745	-0.717	0.110	32.730	-115.693	-5.223	0.10	0.76
Small	τ =3	0.895	14.118[2]	-122.986	-0.250	0.809	-1.266	-11.554	-3.233	0.086	15.383	-111.433	2.983	0.23	0.19
Medium	τ =3	0.951	-12.850[0]	-244.081	-24.104	0.901	-12.889	-42.379	-15.796	0.050	0.040	-201.702	-8.308	0.51	0.05
Large	τ =3	0.932	-98.152	-660.296	-136.120	0.909	-95.899	-161.586	-101.890	0.024	-2.253	-498.711	-34.230	0.16	0.01
Micro	τ =6	0.716	-49.014	-50.049	-49.308	0.524	-0.869	-3.346	-2.047	0.192	-48.145	-46.703	-47.260	0.18	0.69
Small	τ =6	0.842	-39.674	-79.511[2]	-45.962	0.723	-4.231	-8.986	-5.549	0.119	-35.443	-70.525	-40.413	0.27	0.23
Medium	τ =6	0.924	-77.714	-234.773	-89.618	0.856	-17.300	-26.050	-18.563	0.069	-60.414	-208.723	-71.055	0.42	0.06
Large	τ =6	0.900	-188.127	-615.593[0]	-231.086	0.827	-84.374	-199.297	-104.229	0.072	-103.752	-416.296	-126.857	0.13	0.01

Notes: Column (1a) reports the conditional probability of survival. The conditional probability of exit, which is derived from the residual of 1 minus column (1a) is not reported here. Column (2a) represents the conditional mean growth for surviving firms, column (2b) the conditional mean growth for exits. Column (3) reports the overall conditional mean growth for surviving and exiting firms. Differences are calculated by subtracting each of the columns 1a-3 for non-HGFs from those of HGFs. Share reports the share of each firm size class in the total number ob HGFs and non-HGFs.
[0] Statistically not significant, [1]significant at the 10% level, [2]significant at the 5% level, all other values significant at the 1% level.

Absolute growth is measured as $y_{i,t+\tau} = E_{i,t+\tau} - E_{i,t+\tau-3}$

Table 8b Decomposition of conditional mean growth (absolute growth) by firm size classes for relative HGFs

Absolute growth		HGFs Relative				Non-HGFs				Differences				Shares	
Firm size class	t+τ	(1a) Survival rate	(2a) Growth survivors	(2b) Growth exits	(3) Total growth	(1a)	(2a)	(2b)	(3)	(1a)	(2a)	(2b)	(3)	HGF	Non-HGF
Micro	τ =3	0.696	6.961	-20.721	-1.451	0.632	0.425	-2.643	-0.705	0.064	6.535	-18.078	-0.746	0.93	0.76
Small	τ =3	0.860	-11.908[0]	-115.468	-26.357	0.809	-1.015	-11.829	-3.076	0.051	-10.893	-103.639	-23.281	0.06	0.19
Medium	τ =3	1.000	-40.842[0]	-	-40.842	0.907	-12.265	-52.979	-16.038	0.093	-28.577	52.979	-24.804	0.01	0.05
Micro	τ =6	0.760	-16.263	-20.834	-61.368	0.521	-0.727	-3.280	-1.950	0.238	-15.536	-17.554	-59.418	0.97	0.73
Small	τ =6	0.837	-74.201[0]	-2.767	-62.569	0.724	-4.780	-9.311	-6.031	0.113	-69.421	6.544	-56.538	0.03	0.27

See Notes Table 8a
No large relative HGFs; no exit of medium-sized relative HGF in t+3, no medium-sized relative HGF firm in sample for t+6.

Table 8c Decomposition of conditional mean growth (absolute growth) by firm size classes for OECD HGFs

Absolute growth		HGFs OECD				Non-HGFs				Differences				Shares	
Firm size class	t+τ	(1a) Survival rate	(2a) Growth survivors	(2b) Growth exits	(3) Total growth	(1a)	(2a)	(2b)	(3)	(1a)	(2a)	(2b)	(3)	HGF	Non-HGF
Small	τ =3	0.904	3.817	-47.862	-1.132	0.798	-1.793	-10.072	-3.464	0.10	5.609	-37.791	2.331	0.84	0.76
Medium	τ =3	0.961	-2.431[0]	-237.056	-38.350	0.901	-13.238	-45.887	-16.461	0.06	10.806	-191.168	-21.889	0.15	0.21
Large	τ =3	0.972	-117.849	-677.000	-133.748	0.911	-95.578	-255.305	-109.777	0.06̄	-22.271	-421.695	-23.971	0.01	0.04
Small	τ =6	0.853	-14.623	-29.374	-16.792	0.707	-3.091	-8.023	-4.536	0.14	-11.532	-21.350	-12.256	0.86	0.73
Medium	τ =6	0.928	-67.506	-193.293	-76.568	0.855	-18.017	-27.108	-19.335	0.07	-49.489	-166.184	-57.233	0.13	0.23
Large	τ =6	1.000	-213.982[0]	-	-213.982	0.917	-93.070	-167.157	-99.234	0.08̄	-120.912	167.157	-114.748	0.01	0.04

See Notes Table 8a

No micro-sized firms in sample of OECD HGFs. No exits of large OECD HGFs in t+6.

Taken together, the insights from columns (1a) and (2a) therefore largely add to what can be regarded as stylized fact in the empirical firm growth literature (e.g. Caves, 1998, Evans, 1987, Dunne and Hughes, 1994 or Sutton, 1997): smaller firms are less likely to survive, but conditional on survival they exhibit higher growth rates compared to larger firms. Even more important for the purpose of this study, we do not only arrive at the same finding for each group of HGFs and non-HGFs separately, but also for the difference between the two groups: Conditional on survival, smaller HGFs outperform non-HGFs more clearly in terms of persistent growth than larger HGFs. As column (2a) in the right panel 'Differences' in Table 8a indicates for the perspective on t+3, micro-sized absolute HGFs grow by 32.730 employees more than non-HGFs within the same (initial) firm size class, while small absolute HGFs outperform non-HGFs by only 15.383 more employees. The better performance of HGFs compared to non-HGFs of comparable size ceases to exist for medium-sized absolute HGFs (difference of 0.040 employees) and large absolute HGFs are even outperformed by large non-HGFs (growth of 2.253 less employees for HGFs than for non-HGFs). A very similar pattern can be observed for relative HGFs in Table 8b and OECD HGFs in Table 8c.

Column (3) shows results for different size classes when firm exits are taken into account. Overall, only small absolute and OECD HGFs are able to perform better than non-HGFs in the period t+3 following high-growth. Medium-sized and large HGFs are outperformed by non-HGFs. The same is the case for micro-sized absolute HGFs (due to the size threshold of 10 employees OECD HGFs do not contain any micro-sized firms per definition). Fast growth of very small firms has contributed to the fact that initially micro-sized HGFs which exit in t+3 have reached almost the same firm size at the time of exit as initially small HGFs. Since exit rates of micro-sized firms are generally higher than for small firms the overall performance of micro-sized firms is negative compared to non-HGFs when taking job losses by firm exits into account. As far as the group of relative HGFs is concerned, all firm size classes perform worse in terms of growth than non-HGFs. In a similar vein, in t+6 HGFs irrespective of their definition and size classes always create less jobs than non-HGFs.

As a general finding we can therefore state that only those (absolute and OECD) HGFs which are of small size at the beginning of their high-growth period exhibit a superior performance in terms of future growth than non-HGFs of the same initial size do. It consequently seems advisable for policymakers to focus their support effort on potential high growth firms which have reached a minimum size of 10 employees, but have not grown larger than 49 employees.

5.4 Robustness checks for sectors, regions and foreign ownership

Before proceeding with our conclusions, we disaggregate results in two further ways to test their robustness. First, we check whether overall results are robust across different sectors and regions. Sectors are grouped into primary sector (agriculture, mining) and secondary sector (manufacturing) on the one hand and tertiary sector (services) on the other hand. For each sectoral group separately, we then calculate aggregate conditional growth rates in t+3 according to equation (8). Our point of reference are the differences in aggregate growth rates as presented in columns (3) of Tables 7a and 7b for the entire set of firms. As Table A5 of the appendix reveals, results for each sectoral group (columns 2a and 2b for primary and secondary sectors, columns 3a and 3b for tertiary sector) are close to what we have found for all sectors combined (columns 1a and 1b). The difference in aggregate growth between absolute HGFs and non-HGFs for example amounts to -34.666 employees (absolute growth over 3-year period) and 10% (relative average annualized growth) in the case of primary and secondary sector. For firms in the service sectors the difference is -29.439 employees or 12.8% respectively. In the case of OECD HGFs relative growth rates are even almost identical irrespective of disaggregating for sectors (column 2b and 3b) or not (column 1b). Table A5 additionally includes results when firms are grouped from a geographical point of view into southern regions and northern regions. HGFs from economically more developed southern regions tend to perform slightly better than HGFs from northern regions, but again results are very similar both in terms of absolute and relative growth.

We secondly compare foreign-owned and domestically-owned firms. This type of robustness check is motivated by our discussion on total firm growth and firm exits in section 3.1. We argued that our da-

taset does not allow for distinguishing between actual job losses on the one side and the transfer of jobs to other countries (without actually destroying jobs) on the other side. Our definition of firm exits could therefore falsely include firms which have moved their operations abroad. We assume that this occurs in very rare cases and if it does then presumably within foreign-owned firms which can more easily shift production between locations in different countries than domestic firms. Against this background, we compare exit rates of domestic-owned firms to those of foreign-owned ones. As a caveat we need to add that information on the country of origin of firm owners is only available for 7% of sample firms, but the reduced sample should nonetheless allow for the intended comparison of exit rates. Table A6 in the appendix shows that both exit rates for HGFs are similar between domestic firms (column 1a) and foreign-owned firms (column 2a) as well as exit rates for non-HGFs (column 1b for domestic firms compared to column 2b for foreign firms).[18] In addition, contrary to our initial hypothesis that foreign owned firms are more likely to exit the market, they tend to exhibit even lower exit rates than domestic firms which has also been found e. g. by Andrews et al. (2012) for Germany.

6 Discussion and Conclusion

We asked whether high-growth firms continue to create jobs after the high-growth period and if the answer depends on the definition of high growth. For this purpose, we analyzed the growth performance of high-growth firms compared to non-high-growth firms three and six years after their period of high growth. We used data on private firms in Bulgaria for three consecutive 3-year periods (2001-2004, 2004-2007, and 2007-2010) and compared three different types of definitions for high growth – absolute, relative and the composite measure recommended by Eurostat-OECD. This paper contributes to the literature on entrepreneurship and firm growth by providing the first evidence on the long-term performance of high-growth firms defined in terms of absolute increase in employment.

Our findings show that the measurement of growth has a fundamental influence on outcomes. Transition probability matrices reveal that only absolute HGFs (28.52%) and OECD HGFs (11.47%) are able to repeat high growth in the next period. The probability of relative HGFs to repeat high-growth is with 0.71% as low as for any other firm in the sample. In a similar vein, firm exits in the next period are lowest for absolute HGFs (6.71%) and OECD HGFs (7.76%), whereas more than one out of four relative HGFs (27.16%) exits.

Controlling for initial differences between high-growth firms and non-high growth firms, regression results confirm the decisive role of growth measures and add three further important insights: First, by limiting the analysis to surviving firms we find a significantly positive contribution of absolute and OECD high-growth firms to the labor market in the three years (t+3) after high-growth. While their performance is characterized by job destruction two periods after high-growth (t+6), in sum job gains in t+3 are not fully outweighed by subsequent job losses in t+6. Net job creation by surviving absolute and OECD high growth firms therefore remains positive at least up to six years after the high-growth event. Choosing a relative definition of high-growth on the other hand seems unfavorable in terms of job creation as relative HGFs decrease in firm size compared to non-HGFs both in t+3 and t+6.

Second, our conclusions with regard to under- or out-performance are different when considering firm exits. Whether including firm exits in our analysis influences overall growth rates in a positive or negative manner again depends on the way how growth is measured. An absolute growth measure accounts for firm size of exits. Exits by large firms decrease overall growth rates more than exits by small firms. Since an absolute definition of high growth selects larger firms which evidently grow further during high growth, exiting absolute HGFs are on average of much larger size than exiting non-HGFs. Even though exit rates of absolute HGFs are lower than for non-HGFs, the fact that those absolute HGFs which do exit are of very large size leads to a negative growth performance for absolute HGFs compared to non-HGFs both three and six years after the high-growth period. Measuring future growth

[18] The generally lower exit rates for the sub-sample of firms with information on ownership compared to the full sample shown in Tables 7a-b are related to the fact that information on ownership in our dataset is more likely to be available for larger firms (which are generally characterized by lower exit rates than smaller firms).

in a relative way on the other hand ignores the influence of firm size among exits. All exits are counted as a decrease of -100% no matter how large a firm was. Rather than firm size at the time of exit, rates of exit become crucial for results. As fewer HGFs exit than non-HGFs, overall growth rates of HGFs compared to non-HGFs are positive for both OECD HGFs as well as relative HGFs.

As a third insight, the disaggregated results for micro, small, medium and large firms vary strongly and support our empirical approach. We motivated the use of a two part model by the different impact of particularly firm size on exit and growth. Our results indeed confirm that smaller firms are less likely to survive, but conditional on survival they exhibit higher growth rates compared to larger firms. This is the case because lower exit rates for larger firms are offset by much lower growth rates than for smaller firms. We do not only arrive at this finding for each group of HGFs and non-HGFs separately, but also for differences between the two groups. Conditional on survival, smaller HGFs outperform non-HGFs more clearly in terms of persistent growth than larger HGFs.

How do our results based on evidence from a middle-income country compare to previous studies from high-income countries? The largely differing transition probabilities for the three definitions of high growth are very much in line with findings from studies for Sweden (Daunfeldt et al., 2014; Daunfeldt and Halvarsson, 2015) and Austria (Hölzl, 2013). Our regression results also support what has been found in the previous literature with regard to relative and OECD HGFs: The studies by Capasso et al. (2013), Coad (2007), Coad and Hölzl (2009) and Daunfeldt and Halvarsson (2015) which all measure high growth in relative terms and focus on surviving firms find negative future growth rates exactly as we do for surviving relative HGFs. Acs (2013), Hölzl (2013), Satterthwaite and Hamilton (2016) and Senderovitz et al. (2016) who define growth according to Eurostat-OECD or other composite measures detect positive future growth rates as we find for OECD HGFs both with and without exits. Our data therefore seems to very much confirm the external validity of results from high-income countries for economically less advanced countries such as Bulgaria.

What are the policy implications from our results? We argued that entrepreneurship policies typically target high-growth firms due to their potential for job creation. We consequently assume that policy-makers are interested in results from an absolute definition of high growth as – unlike relative definitions – it takes account of the actual number of jobs created and destroyed by high growth firms. In that regard, the support of high-growth firms needs to be questioned because the contribution of absolute HGFs to the labor market is negative compared to non-HGFs after the high-growth event. However, there seems to be one important exception: the disaggregation of results for different firm size classes revealed that HGFs of small size, i.e. firms which have already reached a minimum size of 10 employees but have not grown beyond 49 employees at the beginning of their high-growth period, outperform non-HGFs in terms of future growth. Policymakers wishing to support the emergence of HGFs should therefore focus on targeted policies for small size classes.

In terms of ideas for future research, it would be very interesting to see more studies applying an absolute growth measure and comparing our results to. It could be particularly worthwhile to compare different definitions of high-growth in economically less developed countries where micro- and small firms have a higher share in total firms and contribute stronger to job creation than in high-income countries as shown by Ayyagari et al. (2014). Finally, a replication of our analysis with more recent data that includes not only several years before and during, but also after the recent economic crisis could lead to interesting insights on the role of different growth measures during changing economic environments.

APPENDIX

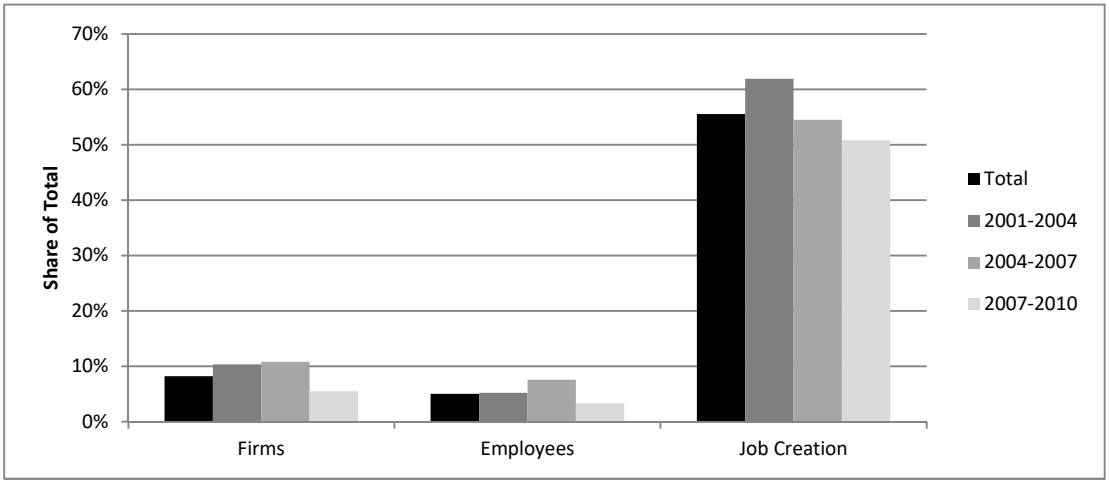
Table A1 Comparison of summary statistics from the Bulgarian National Statistical Institute (NSI) and Amadeus, selected years

	2002		2004		2006	
	NSI	Amadeus	NSI	Amadeus	NSI	Amadeus
Number of observations	230,959	72,427	240,408	113,247	241,390	234,522
Size class						
Micro (1-9 employees)	91.81	78.45	90.15	82.80	88.92	88.87
Small (10-49 employees)	6.47	16.37	8.0	13.50	8.95	8.91
Medium (50-249 employees)	1.40	4.29	1.56	3.15	1.83	1.93
Large (>249 employees)	0.29	0.88	0.29	0.56	0.30	0.29
Sector						
C Mining and quarrying	0.08	0.19	0.09	0.14	0.11	0.12
D Manufacturing	11.12	19.26	11.95	15.67	12.14	12.78
E Electricity, gas, water supply	0.08	0.23	0.10	0.18	0.13	0.15
F Construction	7.35	8.09	5.93	6.43	6.06	6.18
G Wholesale and retail trade	51.74	48.23	52.20	51.05	50.78	52.32
H Hotels and restaurants	9.89	3.76	9.62	6.66	9.37	8.61
I Transportation, communications	10.48	6.62	9.51	7.05	7.90	6.84
K Real estate, business activities	9.26	13.62	10.59	12.82	13.50	13.01

Note: Information reported online by NSI Bulgaria is available from the year 2002 onwards. The number of observations included in Amadeus compared to those reported by NSI amounts to about 33% for 2001-2003, 50% for 2004-2005 and close to 100% from 2006-2010. NSI reports information for sectors C-I and K according to the NACE Rev. 1.1 classification system. The presented information on Amadeus firms is accordingly based on the same sectors.

For NSI data see https://infostat.nsi.bg/infostat/pages/module.jsf?x_2=219 (accessed 22 Nov 2017).

Figure A1 Share of OECD HGFs in firms, employees and gross job creation, by 3-year period for sub-sample of firms with 10+ employees in t-3



Note: Firms corresponds to total number of surviving firms with 10+ employees at the beginning of a period (t-3); Employees corresponds to the aggregate employment of surviving firms with 10+ employees at the beginning of a period (t-3); Job creation corresponds to jobs created by surviving firms with positive growth over a 3-year period and 10+ employees in t-3.

Table A2a Transition probabilities for growth brackets from t to t+6, absolute HGFs

	$g_{i,t+3}^{(0)}$ exit	$g_{i,t+3}^{(1)}$ negative growth	$g_{i,t+3}^{(2)}$ zero growth	$g_{i,t+3}^{(3)}$ positive growth	$g_{i,t+3}^{(4)}$ HGF (absolute)
$g_{i,t}^{(1)}$	43.79	29.75	11.49	14.13	0.84
$g_{i,t}^{(2)}$	62.71	11.60	16.86	8.69	0.15
$g_{i,t}^{(3)}$	31.45	39.60	8.27	18.87	1.82
$g_{i,t}^{(4)}$ = HGF (absolute)	**9.88**	**69.56**	**1.01**	**5.24**	**14.31**
Total	40.10	32.49	10.56	15.52	1.33

Table A2b Transition probabilities for growth brackets from t to t+6, relative HGFs

	$g_{i,t+3}^{(0)}$ exit	$g_{i,t+3}^{(1)}$ negative growth	$g_{i,t+3}^{(2)}$ zero growth	$g_{i,t+3}^{(3)}$ positive growth	$g_{i,t+3}^{(4)}$ HGF (relative)
$g_{i,t}^{(1)}$	43.79	29.75	11.49	14.69	0.28
$g_{i,t}^{(2)}$	62.71	11.60	16.86	8.67	0.17
$g_{i,t}^{(3)}$	31.20	39.97	8.24	20.42	0.18
$g_{i,t}^{(4)}$ = HGF (relative)	**20.36**	**53.69**	**2.59**	**22.55**	**0.80**
Total	40.10	32.49	10.56	16.63	0.23

Table A2c Transition probabilities for growth brackets from t to t+6, OECD HGFs

	$g_{i,t+3}^{(0)}$ exit	$g_{i,t+3}^{(1)}$ negative growth	$g_{i,t+3}^{(2)}$ zero growth	$g_{i,t+3}^{(3)}$ positive growth	$g_{i,t+3}^{(4)}$ HGF (OECD)
$g_{i,t}^{(1)}$	43.79	29.75	11.49	14.34	0.63
$g_{i,t}^{(2)}$	62.71	11.60	16.86	8.56	0.28
$g_{i,t}^{(3)}$	32.38	38.57	8.52	19.15	1.37
$g_{i,t}^{(4)}$ = HGF (OECD)	**12.73**	**62.13**	**2.80**	**19.92**	**2.42**
Total	40.10	32.49	10.56	15.89	0.96

Notes Tables A2a-c: Pooled average values for periods 2001-2004 and 2007-2010. Transition probabilities are calculated using frequencies. Columns denote state at time t at the end of a three-year period; rows denote state at time t+6 at the end of the upper next 3-year period. Growth brackets are defined based on annualized percentage change $g_{i,t+3}$ as follows: $g_{i,t+\tau}^{(0)}$ = -1 (exit), -1<$g_{i,t+\tau}^{(1)}$<0 (negative growth), $g_{i,t+\tau}^{(2)}$ = 0 (zero growth), $g_{i,t+\tau}^{(3)}$>0 (positive growth), and $g_{i,t+\tau}^{(4)}$= HGF. An alternative definition of growth brackets based on absolute growth or log-differences does not influence results.

Table A3 Absolute growth of surviving HGFs (absolute, relative, OECD), same sample t+3 and t+6

$y_{i,t+\tau}$ = Absolute growth	τ=3			τ=6		
	(1)	(2)	(3)	(4)	(5)	(6)
Covariates	Absolute	Relative	OECD	Absolute	Relative	OECD
HGF	82.836***	25.130**	30.043***	-48.993***	-12.472***	-15.925***
	(8.157)	(4.206)	(2.443)	(8.617)	(4.584)	(2.663)
Size	yes	yes	yes	yes	yes	yes
Industry size	yes	yes	yes	yes	yes	yes
Industry growth	yes	yes	yes	yes	yes	yes
Industry	yes	yes	yes	yes	yes	yes
Location	yes	yes	yes	yes	yes	yes
Legal form	yes	yes	yes	yes	yes	yes
Foreign owned	yes	yes	yes	yes	yes	yes
Constant	7.000**	8.541***	5.135**	2.563	1.692	3.483
	(2.764)	(2.829)	(2.768)	(5.451)	(5.536)	(5.401)
Observations	28,691	28,691	28,691	28,691	28,691	28,691
# HGF	447	399	1,371	447	399	1,371
R^2	0.191	0.153	0.165	0.200	0.166	0.174

$y_{i,t+\tau} = E_{i,t+\tau} - E_{i,t+\tau-3}$. Robust standard errors in parentheses. ***p-value < 0.01, ** p-value < 0.05, * p-value <0.1.

Table A4a Decomposition of conditional mean growth (relative growth) by firm size classes for absolute HGFs

Relative growth		HGFs Absolute				Non-HGFs				Differences				Share	
Firm size class	t+τ	(1a) Survival rate	(2a) Growth survivors	(2b) Growth exits	(3) Total growth	(1a)	(2a)	(2b)	(3)	(1a)	(2a)	(2b)	(3)	HGF	Non-HGF
Micro	τ =3	0.742	-0.016[0]	-1	-0.270	0.632	0.004	-1	-0.365	0.110	-0.020	0	0.095	0.10	0.76
Small	τ =3	0.895	-0.037	-1	-0.138	0.809	-0.067	-1	-0.246	0.086	0.030	0	0.108	0.23	0.19
Medium	τ =3	0.951	-0.069	-1	-0.115	0.901	-0.104	-1	-0.193	0.050	0.035	0	0.078	0.51	0.05
Large	τ =3	0.932	-0.083	-1	-0.145	0.909	-0.125	-1	-0.205	0.024	0.042	0	0.060	0.16	0.01
Micro	τ =6	0.716	-0.166	-1	-0.403	0.524	-0.036	-1	-0.494	0.192	-0.131	0	0.091	0.18	0.69
Small	τ =6	0.842	-0.154	-1	-0.287	0.723	-0.079	-1	-0.334	0.119	-0.075	0	0.047	0.27	0.23
Medium	τ =6	0.924	-0.151	-1	-0.215	0.856	-0.107	-1	-0.236	0.069	-0.044	0	0.020	0.42	0.06
Large	τ =6	0.900	-0.129	-1	-0.217	0.827	-0.126	-1	-0.277	0.072	-0.003	0	0.060	0.13	0.01

Notes Tables A4a-c: Column (1a) reports the conditional probability of survival. The conditional probability of exit (1b), which is derived from the residual of 1 minus column (1a) is not reported here. Column (2a) represents the conditional mean growth for surviving firms, column (2b) the conditional mean growth for exits. Column (3) reports the overall conditional mean growth for surviving and exiting firms. Differences are calculated by subtracting each of the columns 1a-3 for non-HGFs from those of HGFs. Share reports the share of each firm size class in total firms. [0] Statistically not significant, [1]significant at the 10% level, [2]significant at the 5% level, all other values significant at the 1% level.

Relative annualized percentage growth over a 3-year period is measured as $y_{i,t+\tau} = \left(\frac{E_{i,t+\tau}}{E_{i,t-3+\tau}}\right)^{\frac{1}{3}} - 1$

Table A4b Decomposition of conditional mean growth (relative growth) by firm size classes for relative HGFs

Relative growth		HGFs Relative				Non-HGFs				Differences				Shares	
Firm size class	t+τ	(1a) Survival rate	(2a) Growth survivors	(2b) Growth exits	(3) Total growth	(1a)	(2a)	(2b)	(3)	(1a)	(2a)	(2b)	(3)	HGF	Non-HGF
Micro	τ =3	0.696	-0.071	-1	-0.353	0.632	0.005	-1	-0.365	0.064	-0.076	0	0.012	0.93	0.76
Small	τ =3	0.860	-0.138	-1	-0.259	0.809	-0.067	-1	-0.244	0.051	-0.072	0	-0.014	0.06	0.19
Medium	τ =3	1.000	-0.067[0]	-	-0.067	0.907	-0.101		-0.091	0.093	0.033	0	0.024	0.01	0.05
Micro	τ =6	0.760	-0.121	-1	-0.266	0.521	-0.034	-1	-0.497	0.238	-0.087	0	0.231	0.97	0.73
Small	τ =6	0.837	-0.033[0]	-1	-0.191	0.724	-0.080	-1	-0.334	0.113	0.047	0	0.144	0.03	0.27

No large firms in sample of relative HGFs; no exit of medium-sized relative HGF in t+3, no medium-sized firm in sample for t+6.

Table A4c Decomposition of conditional mean growth (relative growth) by firm size classes for OECD HGFs

Relative growth		HGFs OECD				Non-HGFs				Differences				Shares	
Firm size class	t+τ	(1a) Survival rate	(2a) Growth survivors	(2b) Growth exits	(3) Total growth	(1a)	(2a)	(2b)	(3)	(1a)	(2a)	(2b)	(3)	HGF	Non-HGF
Small	τ =3	0.904	-0.033	-1	-0.126	0.798	-0.072	-1	-0.259	0.106	0.038	0	0.133	0.84	0.76
Medium	τ =3	0.961	-0.061	-1	-0.210	0.901	-0.104	-1	-0.193	0.060	0.044	0	-0.018	0.15	0.21
Large	τ =3	0.972	-0.099	-1	-0.125	0.911	-0.118	-1	-0.197	0.060	0.019	0	0.072	0.01	0.04
Small	τ =6	0.853	-0.112	-1	-0.242	0.707	-0.075	-1	-0.346	0.146	-0.037	0	0.104	0.86	0.73
Medium	τ =6	0.928	-0.144	-1	-0.206	0.855	-0.107	-1	-0.237	0.073	-0.037	0	0.031	0.13	0.23
Large	τ =6	1.000	-0.210	-	-0.210	0.917	-0.124		-0.114	0.083	-0.086	0	-0.096	0.01	0.04

No micro-sized firms in sample of OECD HGFs. No exits of large OECD HGFs in t+6.

Table A5 Robustness check: Overall conditional mean growth rates from two-part model for t+3, different sectors and regions

	Reference: All firms		Primary and secondary sector		Tertiary sector		Southern Regions		Northern Regions	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)	(5a)	(5b)
Definition HGFs	Absolute Growth	Relative Growth	Absolute Growth	Relative Growth	Absolute Growth	Relative Growth	Absolute Growth	Relative Growth	Absolute Growth	Relative Growth
Absolute HGFs	-31.710	0.109	-34.666	0.100	-29.439	0.128	-26.125	0.126	-38.063	0.101
Relative HGFs	-0.654	0.008	1.596	0.001	-2.037	-0.004	0.730	-0.003	-3.711	0.006
OECD HGFs	-3.986	0.165	-3.830	0.160	-4.587	0.160	-1.974	0.170	-7.467	0.150
Observations	140,262		37,920		102,342		95,776		44,486	

Notes: Reported is difference between HGFs and non-HGFs in terms of the overall conditional mean growth for surviving and exiting firms as defined in equation (8). Primary and secondary sector includes all firms in section A-F according to the NACE Rev. 1.1 classification system. Tertiary sector includes all sample firms in section G-O according to NACE Rev. 1.1.

Statistical regions (NUTS Level 2) as defined by the Bulgarian National Statistical Institute.

Absolute growth is measured as $y_{i,t+\tau} = E_{i,t+\tau} - E_{i,t+\tau-3}$. Relative growth is measured as $y_{i,t+\tau} = \left(\frac{E_{i,t+\tau}}{E_{i,t-3+\tau}}\right)^{\frac{1}{3}} - 1$.

Table A6 Robustness check: Exit rates of domestic and foreign-owned

Exit rate (in percent)					
Domestic firms			Foreign firms		
t+3					
HGFs (1a)		Non-HGFs (1b)	HGFs (2a)		Non-HGFs (2b)
Absolute	0.15	0.21	Absolute	0.13	0.22
Relative	0.18	0.21	Relative	0.10	0.22
OECD	0.11	0.22	OECD	0.11	0.23
No. of obs.	10,093		No. of obs.	5,579	
t+6					
Absolute	0.21	0.32	Absolute	0.18	0.30
Relative	0.14	0.32	Relative	0.11	0.30
OECD	0.15	0.32	OECD	0.12	0.30
No. of obs.	4,614		No. of obs.	2,300	

Notes: Reported is the conditional exit rate as defined in equation (5b)

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