Who persistently creates jobs? Absolute versus relative high-growth firms

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Abstract

This paper examines the economic contribution of high-growth firms after their high-growth event. While the central role of high-growth firms for job creation is well-established, little is known about their dynamic development in coming periods. We address this question for the first time by comparing absolute with relative growth measures and use data on private firms in Bulgaria for three consecutive 3-year periods (2001-2004, 2004-2007, and 2007-2010). Next to calculating transition probability matrices to investigate growth in employees in coming periods, we model future employment growth by means of a two-part model with separate equations for the probability of survival and exit as well as for growth of survivors and growth of exits. The decomposition of aggregate growth effects shows that it is central for outcomes whether growth is measured in absolute or relative terms. High-growth firms defined according to an absolute measure show the biggest potential for job creation in coming periods while those measured in relative terms without size threshold tend to be outperformed by other firms. In that regard, both public support programs for high-growth firms as well as researchers should refrain more from exclusively applying relative growth measures.

Keywords: high-growth firms, growth measures, job creation, persistence, Bulgaria

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

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1 INTRODUCTION

A large share of new jobs is created by a small number of high-growth firms while most other firms do not grow. This finding emerges from a growing amount of literature focusing on high-growth firms also referred to as gazelles when younger than five years (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). Among ten OECD countries for example, high-growth firms accounted only for 3-6% of all firms in the period 2002-2005. At the same time, they contributed to 25-64% of all newly created jobs (Bravo-Biosca et al., 2013). Very much in line with this finding, an influential report from NESTA (2009) confirms that 6% of all existing firms in the United Kingdom generated 50% of all new jobs during 2002–2008.

Because of their disproportionate economic contribution, high-growth firms have attracted significant attention from policymakers. The European Union explicitly mentions the support of high-growth enterprises as an objective in its Europe 2020 strategy (EU, 2010) and most OECD countries have recently adopted targeted policies for financial and technical support of high-growth firms (see Autio et al., 2007; Kolar, 2014; Lilischkis, 2013; Mason and Brown, 2013; OECD, 2013).

The increasing focus on high growth firms is not without problems though. While much is known about the importance of high-growth firms for job creation in the short-term, knowledge on their long-term economic contribution after the high-growth event is still very limited. This is of concern to policymakers, since the implications of studies limited to the period of high growth are of little importance if firm growth is random or, even worse, if high-growth firms display disappointing economic performance after having achieved high-growth (Coad et al., 2014).

Another unresolved issue is whether policymakers should target firms that experience high growth in absolute or relative terms as their economic contribution seems to depend very much on definitions (Almus, 2002, 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 defined by relative growth tend to be smaller than those that are fast growing in absolute terms. Although this is a well-known problem which is often reported in method sections as Davidsson and Delmar (2006) point out, it is usually ignored thereafter when results are discussed or compared to other studies.

The purpose of this paper is to investigate the economic contribution of high-growth firms after their high-growth event. We use data on private firms in Bulgaria for three consecutive 3-year periods (2001-2004, 2004-2007, and 2007-2010). We analyze the growth performance of high-growth firms in terms of employees compared to non-high-growth firms three and six years after their period of high growth. Since there exists no uniform definition of high growth firms, we will compare three different growth measures – absolute, relative and the composite measure recommended by OECD. In particular, we are interested in the growth of high-growth firms after the high-growth period compared to non-high-growth firms. This question is important because if high-growth events are followed by subsequent decline, this fundamentally questions the strategy of targeting high-growth firms to promote future firm growth. A further important objective is to understand the impact of different growth measures on our results. If the long-term growth performance of high-growth firms is largely determined by the measurement of growth, then policymakers and researchers need to put a much larger emphasis on the criteria for selecting high growth firms into support programs.

Recent empirical findings for growth patterns of high-growth firms reveal an ambiguous picture with regard to their long-term economic contribution. Several studies show that high-growth firms display positive, albeit very moderate growth in coming periods (Acs, 2013 for United States; Hölzl, 2013 for Austria; Parker et al., 2010 for the UK; Satterthwaite and Hamilton, 2016 for New Zealand and Senderovitz et al., 2016 for Denmark). Others detect negative autocorrelation of growth rates for high-growth firms (Capasso et al., 2013 for the Netherlands; Coad, 2007 for France; Coad and Hölzl, 2009 for Austria and Daunfeldt and Halvarsson, 2015 for Sweden). Once results are disaggregated across size classes, large differences between firm sizes emerge - although evidence points into different directions: while Coad (2007) and Coad and Hölzl (2009) find that smaller firms are more prone to negative future growth rates than larger high-growth firms, Hölzl (2013) and Daunfeldt and Halvarsson (2015) show that smaller firms perform better.

In the light of different growth trajectories for different firm size classes the definition of high-growth calls for particular care, because growth measures are either biased towards small (relative growth) or large firms (absolute growth). In spite of this, the existing research is limited to measuring growth in relative terms (Capasso et al., 2013; Coad, 2007; Coad and Hölzl, 2009; Daunfeldt and Halvarsson,

2015; Parker et al., 2010), applying composite indices similar to relative measures such as the one recommended by Eurostat-OECD (Dillen et al., 2014, Hölzl, 2013; Satterthwaite and Hamilton, 2016) or by Birch and Medoff (1994) (Gabrielsson et al., 2014; Senderovitz et al., 2016) and in rare cases a combination of relative and absolute growth (Acs, 2013; Hölzl, 2013). No study has so far attempted to estimate the long-term growth performance for firms defined according to absolute high-growth. This is even more striking as one should assume that the absolute rather than relative increase in the number of employees matters most from a labor market perspective.

Finally, the existing evidence on the development of high-growth firms 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 analysis of different sets of countries in terms of economic development might therefore produce different types of insights on the long-term development of high-growth firms. Middle-income countries in Eastern Europe which used to be under the influence of the former Soviet Union and suffered deep economic and political shocks after its collapse provide a particularly interesting case study for research on firm growth.

The contribution of this study to the literature is thus intended to be threefold. To start with, we add evidence to the still rather inconclusive results on the long-term contribution of high-growth firms to employment. We furthermore address this question for the first time by comparing measures of absolute and relative growth. Lastly, after all existing studies on the long-term performance of high growth firms are limited to high-income countries we use data from the middle-income country Bulgaria.

Methodologically we are guided by existing studies on the long-term performance of high growth firms and combine non-parametric and parametric methods. In order to have a first look at the dynamics of high-growth firms over time, we follow Capasso et al. (2013), Daunfeldt and Halvarsson (2015) and Hölzl (2013) and report the estimated transition probabilities that a firm in a given growth category in one period will be located in that or another growth category in the next period. We then model future growth rates for high-growth firms and control firms by means of a two-part model similar to Huber et al. (2017) with separate equations for survival and exit (probit regressions) as well as for growth of survivors and growth of exits (linear regressions). We finally use results from the two-part model as input for the decomposition of aggregate growth effects.

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 according to an absolute growth measure show the biggest potential for job creation in coming periods while those measured in relative terms without a size threshold tend to be outperformed by other firms. Our results furthermore demonstrate that taking firm exits into account, considerably influences results. If possible, analyses thus should not be limited to surviving firms only.

The 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 and the decomposition analysis before Section 6 discusses these results and concludes.

2 LITERATURE REVIEW

The debate about which firms create jobs was sparked by the empirical findings of Birch (1979, 1981, 1987) that small firms generated most new jobs in the U.S. economy. Birch's findings constituted a shift to the previous paradigm that large firms create most jobs and were highly controversial (e.g. Davis et al., 1996). 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 (Birch and Medoff, 1994, Brüderl and Preisendörfer, 2000; Davidsson and Henrekson, 2002; Delmar et al., 2003; Littunen and Tohmo, 2003; Schreyer, 2000; Storey, 1994). It emerges from these studies that about 4% of firms are responsible for more than half of job creation (see Henrekson and Johansson, 2010 for a review). In a similar vein, an influential report by NESTA (2009) later also argued that 6% of firms generated 50% of all new jobs in the UK during 2002–2008 and Daunfeldt et al. (2015) showed that 6% of firms in Sweden contributed to 42% of new jobs during 2005–2008.

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; Davidsson and Delmar, 2003; 2006; 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 is still largely neglected in the literature. The existing research has usually studied high growth between two points in time only (static view). This approach ignores the development of high-growth firms after or before the high-growth period (dynamic view). As a consequence, policymakers who wish to support high-growth firms in order to spur employment still lack an important piece of information about these firms, i.e. their long-term contribution to employment after the high-growth period.

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. Empirical studies that have investigated whether firm growth rates were correlated over time are summarized by Daunfeldt and Halvarsson (2015). The earlier studies 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 average firms are concerned, the evidentiary base is very small as summarized in Table 1. It moreover emerges from Table 1 that 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. Coad (2007) and Coad and Hölzl (2009) found in contrast negative 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 growth rates, whilst larger firms were characterized by positive autocorrelation. Capasso et al. (2013) demonstrated that among their sample of high-growth firms in the Netherlands there were two coexisting subsets, a bigger one showing high negative autocorrelation and a smaller one showing high positive autocorrelation. The coexistence of bouncing firms that alternately strongly grow or strongly decline with persistent growers was most pronounced among micro firms. Daunfeldt and Halvarsson (2015) found negative autocorrelation of growth rates for HGFs in Sweden. The disaggregation of results for different firm sizes showed that autocorrelation 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 after the high-growth period and that again smaller firms had higher growth rates than large firms. Parker et al. (2010) showed that high-growth firms in the Netherlands displayed moderate positive growth in the next period. 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 focused on productivity as growth indicator and demonstrated a positive relationship between previous high-growth and profitability in the next period. 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 also 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.

In addition, it has been demonstrated that different measures of growth (relative or absolute) select different sets of high-growth firms and lead to different outcomes (see for example Almus, 2002; Daunfeldt et al., 2014 or Weinzimmer et al., 1998). A relative measure will favor growth in small firms, whereas an absolute measure will select larger firms. Davidsson and Delmar (2006) exemplify the issue as follows: If firm A has started with 1 employee and has after three years 6 employees, 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%). Consequently, Daunfeldt et al. (2014) find that high growth firms defined as the 1% fastest growing firms in terms of relative change in the number of employees have a very low probability (1.49%) of remaining high-growth firms in the next period, whereas almost one-third (31.67%) of the 1% fastest growing firms in absolute terms will remain high-growth firms in the coming period.

In that regard, it is another central insight from Table 1 for the purpose of our study that none of the existing studies on the persistence of growth uses an absolute measure for defining high-growth (nor is future growth then obviously measured in absolute terms). 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, 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 of studies used different composite measures. Dillen et al. (2014), 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 and a constant minimum growth rate and is increasingly adapted as the standard in the literature (see also

Anyadike-Danes et al., 2009; Anyadike-Danes et al., 2015; Bravo-Biosca et al., 2013). Hölzl (2009) additionally applied a modified version of the Birch index which combines absolute with relative growth rates. He introduces 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. Gabrielsson et al. (2014) utilized a relative definition with size thresholds as originally applied for gazelles by Birch and Medoff (1994). High-growth firms were defined as those with a doubling of sales over a 3-year period, total sales of more than Swedish Kroner 10 million over 3 years, at least 10 employees, and at least four full years of operations with a positive net result every year. Alike, Senderovitz et al. (2016) defined high-growth firms 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.

A final aspect revealed by Table 1 is that all of the existing studies use data from high-income countries (Austria, Belgium, Denmark, France, 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 analysis of different sets of countries in terms of economic development might therefore produce different types of insights on the long-term development of high-growth firms. Middle-income countries in Eastern Europe which used to be under the influence of the former Soviet Union and suffered deep economic and political shocks after its collapse provide a particularly interesting case study for research on firm growth. At the beginning of the transition period firms tended to be large and inefficient before the subsequent privatization of state-enterprises combined with the introduction of a market-led economy resulted in the emergence of new small firms, a decline of old inefficient ones and large aggregate productivity gains (see e.g. Brown and Earle, 2008; Hutchinson and Xavier, 2006). While there exists first empirical evidence on determinants of high-growth firms in Eastern Europe, (e.g. Cuaresma et al., 2014; Hoxha and Capelleras, 2010; Mateev and Anastasov, 2010; Mateev and Anastasov, 2011; Crnogaj and Sirec, 2014), the persistence of high growth over a longer period of time has not been studied in this context.

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.[1] 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 National Social Security Institute 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. Summary statistics for our sample are very similar to data reported by the National Statistical Institute for the entire number of Bulgarian enterprises.[2] Our final sample covers 501,989 observations for three 3 year periods (2001-2004, 2004-2007, and 2007-2010).

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

[2] See https://infostat.nsi.bg/infostat/pages/reports/result.jsf?x_2=789 (Accessed: 30 November 2016) for information on all enterprises in Bulgaria.

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	Exits	Results[c]
			Absolute	Relative	Composite						
					OECD	Other					
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	-
Parker et al., 2010	UK	1992-2001		x			Sales	O/A	4-year	yes	+
Acs, 2013	United States	1998-2006				x	Employees, Sales	T	4-year	yes	+
Capasso et al., 2013	Netherlands	1994-2004		x			Employees	O/A	3-year	no	-
Hölzl, 2013	Austria	1985-2007			x	x	Employees	T	3-year	yes	+
Dillen et al., 2014	Belgium	2000-2009			x		Employees, Value Added	O	3-year	no	-[d]
Gabrielsson et al., 2014	Sweden	2001-2007				x	Employees, Sales	O	3-year	no	-[d]
Daunfeldt and Halvarsson, 2015	Sweden	1997-2008		x			Employees	T	3-year	no	-
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

[d] Repetition of high-growth in next period:+ high-growth, - no high-growth

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 the 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 therefore do not need to confine our analysis to surviving firms and are able to analyze the contribution of firm exit to aggregate employment growth. Technically, we introduced an indicator variable for firm exit which is equal to one for a particular 3-year period if no information on employees or sales[3] was available for a given year and all subsequent years in the dataset. For exiting firms the number of employees is indicated by a zero value. The resulting exit rates for our sample of firms as later presented correspond very much to what is reported by Eurostat (2009) for Bulgaria (11% for 2005-2006).

At the same time, the following issues regarding the database are also worth being highlighted: first, Amadeus reports poor information on firm age. Consequently, we cannot control for firm age in our analysis although prominent studies show that firm age has an important influence on firm growth (see e.g., Haltiwanger et al., 2013). Second, to account for market entry is much more difficult than to account for firm exit. The coverage of firms in our dataset as a share of the total population of firms increases for more recent years. While in 2001 the dataset contains about a third of all Bulgarian firms, it covers almost all firms from 2007 onwards. If a firm therefore newly enters the dataset it is not clear whether this is due to firm birth or due to an increased coverage of firms on behalf of the data provider. For that reason we excluded all firm entries from our analysis. Finally, all measures of job creation compared in this paper capture total firm growth, regardless of whether the increase in employment is the result of organic growth (internal) 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 of new independent firm through sale or distribution of new shares without reducing employees.

A job in this study therefore means an employment position filled by a worker or owner of a firm. Since our data does not distinguish among part-time, full-time and overtime employees, all count equally as a single job (see also Davis et al., 1996). Job creation is then 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 persistence of high-growth firms. Bulgaria seems to provide a typical case study in that regard. 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).[4] According to the Human Development Index by the United Nations[5] 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 upper middle income countries in the Doing Business Ranking 2017 by World Bank[6] 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 exam-

[3] For a limited number of firms we also have information on sales.

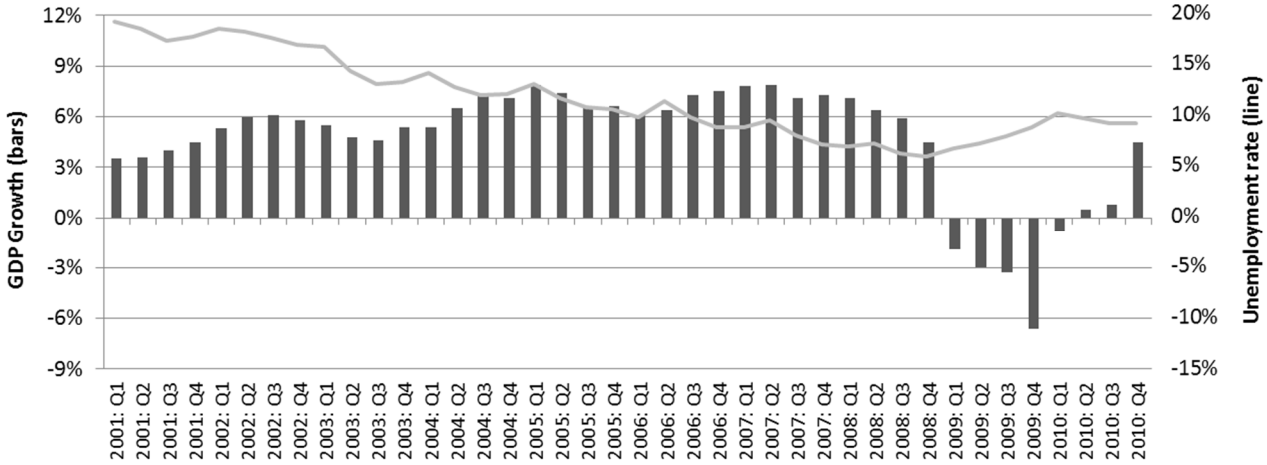
[4] https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups (Accessed: 1 November 2016): For 2017, upper middle income countries range between a GNI per capita of USD 4,036-12.475.

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

[6] 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 November 2016).

ple amount to 1 month as in many other middle income countries. Also in terms of hiring Bulgaria displays the same ratio of minimum wage to value added per worker (0.3) as other middle-income countries in the region (e.g. Romania, Serbia, Russian Federation).

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



Source: NSI Bulgaria[7]

The macroeconomic environment during the studied three 3 year periods (2001-2004, 2004-2007, and 2007-2010) is furthermore 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 a central objective of this paper to understand how different methods of measuring high growth impact our 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).

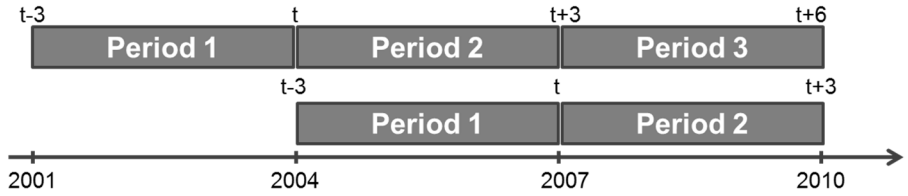
As indicator for growth we use the number of employees which is also applied by most other studies as indicated in Table 1. Using employees as indicator for size additionally has the advantage that firms born in the start year of a growth period (t-3) do not need to be excluded from the sample, because 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. Organic growth refers to new employment internal to a firm, while acquired refers to gaining employment through external acquisitions or mergers. Total growth is the sum of both. We focus on total growth as many other studies do due to a lack of information on acquisitions or mergers.

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). 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

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

period 3 (2007-2010). Since the period 2007-2010 is furthermore characterized by the beginning of the economic crisis, results for t+6 need to be interpreted with adequate caution. 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. As robustness test we additionally present results when growth rates in t+3 have been calculated for different 3-year periods.

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 indicated in Table 1, 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. High growth firms in absolute terms (absolute HGF) are then 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 35 employees 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

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

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 8 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 4 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: Absolute and relative growth in employment over a 3-year period required to enter as last firm for 1%, 5% and 10% cut-off points to define HGFs, pooled for all periods

Threshold	Absolute	Relative (Δ log)
1%	35	1.9
5%	8	1.1
10%	4	0.7

Whether high growth firms are defined in absolute or relative ways makes a large difference as discussed in section 2. A relative measure will favor growth in small firms, whereas an absolute measure will bias the results in favor of 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) which is used both by the European statistical offices and the OECD in statistical reports on high-growth firms. 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:

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

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 small firms. Another advantage of defining HGFs as firms growing at or above a particular rate is their comparability across time or countries in contrast to HGFs defined in absolute or relative ways. In sum, the OECD definition can also be considered as variant of a relative growth measure with thresholds for size and growth. Since it is easier to interpret than the log difference, we utilize it as relative growth measure for the dependent variable in most analyses of this paper.

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[8] definition for firm 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 (*t-3)*.

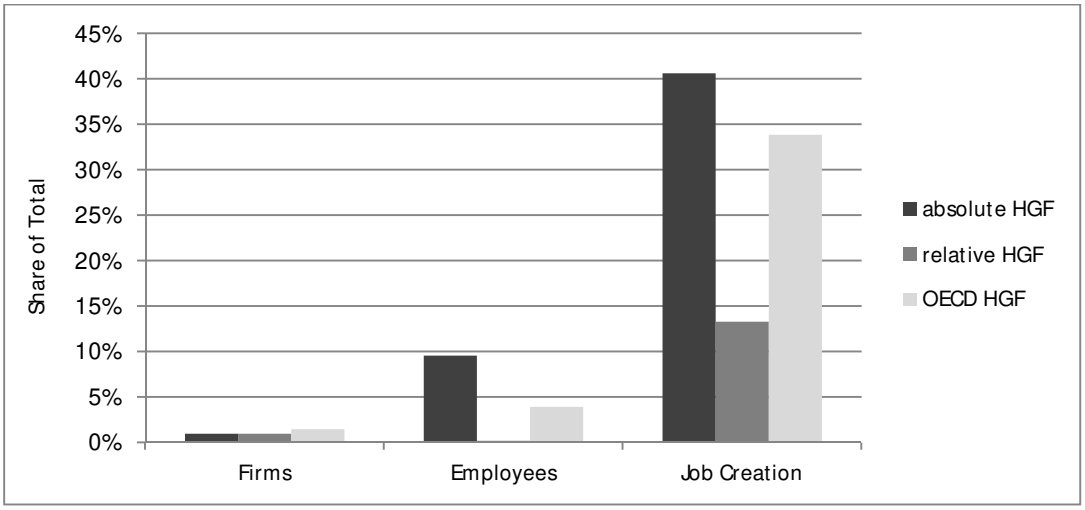
It is common to alternatively allocate firms to size classes based on the average firm size of a period. This is meant to reduce the bias inherent to sorting growing entities into size classes and is for example incorporated into the growth measure proposed by Davis et al. (1996). Using $E_{i,t-3}$ at the beginning of a period will introduce a bias towards smaller size classes, while using $E_{i,t}$ at the end of a period is biased towards larger size classes. We choose not to use average firm size however since the main interest of our study is to compare definitions of firm growth which are precisely based on differences in initial firm size. Average firm size would mitigate the effects we are trying to identify.

3.3 Descriptive Statistics

This section presents first interesting findings emerging from a simple descriptive comparison of average Bulgarian firms and the three different definitions of HGFs. In total, the dataset covers 501,989 observations pooled over the three 3-year periods 2001-2004, 2004-2007, and 2007-2010. Included are all surviving and exiting firms over a 3-year period. Firm entries during a 3-year period are excluded. The three different samples of high-growth firms are of comparable magnitude: 3,764 absolute HGFs, 3,770 relative HGFs (each representing 1.0% of all surviving firms), and 5,574 OECD HGFs (representing 1.4% of total surviving firms).

[8] http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Enterprise_size (Accessed 2 November 2016)

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



Note: Pooled average values for periods 2001-2004, 2004-2007, and 2007-2010. Firms corresponds to total number of surviving firms at the beginning of a period (t-3); Employees corresponds to the aggregate employment of surviving firms 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.

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 firms, their share in total employment, and their contribution to 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% of firms, 10% employees and are responsible for 41% of job creation. OECD HGFs have a share of 1% in total firms, 4% in total employees and 34% in newly created jobs.[9] These shares for our sample of Bulgarian firms correspond very much to what has been found for high-income countries. Bravo-Biosca et al. (2013) for example showed a contribution to total job creation of 25-64% for 11 OECD countries in the period 2002-2005 for OECD HGFs. Relative HGFs on the other hand, display a much smaller contribution to new jobs of only 13% and Figure 3 prompts to question if relative HGFs should indeed be supported by public programs.

Summary descriptives statistics are presented in Table 3 based on average values for the three 3-year periods considered in our work. It reveals 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 take a closer look at differences in firm size among the different samples. Table 3 shows that the average firm had 10.69 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 120.75 employees in *t-3*. In big contrast, relative HGFs defined as the 1% of firms with the highest log growth exhibit a strong bias towards smaller firms with 2.73 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 33.36 employees. The distribution of firms among the four firm size classes reveals more details on the bias of different growth measures towards certain firm sizes. Absolute HGFs display a much smaller share of micro-sized businesses with less than 10 employees (21.20%) compared to the total sample of firms (83.49%).[10] Relative HGFs on the other hand are almost entirely

[9] The comparison of OECD HGFs to a sub-sample of firms with 10+ employees rather than the full sample in Figure 3 results in a share of OECD HGFs in firms of 8%, in employees of 5% and 54% of job creation.

[10] The shares of firm size classes are similar to data from NSI Bulgaria for the entire number of enterprises in 2008 (earliest available year online): 89.78% micro, 8.28% small, 1.68% medium and 0.26% large firms (see https://infostat.nsi.bg/infostat/pages/reports/result.jsf?x_2=789 Accessed: 30 November 2016).

composed of micro firms (95.54%), 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.

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

	All firms	**HGFs absolute**	**HGFs relative**	**HGFs OECD**
	mean / percentage			
Firm size in t-3 (S.D.)	10.69 (54.00)	120.75 (254.52)	2.73 (6.87)	33.36 (52.36)
Firm size class in t-3				
Micro (<10 employees)	83.49	21.20	95.54	-
Small (10-49 employees)	12.79	31.48	4.08	85.54
Medium (50-249 employees)	3.22	35.97	0.36	13.37
Large (>249 employees)	0.50	11.34	-	1.09
Sector [a]				
Agriculture, hunting, forestry	3.44	2.82	4.48	3.46
Fishing	0.05	0.08	-	0.09
Mining and quarrying	0.11	0.58	0.19	0.22
Manufacturing	11.66	26.99	16.31	21.47
Electricity, gas and water supply	0.16	0.64	0.29	0.22
Construction	5.89	12.96	12.41	13.78
Wholesale and retail trade	41.73	23.43	31.27	32.15
Hotels and restaurants	6.07	4.60	8.57	4.07
Transportation, communications	6.02	5.39	5.89	5.35
Financial intermediation	1.30	2.34	1.86	1.99
Real estate and renting activities	12.35	11.77	11.06	10.44
Education	1.90	1.06	0.72	1.38
Health and social work	3.73	2.63	1.67	1.63
Other services activities	5.57	4.70	5.28	3.75
Region [b]				
North West	8.65	5.71	7.11	5.85
North Central	10.72	9.19	9.44	9.35
North East	14.66	12.67	13.32	13.02
South East	12.32	8.87	10.77	9.38
South West	35.45	46.60	41.75	44.58
South Central	18.10	16.92	17.53	17.80
no information	0.10	0.03	0.08	0.02
Legal form [c]				
Partnership	1.54	0.69	0.53	1.52
Limited liability company	39.92	69.42	74.91	70.31
Joint-stock company	3.25	20.80	7.53	10.82
Sole proprietorship	47.57	3.59	11.08	12.40
Other	3.81	1.89	2.04	1.85
No information	3.91	3.61	3.18	3.10
Foreign Ownership [d]				
Domestic	66.42	55.83	54.94	58.09
Foreign	33.58	44.17	46.06	41.91
Sample Size	501,989	3,764	3,770	5,574

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)

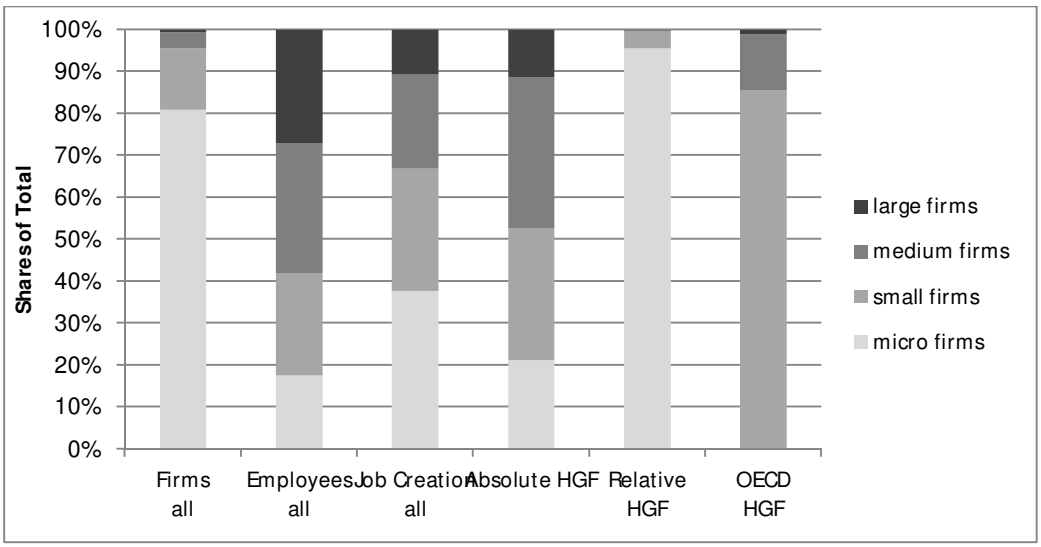
c Legal form category "other" includes state-owned and municipal enterprises, associations and co-operations

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

Figure 4 illustrates the contribution of firm size classes to the labor market for all firms in the sample (bars 1-3) as well as to the three differently defined types of high-growth firms (bars 4-6). Among all firms, micro-sized firms constitute with 81% a very large share of firms as shown in the first bar. In terms of employment as indicated in the second bar the role of micro-businesses is less prominent with 18% and below the contribution of other firm size classes. Regarding overall job creation depicted

in the third bar, micro-firms contribute with a share of 38%. This is the same 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 29% to total job creation, medium-sized firms 22% and larger firms 11%. Focusing now on how different firm size classes contribute to each set of HGFs in bars 4-6, the distribution for absolute HGFs is very similar to that of average firms in terms of employees and job creation. The situation is totally different for relative HGFs. 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. OECD HGFs 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 38% of total job creation. Overall, comparing the contribution of firm size classes to the labor market for average firms to the three sets of HGFs shows that the 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. The definition for OECD HGFs counteracts the emphasis on micro-sized firms at the price of ignoring a considerable share of overall job creation.

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 at the beginning of a period (t-3); Employees corresponds to the aggregate employment of surviving firms at the beginning of a period (t-3); Job creation corresponds to jobs created by surviving firms with positive growth during the three 3-year periods. 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).

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 economically least developed North Western region. The distribution of legal forms among HGFs compared to average firms differs considerably. There also 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 a descriptive look 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 firms results in an annual growth of -1.635 employees or -22% annually for surviving and exiting firms during a 3-year period (entries during a period cannot be taken into account). The average growth for surviving firms in absolute terms is also negative (-0.539 employees), while measured in terms of relative growth surviving firms exhibit small positive growth (1.4%). By definition, high growth firms exhibit much higher growth rates and, as expected also exhibit large variations among the different definitions. Which type of HGF grows most depends on the growth measure used. Not surprisingly, absolute HGFs perform best in terms of absolute growth (89.795 employees more) and relative HGFs in terms of relative growth (131.3% annually).

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

	Obs.	Absolute growth (S.D.)	Relative growth (S.D.)
All firms	501,989	-1.635 (22.775)	-0.222 (0.485)
All surviving firms	385,089	-0.539 (22.071)	0.014 (0.260)
High Growth firms			
Absolute	3,764	89.795 (103.110)	0.622 (0.762)
Relative	3,770	29.350 (59.212)	1.313 (0.567)
OECD	5,574	50.559 (80.926)	0.355 (0.197)

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 $\left(E_{i,t}/E_{i,t-3}\right)^{\frac{1}{3}} - 1$.

3.4 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 firm growth rates for high-growth firms and control firms by means of a two part model with separate equations for the probability of participation and growth. The two-part model consists of probit regressions for firm survival and exit as well as linear regressions for growth of surviving and exiting firms. In a third stage, the conditional means of the two-part model are used as input for a decomposition analysis of the aggregate regression results for different sets of firms: exiting as well as surviving high-growth firms and exiting as well as surviving control firms.

Our econometric strategy for modeling future growth rates of HGFs is guided by the fact that we do not only want to take surviving firms into account, but also firm exits. Empirical studies on the determinants of firm growth find that factors affecting market exit are different from those affecting firm survival (e.g. Sutton, 1997; Caves, 1998). In particular, firm size has a different impact on survival and growth. Smaller firms are less likely to survive, but exhibit higher growth rates compared to larger firms (Evans, 1987; Dunne and Hughes, 1994 or Haltiwanger et al., 2013). For this reason, we follow Huber et al. (2017) and Hölzl (2013) who suggest to model firm growth rates by two distinct equations - one for the exit decision and a second for firm growth of surviving firms. The two-part model further allows for a decomposition of the individual contributions of firm exit and survival to the persistence of growth for different sets of high-growth firms.

We also considered alternative models. Theory suggests that a Tobit model is too restrictive for our context as a single mechanism would need to govern the 'participation decision' (y = 0 versus y > 0) and the 'growth decision' (how much y is if it is positive). For a continuous variable x_i, the partial ef-

fects on $P(y > 0 \mid x)$ and $E(y \mid x, y > 0)$ would have the same signs and it would not be possible for x_i to have a positive effect on $P(y > 0 \mid x)$ and a negative effect on $E(y|x, y > 0)$. We could also have chosen a sample selection model if some correlation had been assumed between the error terms of the participation equation and the growth equation. While the two-part model specifies a model for the participation decision and a model for the outcome conditional on the outcome being observed, the sample selection model instead specifies a joint distribution for participation and outcome and then finds the implied distribution condition on the outcome observed (Cameron and Trivedi, 2005).

The 1st part of the two-part model describes the binary choice of survival versus exit for a particular firm *i* in period *t+τ*:

$$y_{i,t+\tau} = \begin{cases} 1 \text{ for } E_{i,t+\tau} \neq 0 \\ 0 \text{ for } E_{i,t+\tau} = 0 \end{cases}$$

where $y_{i,t+\tau}$ is the outcome variable at time *t+τ* for a firm *i*. *τ* is the time after the high-growth period, τ = (3,6) and $E_{i,t+\tau}$ is the number of employees at time *t+τ*.

The probit model for survival is then given as follows:

$$P(y_{i,t+\tau} = 1|x_i) = P(E_{i,t+\tau} \neq 0|x_i) = \Phi(\boldsymbol{x_i}'\boldsymbol{\gamma}) \quad (4)$$

where Φ is the cumulative distribution function of the standard normal distribution, *X* is the set of regressors, and $\boldsymbol{\gamma}$ is the vector of estimation coefficients.

The probability of exit can simply be derived as the residual

$$P(y_{i,t+\tau} = 0|x_i) = 1 - P(y_{i,t+\tau} = 1x_i) \quad (5)$$

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.[11] For surviving firms we estimate the following regression:

$$E(g_{i,t+\tau}|x_i, y_{i,t+\tau} = 1) = \mathrm{X}\boldsymbol{\beta} \quad (6)$$

In the case of measuring $g_{i,t+\tau}$ in absolute terms, we furthermore estimate for exiting firms:

$$E(g_{i,t+\tau}|x_i, y_{i,t+\tau} = 0) = \mathrm{X}\boldsymbol{\beta} \quad (7)$$

In the case of relative growth when $E(g_{i,t+\tau}|X, y_{i,t+\tau} = 0) = -1$ this step is unnecessary. β is the vector of coefficients and X is the same set of regressors as used in the first part of the model. As regressors we use an indicator variable that takes the value 1 if the firm was a high-growth firm (absolute, relative, OECD) at time *t* and 0 otherwise. In addition, we use firm-specific and industry-specific covariates in our analysis. The firm-specific variables are firm size, industry affiliation at the 2-digit NACE level, location at district level, legal form (partnership, limited liability company, joint-stock company, sole proprietorship and other), and a dummy variable for foreign ownership.[12] All are measured at t-3. As industry variables we use industry size at the 4-digit NACE level in terms of mean employment for other firms in the industry at time t-3. This variable controls for the fact that larger industries may reduce competitive pressures. The second industry control variable is mean growth for other firms in the

[11] One could argue that standard OLS estimation might lead to inconsistent results since the regressor includes the lagged dependent variable and the use of a dynamic panel model would be more appropriate. 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). For our research we do not attempt to distinguish between these two types of state dependence and a standard OLS estimator seems sufficient.

[12] 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 4.3.

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.

In the third stage of our econometric model, we make use of the regression results from the two-part model to decompose growth into different components. We use the conditional mean function to calculate predictions (conditional means) from the probit (1st stage of two-part model) and OLS estimations (2nd stage of two-part model) for four different sets of firms, i.e. surviving firms and exiting firms for both groups of high-growth firms and non-high-growth firms.

The conditional mean of the two-part model for the decomposition of effects for absolute growth is then given by

$$E(y_{i,t+\tau}|x_i) = P(y_{i,t+\tau} = 1|x_i)E(g_{i,t+\tau}|x_i, y_{i,t+\tau} = 1) + P(y_{i,t+\tau} = 0|x_i)E(g_{i,t+\tau}|x_i, y_{i,t+\tau} = 0) \quad (8a)$$

and for the case of relative growth this expression reduces to

$$E(y_{i,t+\tau}|x_i) = P(y_{i,t+\tau} = 1|x_i)E(g_{i,t+\tau}|x_i, y_{i,t+\tau} = 1) - P(y_{i,t+\tau} = 0|x_i) \quad (8b)$$

where we multiply the conditional mean probability of survival with conditional mean growth rates of surviving firms in coming period(s) and add to it the conditional mean probability of exits with the conditional mean growth rates for exits to arrive at the overall conditional mean growth rate for both sets of surviving and exiting firms. We perform this task for the two groups of HGFs and non-HGFs and then take differences for each step of our calculation between the groups of HGFs and non-HGFs. As a result, we arrive at the difference in survival (and exit), the growth of survivors, exits and the overall difference in growth for all firms.

4 RESULTS

4.1 TRANSITION PROBABILITY MATRICES

The reported transition probability matrices in Tables 4 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. The rows all add up to 100% each. 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.

Starting with the first column in Tables 4a-c, about a third of all firms (31.43%) 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 one period are most likely to exit in the next period. About another third of firms (30.22%) as indicated 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 (35.41%), but even more so to exit (44.90%). 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%).

Table 4a: 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)
$g_{i,t}^{(1)}$	34.73	31.55	12.67	20.52	0.54
$g_{i,t}^{(2)}$	44.90	8.68	35.41	10.96	0.05
$g_{i,t}^{(3)}$	20.68	40.33	6.30	31.20	1.49
$g_{i,t}^{(4)}$ = HGF (absolute)	7.32	52.43	0.28	11.82	28.15
Total	31.43	30.22	14.94	22.36	1.05

Table 4b: 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)
$g_{i,t}^{(1)}$	34.73	31.55	12.67	20.53	0.52
$g_{i,t}^{(2)}$	44.90	8.68	35.41	10.65	0.36
$g_{i,t}^{(3)}$	20.15	40.72	6.25	32.51	0.37
$g_{i,t}^{(4)}$ = HGF (relative)	27.03	37.89	2.17	32.21	0.70
Total	31.43	30.22	14.94	22.98	0.43

Table 4c: 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)
$g_{i,t}^{(1)}$	34.73	31.55	12.67	20.49	0.56
$g_{i,t}^{(2)}$	44.90	8.68	35.41	10.93	0.08
$g_{i,t}^{(3)}$	21.24	40.21	6.47	29.23	2.86
$g_{i,t}^{(4)}$ = HGF (OECD)	8.29	46.46	1.81	32.15	11.29
Total	31.43	30.22	14.94	21.87	1.55

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 a 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.

By focusing on firms exhibiting high growth ($g_{i,t+\tau}^{(4)}$), Tables 4a-c very much add to the fact that growth measures for defining high growth play a decisive role for the economic contribution of high growth firms. In terms of repeating high growth in the next period, 28.15% of absolute HGFs are able to do so. Relative HGFs in contrast show with 0.70% a probability to repeat high-growth as low as for any other firm in the sample. OECD HGFs have a probability of 11.29% 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. 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.

Additionally, Tables 4a-c suggest that it is worthwhile not to limit ones research interest to the repetition of the high-growth status in coming periods. Sustaining the achieved high levels of employment in the following period would already provide a justification for supporting high-growth firms. In that regard, Tables 4a-c reveal that the three sets of HGFs again vary very much. As discussed above, absolute HGFs show the highest probability to repeat high growth. This however seems to happen at the cost 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 (40.25%) and relative HGFs (35.08%) then have a closer probability not to decline or to exit in the next period, while OECD HGFs perform best with a probability of 45.25%. 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 (54.75%), followed by absolute HGFs (59.75%) and relative HGFs (64.92%). 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 27.03% of relative HGFs exit compared to only 8.29% OECD HGFs and 7.32% 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 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 A1a-c of the appendix. In essence, results for two periods later are similar to what is shown in Tables 4a-c. Absolute HGFs exhibit the highest probability to repeat high-growth two periods later (13.52%), whereas only 0.80% of relative HGFs and 2.41% of OECD HGFs are able to. Aggregating probabilities for stagnation, positive and high-growth two periods later shows that absolute HGFs (20.08%) have a lower probability not to decline or exit than relative HGFs (26.00%) and OECD HGFs (25.06%). Exit rates on the other hand are again highest for relative HGFs (20.40%) followed by OECD HGFs (13.06%) and absolute HGFs (10.14%), which is again partially off-set by an inverse ranking in terms of declining growth (53.60% of relative HGFs, 61.88% of OECD HGFs and 69.78% 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.

4.2 Regression Results for all firms

Before presenting decomposition results, we start with showing growth estimates from OLS (2nd part of 2-part model) for surviving firms in more detail in Tables 5a-5c. This is done in order to increase comparability of our results to the previous studies focusing on surviving firms only (for example Daunfeldt and Halvarsson, 2015; Coad and Hölzl, 2009; Coad, 2007). In Tables 5a-5c we 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 $y_{i,t+\tau}$. Table 5a reports results for absolute growth as defined in equation (1). We control for the firm- and industry specific

covariates as described above. 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 it shows 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 (13.579 more jobs), followed by OECD (6.525) and relative HGFs (4.890). 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 (-55.653), whereas relative and OECD HGFs shrink by -14.289 and -17.542 employees respectively. The coefficients for other control variables on the other hand are very similar for t+3 and t+6. Initial firm size in terms of number of employees has a significantly negative coefficient which is also reflected in the coefficients for different firm size classes. In other words, initially larger firms exhibit lower absolute growth rates in t+3 and t+6.

Since the regression sample for growth in t+3 is derived by pooling the two periods 2001-2004 and 2004-2007, while the sample for growth in t+6 consists only of period 2004-2007, 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 A2 in the appendix presents regression results in terms of absolute growth for identical subsamples in periods 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, net job creation by surviving high growth firms is positive even two periods after the high-growth event during the economic crisis. Absolute growth in employees after two periods is again highest for absolute HGFs with 28,589 jobs more than non-HGFs. Relative HGFs and OECD HGFs create 11,012 and 11,859 jobs respectively more than non-HGFs.

The contribution of each group of HGFs changes when using relative growth as dependent variable. Table 5b shows regression results for measuring growth in terms of relative log-differences similar to equation (2) used for defining relative HGFs. Table 5c 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 (0.075 log growth and 3.0 annual percentage growth over a 3-year period) and even more so for OECD HGFs (0.113 log growth or annually 3.8%). For relative HGFs however growth rates become considerably negative in t+3 (-0.304 log growth and -6.0% annually) compared to non-HGFs. In the long run all types of HGFs again reduce their number of employees until t+6 compared to non-HGFs. As for the initial number of employees, the effect is insignificant for all types of HGFs and time periods. In terms of firm size classes larger firms again grow less than smaller ones.

Table 5a: Absolute growth of surviving HGFs (absolute, relative, OECD), t+3 and t+6

$y_{i,t+\tau}$ = Absolute growth	τ=3			τ=6		
	(1)	(3)	(3)	(4)	(5)	(6)
Covariates	Absolute	Relative	OECD	Absolute	Relative	OECD
HGF	13.579***	4.890**	6.525***	-55.653***	-14.289***	-17.542***
	(4.473)	(2.268)	(1.455)	(7.968)	(3.392)	(2.486)
E_{t-3}	-0.075***	-0.074***	-0.073***	-0.085***	-0.090***	-0.090***
	(0.019)	(0.019)	(0.019)	(0.017)	(0.018)	(0.018)
Size class						
small (10-49)	-0.844**	-0.580*	-1.553***	-1.232***	-2.210***	0.835*
	(0.334)	(0.341)	(0.353)	(0.411)	(0.462)	(0.434)
medium (50-249)	-7.608***	-6.256***	-7.049***	-6.753***	-9.924***	-7.832***
	(1.785)	(1.827)	(1.806)	(1.833)	(1.925)	(1.873)
large (>249)	-37.895***	-35.773***	-36.456***	-22.151**	-25.799***	-24.091**
	(9.135)	(9.195)	(9.185)	(9.042)	(9.378)	(9.370)
Industry size (*t-3*)	0.084***	0.084***	0.084***	0.029*	0.020	0.022
	(0.012)	(0.012)	(0.012)	(0.018)	(0.018)	(0.018)
Industry Growth	12.373***	12.640***	12.330***	10.649***	9.616***	10.841***
(*t-3* to *t*)	(1.058)	(1.084)	(1.066)	(2.222)	(2.250)	(2.229)
Industry (2-digit NACE)	yes	yes	yes	yes	yes	yes
District	yes	yes	yes	yes	yes	yes
Legal form	yes	yes	yes	yes	yes	yes
Foreign ownership	yes	yes	yes	yes	yes	yes
Constant	2.591*	2.223*	2.623*	3.133	4.952**	2.991
	(1.429)	(1.422)	(1.417)	(2.126)	(2.235)	(2.210)
Observations	99,531	99,531	99,531	30,199	30,199	30,199
# HGF	1,317	1,042	3,494	452	398	1,405
R^2	0.118	0.116	0.117	0.198	0.165	0.173

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

Table 5b: 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	0.075**	-0.304***	0.113***	-0.286***	-0.290***	-0.133***
	(0.031)	(0.036)	(0.016)	(0.058)	(0.052)	(0.026)
E_{t-3}	-0.000	-0.000	-0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Size class						
small (10-49)	-0.256***	-0.261***	-0.271***	-0.163***	-0.174***	-0.146***
	(0.007)	(0.007)	(0.007)	(0.011)	(0.011)	(0.011)
medium (50-249)	-0.402***	-0.403***	-0.407***	-0.268***	-0.292***	-0.269***
	(0.014)	(0.013)	(0.014)	(0.019)	(0.019)	(0.019)
large (>249)	-0.494***	-0.492***	-0.492***	-0.363***	-0.392***	-0.370***
	(0.045)	(0.045)	(0.045)	(0.062)	(0.061)	(0.062)
Industry size (*t-3*)	0.001***	0.001***	0.001***	0.000**	0.000**	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Industry Growth	0.540***	0.542***	0.536***	0.511***	0.505***	0.515***
(*t-3* to *t*)	(0.024)	(0.024)	(0.024)	(0.045)	(0.045)	(0.045)
Industry (2-digit NACE)	yes	yes	yes	yes	yes	yes
District	yes	yes	yes	yes	yes	yes
Legal form	yes	yes	yes	yes	yes	yes
Foreign ownership	yes	yes	yes	yes	yes	yes
Constant	-0.074	-0.074	-0.707	0.196***	0.212***	0.192***
	(0.214)	(0.214)	(0.204)	(0.043)	(0.043)	(0.043)
Observations	99,531	99,531	99,531	30,199	30,199	30,199
# HGF	1,317	1,042	3,494	452	398	1,405
R^2	0.052	0.054	0.053	0.057	0.057	0.056

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

Table 5c: 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	0.030***	-0.060***	0.038***	-0.061***	-0.071***	-0.032***
	(0.007)	(0.010)	(0.004)	(0.011)	(0.011)	(0.006)
E_{t-3}	-0.000**	-0.000**	-0.000*	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Size class						
small (10-49)	-0.075***	-0.076***	-0.080***	-0.047***	-0.050***	-0.043***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
medium (50-249)	-0.113***	-0.112***	-0.114***	-0.074***	-0.080***	-0.074***
	(0.003)	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)
large (>249)	-0.128***	-0.126***	-0.127***	-0.083***	-0.090***	-0.085***
	(0.010)	(0.009)	(0.009)	(0.014)	(0.014)	(0.014)
Industry size (*t-3*)	0.000***	0.000***	0.000***	0.000*	0.000*	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Industry Growth (*t-3* to *t*)	0.156***	0.146***	0.145***	0.128***	0.127***	0.129***
	(0.007)	(0.007)	(0.007)	(0.013)	(0.013)	(0.013)
Industry (2-digit NACE)	yes	yes	yes	yes	yes	yes
District	yes	yes	yes	yes	yes	yes
Legal form	yes	yes	yes	yes	yes	yes
Foreign ownership	yes	yes	yes	yes	yes	yes
Constant	-0.034	-0.035	-0.033	0.055***	0.058***	0.053***
	(0.067)	(0.067)	(0.067)	(0.012)	(0.012)	(0.012)
Observations	99,531	99,531	99,531	30,199	30,199	30,199
# HGF	1,317	1,042	3,494	452	398	1,405
R^2	0.045	0.046	0.046	0.048	0.048	0.048

$y_{i,t+\tau} = \left(\frac{E_{i,t+\tau}}{E_{i,t-3+\tau}}\right)^{\frac{1}{3}} - 1$. Robust standard errors in parentheses. ***p-value < 0.01, ** p-value < 0.05, * p-value <0.1.

The findings emerging from the regression of growth rates in coming periods for surviving firms are at least threefold. To begin with, it becomes very clear that there are two important choices to make in terms of measuring growth. As expected after descriptive analyses, results for the economic contribution of high growth firms in coming periods are very much affected by how high-growth is defined. Considering each of the Tables 5a-c separately, the contribution largely varies for absolute, relative or OECD HGFs. Secondly, comparing Tables 5a-c with each other additionally shows that results are also affected by how we measure growth in terms of outcome variable. A focus on the economic contribution of firms in terms of absolute growth in employment results in positive effects for all types of HGFs compared to non-HGFs. When measuring relative growth in employment on the other hand, we do not find positive effects for relative HGFs. Third, 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, net 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 decomposition for different size classes and time periods in section 4.3 will shed more light on these first aggregate 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 6a presents the decomposition of results for growth measured in absolute terms. As relative growth measure in Table 6b we use annualized per-

centage 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 6a-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 6a shows differences in absolute growth rates between HGFs and non-HGFs for surviving firms identical to those in Table 5a. The very last column (3) in Table 6a on the other hand reports the overall growth for both surviving and exiting HGFs compared to non-HGFs. It shows that results change dramatically when exits are taken into account. The positive economic contribution of HGFs in t+3 completely vanishes for all types of HGFs with most jobs destroyed by absolute HGFs. The negative results in t+6 for survivors remain largely unchanged when exits are included. In stark contrast, overall results for using relative growth as outcome variable in Table 6b turn positive for all types of HGFs both for t+3 and t+6. What causes this opposite impact of firm exits on results depending on how growth is measured? The rates of decline for exiting firms in each group as shown in columns (2b) seem pivotal for an explanation. Even though exit rates are lower for HGFs compared to non-HGFs, those HGFs which do exit are of much larger firm size and are responsible for a much lower overall growth rate than firm exits among 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 therefore tend to be particularly large. For the period of economic recession 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 6b. Instead, the differences in exit rates 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 growth performance of high-growth firms in coming periods. Limiting the analysis to surviving firms only 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. Thus again, it not only seems to exert a great influence on results how high-growth is measured, but also how growth is measured in terms of dependent variable. Different types of growth measures are biased towards different types of firm sizes. Their influence unfolds into opposite directions depending if the measurement of high growth or the measurement of future growth is concerned.

Table 6a 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 5a*	(2b)	(3)
Absolute HGFs	τ =3	0.754	0.246	11.679	-182.493	-36.094	0.685	0.315	-1.899	-5.142	-2.919	0.069	-0.069	13.579	-177.35	**-33.174**
Relative HGFs	τ =3	0.732	0.268	3.120[0]	-24.363	-4.235	0.685	0.315	-1.771	-5.386	-2.909	0.047	-0.047	4.890	-18.98	**-1.326**
OECD HGFs	τ =3	0.810	0.190	4.576	-59.282	-7.587	0.684	0.316	-1.949	-5.171	-2.968	0.126	-0.126	6.525	-54.11	**-4.618**
Absolute HGFs	τ =6	0.712	0.288	-60.576	-66.198[2]	-62.194	0.593	0.407	-4.923	-2.043	-3.750	0.119	-0.119	-55.653	-64.15	**-58.444**
Relative HGFs	τ =6	0.793	0.207	-19.857	-20.643	-20.020	0.591	0.409	-5.567	-1.930	-4.081	0.201	-0.201	-14.289	-18.71	**-15.939**
OECD HGFs	τ =6	0.730	0.270	-22.482	-12.102	-19.679	0.590	0.410	-4.939	-1.917	-3.701	0.140	-0.140	-17.542	-10.18	**-15.979**

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 Table 5. [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 6b 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 5c*	(2b)	(3)
Absolute HGFs	τ =3	0.754	0.246	0.010[0]	-1	-0.239	0.685	0.315	-0.021	-1	-0.329	0.069	-0.069	0.030	0.000	**0.090**
Relative HGFs	τ =3	0.732	0.268	-0.080	-1	-0.326	0.685	0.315	-0.020	-1	-0.328	0.047	-0.047	-0.060	0.000	**0.002**
OECD HGFs	τ =3	0.810	0.190	0.016	-1	-0.177	0.684	0.316	-0.022	-1	-0.331	0.126	-0.126	0.038	0.000	**0.154**
Absolute HGFs	τ =6	0.712	0.288	-0.116	-1	-0.370	0.593	0.407	-0.055	-1	-0.440	0.119	-0.119	-0.061	0.000	**0.070**
Relative HGFs	τ =6	0.793	0.207	-0.126	-1	-0.307	0.591	0.409	-0.055	-1	-0.441	0.201	-0.201	-0.071	0.000	**0.134**
OECD HGFs	τ =6	0.730	0.270	-0.087	-1	-0.334	0.590	0.410	-0.055	-1	-0.442	0.140	-0.140	-0.032	0.000	**0.109**

See notes Table 6a.

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

4.3 REGRESSION RESULTS BY FIRM SIZE CLASS AND BY TIME PERIOD

In this section we moreover disaggregate the results for absolute growth in Table 6a for micro, small, medium and large firms separately and hope to gain additional insights on the influence of different growth measures (for a disaggregation of relative growth rates see Table A3a-c in the appendix). It shows that the negative overall results for absolute future growth in Table 6a are mainly driven by large firms. As a cautionary note, some results for conditional mean growth rates for surviving and exiting HGFs lack statistical significance, but the general trend seems to hold: Smaller firms perform better than larger firms. Smaller firms exhibit higher exit rates than large firms, but this is compensated for by much higher growth rates than for larger firms. This holds true for both HGFs and non-HGFs. We moreover added the right two columns in Tables 7a-c to indicate the largely differing distributions of firm size classes among HGFs and non-HGFs. Comparing the firm size distributions for each definition of high-growth with each other illustrates why we find a more pronounced negative absolute performance for absolute HGFs (low share of smaller firms) than for relative and OECD HGFs (high shares of smaller firms).

We also analyze alternative consecutive 3-year periods during 2001-2010. We do so not only to gain additional insights on the influence of macroeconomic conditions on the future performance of HGFs, but also to evaluate robustness of our main results. Table 8 reports the overall aggregate results for HGFs compared to non-HGFs as defined in equations (8a) and (8b) and as reported in column (3) of previous tables (for decomposed results see Tables A4a-d in the appendix). As alternate time periods we compare 2001-2004 to 2004-2007, 2002-2005 to 2005-2008, 2003-2006 to 2006-2009, and 2004-2007 to 2007-2010. As a reminder, in our main results we pooled the two samples of consecutive 3-year periods 2001-2004 to 2004-2007 and 2004-2007 to 2007-2010 for our analysis of effects in t+3 while we used only the sample for period 2001-2004 to 2007-2010 for the analysis of t+6 effects. For each time period we show results for absolute as well as for relative growth in t+3.

What strikes first is that while absolute growth largely varies depending on more or on less favorable economic conditions, relative growth remains fairly stable over time. This is the case for all three definitions of high growth (absolute, relative and OECD HGFs). In terms of absolute growth, high-growth firms perform best in periods that do not include the crisis years 2009 and 2010. The performance of HGFs from 2002-2005 to 2005-2008 has been particularly strong as indicated in column (2a) of Table 8 and absolute HGFs show the largest increase in the number of employees in the next period. In those 3-year periods which are characterized by the economic crisis (2006-2009 and 2007-2010), absolute growth turns negative for HGFs and in particular for absolute HGFs. This development is related to a slowdown in growth for surviving high-growth firms as well as an increase in exit rates for 2010 as can be seen in Tables A4a-d. Since high-growth firms (in particular absolute HGFs) are larger than average firms, both trends (slowdown of growth and exit) have a larger influence on overall growth than for non-HGFs. Against this background, high-growth firms do not seem to be less resilient to economic crises. Their negative absolute performance during the crisis compared to non-HGFs is rather driven by larger firm sizes for high-growth firms. In terms of relative growth the performance in each of the compared periods shows only small variation for absolute HGFs (7.6%-14.5% annually over 3-year period). For OECD HGFs relative growth even shows the strongest performance with 24.0% in the period with the least favorable economic conditions (column 4b). Relative HGFs however grow least in relative (as in absolute) terms and exhibit negative growth during the crisis with -0.1% compared to 14.5% for absolute HGFs and 24.0% for OECD HGFs. This is mainly related to higher exit rates for relative HGFs than for absolute and OECD HGFs during the crisis.

Table 7a 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	0.745	33.143	-110.466	-3.448	0.633	0.452	-2.743	-0.722	0.113	32.691	-107.722	-2.727	0.09	0.74
Small	τ =3	0.888	16.454[2]	-117.581	1.448	0.807	-1.299	-12.201	-3.407	0.081	17.753	-105.380	4.855	0.23	0.20
Medium	τ =3	0.952	-8.316[0]	-239.228	-19.288	0.906	-12.146	-48.927	-15.599	0.046	3.830	-190.301	-3.689	0.50	0.05
Large	τ =3	0.895	-68.110	-572.037	-120.897	0.903	-73.581	-245.741	-90.257	-0.008	5.471	-326.296	-30.641	0.18	0.01
Micro	τ =6	0.710	-53.936	-53.357	-53.768	0.527	-0.851	-3.351	-2.034	0.183	-53.084	-50.006	-51.734	0.16	0.68
Small	τ =6	0.836	-45.248	-95.325	-53.477	0.730	-4.161	-9.345	-5.559	0.105	-41.086	-85.980	-47.918	0.28	0.24
Medium	τ =6	0.925	-74.669	-237.221	-86.781	0.873	-16.512	-27.995	-17.966	0.052	-58.156	-209.226	-68.815	0.42	0.08
Large	τ =6	0.871	-172.975	-615.593[0]	-229.933	0.845	-65.677	-164.445	-80.989	0.026	-107.298	-451.147	-148.944	0.15	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. Values in column (2a) in panel 'differences' are equivalent to coefficients for HGF in Table 6a. 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.

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 (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	0.714	6.563	-19.820	-0.986	0.632	0.414	-2.636	-0.709	0.082	6.148	-17.184	-0.277	0.93	0.74
Small	τ =3	0.869	-1.842[0]	-114.865	-16.694	0.807	-1.059	-12.495	-3.263	0.061	-0.784	-102.371	-13.431	0.06	0.20
Medium	τ =3	1.000	-98.083[0]		-98.083	0.911	-11.671	-58.328	-15.830	0.089	-86.412	58.328	-82.253	0.01	0.06
Micro	τ =6	0.794	-16.662	-21.321	-16.851	0.523	-0.698	-3.283	-1.930	0.271	-15.964	-18.038	-14.921	0.97	0.74
Small	τ =6	0.882	-15.694[0]	-3.025	-14.204	0.732	-4.733	-9.757	-6.079	0.150	-10.960	6.732	-8.125	0.03	0.26

See Notes Table 7a

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 7c 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	0.899	3.856	-48.111	-1.406	0.797	-1.772	-10.712	-3.588	0.102	5.628	-37.398	2.182	0.84	0.73
Medium	τ =3	0.959	-2.991[0]	-234.202	-38.448	0.906	-12.492	-51.751	-16.170	0.053	9.501	-182.451	-22.279	0.15	0.23
Large	τ =3	0.945	-106.159[1]	677.000	-62.846	0.899	-71.420	311.861	-32.670	0.046	-34.739	365.139	-30.176	0.01	0.04
Small	τ =6	0.851	-15.097	-31.143	-17.492	0.716	-3.089	-8.359	-4.585	0.135	-12.008	-22.784	-12.907	0.86	0.71
Medium	τ =6	0.929	-66.215	-186.720	-74.830	0.873	-16.962	-29.080	-18.503	0.056	-49.253	-157.639	-56.327	0.13	0.25
Large	τ =6	1.000	-224.297[1]		-224.297	0.921	-74.686	-209.560	-85.373	0.079	-149.611	209.560	-138.924	0.01	0.04

See Notes Table 7a

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

Table 8 Overall conditional mean growth rates from two-part model for t+3 (column 3 in previous tables), alternate periods

	2001-2004 to 2004-2007		2002-2005 to 2005-2008		2003-2006 to 2006-2009		2004-2007 to 2007-2010	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)
Definitions	Absolute Growth	Relative Growth	Absolute Growth	Relative Growth	Absolute Growth	Relative Growth	Absolute Growth	Relative Growth
Absolute HGFs	43.276	0.076	129.969	0.106	-14.984	0.080	-62.449	0.145
Relative HGFs	11.818	0.014	38.439	0.042	-0.741	0.029	-9.788	-0.001
ÓECD HGFs	16.441	0.083	50.165	0.146	-2.346	0.110	-17.690	0.240
Observations	57,255		58,415		57,748		87,851	

Notes: Reported is the overall conditional mean growth for surviving and exiting firms as defined in equations (8a) and (8b)

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

5 DISCUSSION AND CONCLUSION

The support of high growth firms has become an important objective for policymakers since research has revealed their important role for job creation. Surprisingly however, knowledge about the long-term economic contribution of high-growth firms after the period of fast growth is still very limited. The few existing studies furthermore exclusively focus on a relative measurement of high growth.

We analyzed the growth performance of high-growth firms in terms of employees compared to non-high-growth firms three and six years after their period of high growth. We use data on private firms in Bulgaria for three consecutive 3-year periods (2001-2004, 2004-2007, and 2007-2010). We compare three different types of definitions for high growth – absolute, relative and the composite measure recommended by Eurostat-OECD. We first calculate transition probability matrices to investigate growth rates of HGFs and non-HGFs in coming periods. We then model future growth by means of a two-part model with separate equations for survival and exit (probit regressions) as well as for growth of survivors and growth of exits (linear regressions). We finally use results from the two-part model as input for the decomposition of aggregate growth effects.

Our findings show that the measurement of growth has a fundamental influence on outcomes. Not only does the economic contribution of previous HGFs in coming periods largely depend on the way how high growth is defined (absolute, relative and OECD), but also on how future growth is measured. Different types of growth measures are biased towards different types of firm sizes. Absolute definitions of high growth for example are biased towards larger firms while relative definitions (including the one recommended by Eurostat-OECD) are biased towards smaller firms. Since the performance of different firm sizes considerably varies in terms of survival and growth rates, growth measures matter very much.

To start with, our descriptive statistics revealed that only absolute and OECD high-growth firms indeed exhibit the widely acclaimed vital role of high-growth firms for job creation from a single period point of view. Absolute HGFs constitute 1% of firms, 10% employees and are responsible for 41% of job creation. OECD HGFs have a share of 1% in total firms, 4% in total employees and 34% in newly created jobs. In contrast, the public support of relative HGFs whose contribution to the labor market is much smaller (13% of total job creation) is more questionable. The decisive role of different definitions of high-growth for the economic contribution of high growth firms is further confirmed by transition probability matrices. Only absolute HGFs (28.15%) and OECD HGFs (11.29%) are able to repeat high growth in the next period. The probability of relative HGFs to repeat high-growth is with 0.70% 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 (7.32%) and OECD HGFs (8.29%), whereas more than one out of four relative HGFs (27.03%) exits.

Overall our findings from descriptive statistics and transition probabilities are very similar to what has been found so far for high-income countries. We argued at the beginning of this paper that differences in job creation and destruction processes across countries make it worthwhile to analyze for the first time growth persistence of high-growth firms in a middle-income country like Bulgaria. As we find, middle-income countries in Eastern Europe might however not be that different anymore from Western countries 25 years after their transition to market economies. This is also suggested by Faggio and Konings (2003) who analyzed job flows in Poland, Estonia, Slovenia, Bulgaria, and Romania. They found that patterns of employment growth in the more advanced transition countries Poland, Estonia, and Slovenia were already comparable to those found in Western economies shortly after the beginning of the transition period in the 1990s. It is very probable that Bulgaria has also reached similar levels of firm growth as high-income countries throughout the following years.

Regression results and their decomposition add four further important insights: First of all, next to the definition of high-growth, it additionally matters very much how we measure growth as dependent variable. For surviving firms for example, a focus on absolute growth in employment resulted in a significantly positive performance for all three types of HGFs compared to non-HGFs. When measuring

relative growth (in percentages or logs) on the other hand, we found negative effects for relative HGFs.

Second, it appears important to take firm exits into account when analyzing the growth performance of HGFs in coming periods. If accounting for firm exits influences overall growth rates in a positive or negative manner again depends on the way how growth is measured. An absolute growth measure attributes a higher weight to firm exits from larger firms. Since HGFs are characterized by larger firm sizes than average firms, we found a negative growth performance for HGFs compared to non-HGFs both three and six years after the high-growth period. Measuring future growth in a relative way on the other hand ignores the influence of firm size among exits since all exits are counted as a decrease of -100% no matter how large a firm was. Instead, differences in exit rates become a decisive factor for results. As fewer HGFs than non-HGFs exit, overall growth rates of HGFs compared to non-HGFs turn positive, most of all for absolute HGFs. Since all of the existing studies apply relative growth measures, Table 1 accordingly shows that those which take firm exit into account find positive results in terms of future performance of high-growth firms while most of those focusing only on surviving firms report negative results.

Thirdly, the positive coefficients for firm size controls in our survival regressions and the negative coefficients for firm size in our regressions for growth of surviving firms suggest what has been found by other studies on firm growth (e.g. Daunfeldt and Halvarsson, 2015; Hölzl, 2013): Smaller firms are less likely to survive, but those which do survive exhibit higher growth rates compared to larger firms. The disaggregation of results for micro, small, medium and large firms points into the same direction. Smaller firms perform better than larger firms, because lower exit rates for larger firms are offset by much lower growth rates than for smaller firms.

Finally, a fourth striking finding emerges from the comparison of alternate consecutive 3-year periods. While absolute growth largely varies depending on more or on less favorable economic conditions, relative growth remains fairly stable over time. This is the case for all three definitions of high growth. In terms of absolute growth, HGFs perform best in periods that do not include the crisis years 2009 and 2010. In 3-year periods which are characterized by the economic crisis (2006-2009 and 2007-2010) however, absolute growth becomes negative for previous high-growth firms and in particular for absolute HGFs. This development is related to both a slowdown in growth for surviving high-growth firms as well as an increase in exit rates during the economic crisis. Again, since high-growth firms (in particular absolute HGFs) have larger firm sizes than average firms, both trends (slowdown of growth and exit) have a larger influence on overall growth than for non-HGFs. In clear contrast, the performance in terms of relative growth in each of the compared periods shows only small variations for absolute HGFs (7.6-14.5% annually over 3-year period). For OECD HGFs it varies between 8.3-24.0% annually and is highest during the period with the least favorable economic conditions. Relative HGFs once again exhibit much lower growth rates with the highest value at 4.2% and negative growth (-0.1%) during the crisis. Relative HGFs both contract stronger in terms of employees and exit more often during the crisis compared to other types of high-growth firms. This might indicate that smaller firms which are overrepresented among relative HGFs are less resistant to economic crises than larger firms. Recent evidence from the United Kingdom by Butcher and Bursnall (2013) for example also showed that smaller firms contributed less to job creation during the economic crisis and suggested this may reflect the tight credit constraints for small firms due to the downturn.

What do our results imply for policymakers? We assume that the overall number of jobs created and destroyed is central for policymakers. They should therefore be most interested in absolute growth in employees. In this respect, we find a significantly positive contribution of high-growth firms to the labor market in the next 3 years during periods of favorable economic conditions. While this holds for both absolute and relative (with and without size threshold) definitions of high growth, absolute HGFs show the biggest potential for increasing the number of jobs in the next period. For periods of economic downturn on the other hand the absolute growth performance of high-growth firms becomes negative compared to non-HGFs. Overall however, job gains in t+3 are not fully outweighed by subsequent job losses in t+6. Net job creation for surviving high growth firms is still positive two periods after the high-

growth event and it is highest for absolute high-growth firms. In contrast, a relative definition of high-growth without a firm size threshold seems least favorable in terms of job creation. If only surviving firms or periods of economic downturn are taken into account, relative HGFs even shrink in the coming period. Taken together, definitions should be considered very carefully. Support programs for high-growth firms should probably refrain from defining high-growth in relative terms. If a relative definition is applied than at least a firm size threshold should be introduced. In that regard, the definition of high growth recommended by Eurostat-OECD seems a very viable option.

In terms of implications for future research, we believe that studies should put more emphasis on how high-growth is measured. None of the existing studies on the persistence of high-growth firms measures growth in absolute terms. As our results show, this omits the opportunity for important findings. Our findings particularly put into question the strong focus in the literature on a relative definition of high-growth without size thresholds as the selected set of firms perform worst in most of our analyses. Our results furthermore demonstrate that taking firm exits into account, considerably influences results. If possible, we thus recommend no to limit an analysis of high-growth to surviving firms. Since we used for the first time data from a middle-income country to analyze the long-term performance of high-growth firms, it would be very interesting to find further studies in the future for similar sets of countries and compare our results to. Moreover, it could be particularly worthwhile to compare different definitions of high-growth in 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 further insights on the role of different growth measures during changing economic environments.

APPENDIX

Table A1a 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	$g_{i,t+3}^{(4)}$ high growth firms (absolute)
$g_{i,t}^{(1)}$	42.36	31.02	11.41	14.37	0.84
$g_{i,t}^{(2)}$	61.63	12.18	17.04	9.01	0.15
$g_{i,t}^{(3)}$	30.82	40.33	8.22	18.79	1.83
$g_{i,t}^{(4)}$ = HGF (absolute)	10.14	69.78	1.19	5.37	13.52
Total	39.08	33.44	10.52	15.63	1.33

Table A1b 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	$g_{i,t+3}^{(4)}$ high growth firms (relative)
$g_{i,t}^{(1)}$	42.36	31.02	11.41	14.95	0.26
$g_{i,t}^{(2)}$	61.63	12.18	17.04	8.99	0.17
$g_{i,t}^{(3)}$	30.58	40.71	8.19	20.35	0.17
$g_{i,t}^{(4)}$ = HGF (relative)	20.40	53.60	2.80	22.40	0.80
Total	39.08	33.44	10.52	16.74	0.22

Table A1c **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	$g_{i,t+3}^{(4)}$ high growth firms (OECD)
$g_{i,t}^{(1)}$	42.36	31.02	11.41	14.58	0.63
$g_{i,t}^{(2)}$	61.63	12.18	17.04	8.86	0.30
$g_{i,t}^{(3)}$	31.71	39.37	8.47	19.11	1.35
$g_{i,t}^{(4)}$ = HGF (OECD)	13.06	61.88	2.85	19.80	2.41
Total	39.08	33.44	10.52	16.01	0.95

Notes Tables A1a-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 A2 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)	(3)	(3)	(4)	(5)	(6)
Covariates	Absolute	Relative	OECD	Absolute	Relative	OECD
HGF	84.242***	25.301**	29.401***	-55.653***	-14.289***	-17.542***
	(7.960)	(4.437)	(2.443)	(7.968)	(3.392)	(2.486)
E_{t-3}	-0.091***	-0.084***	-0.083***	-0.085***	-0.090***	-0.090***
	(0.020)	(0.021)	(0.021)	(0.017)	(0.018)	(0.018)
Size class						
small (10-49)	1.750***	3.333*	-1.809***	-1.232***	-2.210***	0.835*
	(0.467)	(0.530)	(0.482)	(0.411)	(0.462)	(0.434)
medium (50-249)	1.851	6.798***	3.239***	-6.753***	-9.924***	-7.832***
	(2.086)	(2.222)	(2.164)	(1.833)	(1.925)	(1.873)
large (>249)	-13.566	-7.873	-10.799***	-22.151**	-25.799***	-24.091**
	(8.988)	(9.447)	(9.393)	(9.042)	(9.378)	(9.370)
Industry size (*t-3*)	yes	yes	yes	yes	yes	yes
Industry Growth (*t-3* to *t*)	yes	yes	yes	yes	yes	yes
Industry (2-digit NACE)	yes	yes	yes	yes	yes	yes
District	yes	yes	yes	yes	yes	yes
Legal form	yes	yes	yes	yes	yes	yes
Foreign ownership	yes	yes	yes	yes	yes	yes
Constant	4.680**	1.813	5.142**	3.133	4.952**	2.991
	(1.429)	(2.016)	(2.003)	(2.126)	(2.235)	(2.210)
Observations	30,199	30,199	30,199	30,199	30,199	30,199
# HGF	452	398	1,405	452	398	1,405
R^2	0.186	0.117	0.137	0.198	0.165	0.173

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

Table A3a 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	0.745	-0.018[0]	-1	-0.268	0.633	0.004	-1	-0.365	0.113	-0.022	0	0.096	0.09	0.74
Small	τ =3	0.888	-0.032[2]	-1	-0.140	0.807	-0.065	-1	-0.246	0.081	0.033	0	0.105	0.23	0.20
Medium	τ =3	0.952	-0.059	-1	-0.104	0.906	-0.095	-1	-0.180	0.046	0.036	0	0.076	0.50	0.05
Large	τ =3	0.895	-0.073	-1	-0.170	0.903	-0.115	-1	-0.201	-0.008	0.043	0	0.031	0.18	0.01
Micro	τ =6	0.710	-0.172	-1	-0.412	0.527	-0.035	-1	-0.492	0.183	-0.137	0	0.080	0.16	0.68
Small	τ =6	0.836	-0.152	-1	-0.291	0.730	-0.076	-1	-0.325	0.105	-0.076	0	0.034	0.28	0.24
Medium	τ =6	0.925	-0.140	-1	-0.204	0.873	-0.098	-1	-0.212	0.052	-0.043	0	0.008	0.42	0.08
Large	τ =6	0.871	-0.131	-1	-0.243	0.845	-0.114	-1	-0.096	0.026	-0.017	0	-0.146	0.15	0.01

Notes Tables A3a-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. Values in column (2a) in panel 'differences' are equivalent to coefficients for HGF in Table 6b. 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 A3b 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	0.714	-0.084	-1	-0.346	0.632	0.005	-1	-0.365	0.082	-0.089	0	0.019	0.93	0.74
Small	τ =3	0.869	-0.127	-1	-0.242	0.807	-0.064	-1	-0.245	0.061	-0.063	0	0.003	0.06	0.20
Medium	τ =3	1.000	-0.099[1]		-0.099	0.911	-0.092		-0.083	0.089	-0.007	0	-0.015	0.01	0.06
Micro	τ =6	0.794	-0.133	-1	-0.222	0.523	-0.033	-1	-0.494	0.271	-0.100	0	0.273	0.97	0.74
Small	τ =6	0.882	-0.020[2]	-1	-0.135	0.732	-0.077	-1	-0.324	0.150	0.057	0	0.189	0.03	0.26

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 A3c 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	0.899	-0.032	-1	-0.130	0.797	-0.069	-1	-0.258	0.102	0.037	0	0.128	0.84	0.73
Medium	τ =3	0.959	-0.050	-1	-0.199	0.906	-0.095	-1	-0.180	0.053	0.045	0	-0.020	0.15	0.23
Large	τ =3	0.945	-0.090	-1	-0.140	0.899	-0.108	-1	-0.198	0.046	0.018	0	0.058	0.01	0.04
Small	τ =6	0.851	-0.109	-1	-0.242	0.716	-0.072	-1	-0.336	0.135	-0.036	0	0.094	0.86	0.71
Medium	τ =6	0.929	-0.131	-1	-0.193	0.873	-0.098	-1	-0.213	0.056	-0.032	0	0.020	0.13	0.25
Large	τ =6	1.000	-0.210		-0.210	0.921	-0.114		-0.105	0.079	-0.096	0	-0.105	0.01	0.04

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

Table A4a Decomposition of conditional mean growth in t+3 by definition of HGFs, time period 2001-2004 and 2004-2007

	HGFs					Non-HGFs					Differences				
Definition	(1a) Survival rate	(1b) Exit rate	(2a) Growth survivors	(2b) Growth exits	(3) Total mean growth	(1a)	(1b)	(2a)	(2b)	(3)	(1a)	(1b)	(2a)	(2b)	(3)
Absolute growth															
Absolute HGFs	0.863	0.137	76.577	-179.549	41.393	0.865	0.135	-0.517	-10.627	-1.882	-0.002	0.002	77.094	-168.92	**43.276**
Relative HGFs	0.889	0.111	18.308	-53.789	10.341	0.865	0.135	0.086[0]	-11.467	-1.477	0.025	-0.025	18.222	-42.32	**11.818**
OECD HGFs	0.870	0.130	25.507	-59.385	14.513	0.865	0.135	-0.582	-10.537	-1.928	0.006	-0.006	26.089	-48.85	**16.441**
Relative growth															
Absolute HGFs	0.863	0.137	0.085	-1	-0.064	0.865	0.135	-0.006	-1	-0.140	-0.002	0.002	0.090	0	**0.076**
Relative HGFs	0.889	0.111	-0.016[0]	-1	-0.125	0.865	0.135	-0.004	-1	-0.139	0.025	-0.025	-0.011	0	**0.014**
OECD HGFs	0.870	0.130	0.081	-1	-0.059	0.865	0.135	-0.007	-1	-0.142	0.006	-0.006	0.088	0	**0.083**

Table A4b Decomposition of conditional mean growth in t+3 by definition of HGFs, time period 2002-2005 and 2005-2008

	HGFs					Non-HGFs					Differences				
Definition	(1a) Survival rate	(1b) Exit rate	(2a) Growth survivors	(2b) Growth exits	(3) Total mean growth	(1a)	(1b)	(2a)	(2b)	(3)	(1a)	(1b)	(2a)	(2b)	(3)
Absolute growth															
Absolute HGFs	0.890	0.110	152.194	-73.075	127.309	0.850	0.150	-0.902	-12.609	-2.659	0.040	-0.040	153.096	-60.47	**129.969**
Relative HGFs	0.919	0.081	42.277	-25.681	36.747	0.850	0.150	0.273	-12.789	-1.692	0.069	-0.069	42.003	-12.89	**38.439**
OECD HGFs	0.907	0.093	55.562	-35.272	47.113	0.849	0.151	-1.364	-12.515	-3.052	0.058	-0.058	56.926	-22.76	**50.165**
Relative growth															
Absolute HGFs	0.890	0.110	0.072	-1	-0.046	0.850	0.150	-0.003	-1	-0.153	0.040	-0.040	0.075	0	**0.106**
Relative HGFs	0.919	0.081	-0.032	-1	-0.111	0.850	0.150	-0.002	-1	-0.152	0.069	-0.069	-0.030	0	**0.042**
OECD HGFs	0.907	0.093	0.091	-1	-0.010	0.849	0.151	-0.006	-1	-0.156	0.058	-0.058	0.097	0	**0.146**

Table A4c Decomposition of conditional mean growth in t+3 by definition of HGFs, time period 2003-2006 and 2006-2009

	HGFs					Non-HGFs					Differences				
Definition	(1a) Survival rate	(1b) Exit rate	(2a) Growth survivors	(2b) Growth exits	(3) Total mean growth	(1a)	(1b)	(2a)	(2b)	(3)	(1a)	(1b)	(2a)	(2b)	(3)
Absolute growth															
Absolute HGFs	0.912	0.088	2.7570	-234.821	-18.163	0.829	0.171	-2.285	-7.509	-3.179	0.083	-0.083	5.042	-227.31	**-14.984**
Relative HGFs	0.920	0.080	-0.5610	-43.104	-3.964	0.829	0.171	-2.244	-7.950	-3.223	0.092	-0.092	1.683	-35.15	**-0.741**
OECD HGFs	0.923	0.077	-0.5000	-66.168	-5.549	0.827	0.173	-2.305	-7.478	-3.202	0.096	-0.096	1.805	-58.69	**-2.346**
Relative growth															
Absolute HGFs	0.912	0.088	-0.032	-1	-0.117	0.829	0.171	-0.031	-1	-0.197	0.083	-0.083	0.000	0	**0.080**
Relative HGFs	0.920	0.080	-0.096	-1	-0.168	0.829	0.171	-0.031	-1	-0.197	0.092	-0.092	-0.065	0	**0.029**
OECD HGFs	0.923	0.077	-0.014	-1	-0.090	0.827	0.173	-0.032	-1	-0.200	0.096	-0.096	0.018	0	**0.110**

Table A4d Decomposition of conditional mean growth in t+3 by definition of HGFs, time period 2004-2007 and 2007-2010

	HGFs					Non-HGFs					Differences				
Definition	(1a) Survival rate	(1b) Exit rate	(2a) Growth survivors	(2b) Growth exits	(3) Total mean growth	(1a)	(1b)	(2a)	(2b)	(3)	(1a)	(1b)	(2a)	(2b)	(3)
Absolute growth															
Absolute HGFs	0.711	0.289	-22.488	-173.516	-66.137	0.568	0.432	-3.412	-4.050	-3.688	0.143	-0.143	-19.076	-169.47	**-62.449**
Relative HGFs	0.632	0.368	-10.259	-19.490	-13.652	0.568	0.432	-3.652	-4.143	-3.865	0.065	-0.065	-6.606	-15.35	**-9.788**
OECD HGFs	0.810	0.190	-12.051	-61.117	-21.392	0.565	0.435	-3.399	-4.094	-3.701	0.245	-0.245	-8.652	-57.02	**-17.690**
Relative growth															
Absolute HGFs	0.711	0.289	-0.027	-1	-0.308	0.568	0.432	-0.036	-1	-0.453	0.143	-0.143	0.010	0	**0.145**
Relative HGFs	0.632	0.368	-0.136	-1	-0.453	0.568	0.432	-0.035	-1	-0.452	0.065	-0.065	-0.101	0	**-0.001**
OECD HGFs	0.810	0.190	-0.031	-1	-0.215	0.565	0.435	-0.036	-1	-0.456	0.245	-0.245	0.005	0	**0.240**

Notes Tables A4a-d: 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. [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 $y_{i,t+\tau} = E_{i,t+\tau} - E_{i,t+\tau-3}$; Relative annualized percentage growth over a 3-year period is measured as $y_{i,t+\tau} = \left(\frac{E_{i,t+\tau}}{E_{i,t-3+\tau}}\right)^{\frac{1}{3}} - 1$

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