ERF 2020
26TH Annual
Conference

Determinants of Growth Performance of High Growth Firms: An Analysis of the Turkish Manufacturing Sector

Fatma M. Utku-Ismihan and M. Teoman Pamukçu

ECONOMIC RESEARCH FORUM
منتدى البحوث الاقتصادية

Determinants of Growth Performance of High Growth Firms: An Analysis of the Turkish Manufacturing Sector

Fatma M. UTKU-ISMIHAN[1] and M. Teoman PAMUKÇU[2]

Abstract

Due to their important contribution to overall growth performance of economies policy makers have attributed great importance to high growth firms (HGFs). In order to support the efforts of these firm's researchers have tried to find the factors that initiated and promoted the growth performance of HGFs. However, this is not a simple task since the factors that contribute to the growth performances of firms seems to vary across sectors and countries. This study examines the characteristics of HGFs and tries to identify factors that stimulate HGFs in the Turkish manufacturing sector using a rich firm-level dataset over the period 2003-2014.

Keywords: high growth firms, firm growth, firm size and R&D

JEL classifications: L25, L26 and D24

1. Introduction

Sustainable economic growth and factors that induce economic growth have always been at the centre of the attraction of policy makers and researchers. Due to their important contribution to overall growth performance of economies, high growth firms (HGFs) are considered to be powerful engines of both employment and output growth. Due to their potential in creating job opportunities HGFs are particularly important for countries with high unemployment rates.

The main focus research on HGFs has been on the factors that initiated and promoted the growth performance of HGFs so as to understand the potential growth areas in the economy and accordingly develop public policy that would promote further growth.

However, one of the biggest drawback or at same time the merit of doing research in this area is the amount of controversy among different studies. As will be discussed in the proceeding parts of the article the most important drawback is that there is no general consensus on the definition and thus the measurement methods of HGFs. The merit on the other hand is that this

[1] EU Expert, Ministry of Agriculture and Forestry and part-time lecturer, Department of Economics, Middle East Technical University, Ankara, Turkey (fmutku@yahoo.com).

[2] Corresponding author. Department of Science and Technology Policy Studies, Graduate School of Social Sciences, Middle East Technical University, Ankara, Turkey (pamukcu@metu.edu.tr) .

situation provides us researchers an opportunity to further investigate HGFs and their determinants in different economic and institutional structures without any boundaries.

In this study we attempt to examine the characteristics and factors (such as, age, ownership, firm size, research and development, etc.) that stimulate HGFs in the manufacturing sector in Turkey during 2003-2014 period. Two surveys from Turkish Institute of Statistics (TurkStat) will be used in this study, namely; the Research and Development Survey (R&D) and Structural Business Survey (SBS). The paper is organized as follows. The second section will provide a brief literature survey and the third section will give background information on the Turkish manufacturing sector. The fourth section will provide the model, the data, provide and evaluate the empirical results and the final section will provide the concluding remarks.

2. Literature Review

Following the ground breaking study of Birch (1979), due to their ability to create new employment opportunities, firms with high growth levels have been seen as driving engines of economic growth. Birch (1979) in his study defines these firms as young, small fast-growing firms that create new employment opportunities.

But later, other studies have proven that the definition and determinants of firms with high growth levels varied from sector to sector and also from country to country. This in turn, has resulted in different definitions of firms with high growth levels. As has been highlighted by Parker et al. (2010) this led to a confusion and lack of commonly accepted denomination. For example, in some studies these firms are referred to as gazelles (Birch and Madoff, 1994)[3], HGFs (Schreyer, 2000), high-growth impact firms (Acs et al. 2008), fast-growth firms (Almus, 2002 and Storey, 1994,) and so on. Not surprisingly, these different denominations lead to different definitions and growth indicators to measure the performances of firms with high growth levels. For example, Acs et al. (2008) added revenue growth variable alongside employment and he referred to these firms that showed both revenue and employment growths were referred to as "high-impact firms" in order to distinguish them from gazelles. The major conclusion of Acs et al. (2008) is that in contrast to "gazelles" (Birch and Madoff, 1994) the high-impact firms are relatively old and rare and moreover contribute to the overall economic growth performance of countries. The most widely used indicators in the literature are sales, employment, capital stock and research and development (R&D) (Daunfeldt et al., 2013).

However, as Delmar and Davidsson (1998) emphasize, when measuring firm growth there are several factors that one must take into account. First the indicator of growth, secondly the measurement of growth, thirdly the period studied and finally the process of growth. The choice of the measurement (sales or employment) affects the selection of HGFs and whether growth is measured in relative or absolute terms does make a difference on the size of HGFs. Almus

[3] Birch and Madoff (1994) define gazelles as firms that "move between small and large quickly—at various times in either direction—and to classify them by their size is to miss their unique characteristics of great innovation and rapid job growth' (Birch and Madoff 1994: p.163).

(2002) and Daunfeldt et al. (2013) show that the selection of HGFs using different growth measures is primarily driven by whether high growth is measured as absolute or relative growth. In the literature the most popular method of measurement is using the combination of the two measurements, i.e. Birch index.[4] So, even though Brich (1979) had defined HGFs to be new established small firms majority of the studies confirm that the choice of measurement determines the size and the age of HGFs. In terms of the relationship between HGFs and size while some researchers did not find relationship between firm size and employment opportunities, some researchers, such as, Audretsch (2012) found that there was strong relationship between large firms and employment growth. There are very different methods used to define HGFs. These are utilizing variation in turnover (Birch, 1987), average employment growth rate (OECD, 1998) and growth of at least 100% in four years (Acs et al., 2007). There is also a diversity of approaches regarding the time period to analyze the growth performances of HFGs. As Delmar et al. (2003) and Acs and Mueller (2008) have demonstrated high growth is something that firms could not sustain for a very long time period.

Another important debated issue in the literature is on sectors that have the potential to promote HGFs. In general, policy makers have the tendency to view high-tech industries as generators of HGFs.[5] It seems that the main reason for this tendency is the belief that firms grow faster in this sector due to its comparatively higher R&D potential and capabilities (OECD, 2010) and there seems to be more start-ups (i.e. young firms) with exceptional growth performance in these sectors compared to other sectors. But in the literature there seems to be virtually no evidence to prove that HGFs are mainly in high-tech industries.[6] For example, while some researchers, such as Brown and Mason (2014), have found empirical evidence that supports the relationship between high technology industries and HGFs other researchers, such as Daunfeldt et al. (2015), have proven otherwise.

In the literature it is also argued that regions are important in the performances of HGFs (Acs and Mueller, 2008) due to spillovers generated by nearby firms for HGFs (Sena et al., 2013). So in sum, as can be seen from Table 1, there are contradictions concerning the size, age, industry, regional proximity, R&D involvement, and so on.

There are both merits and drawbacks arising from the contradictions that exists in the literature of HGFs. The most important drawback is that there is no general consensus on the definition and thus the measurement methods of HGFs. As Coad et al. (2014) underlines different growth indicators leads to the selection of different set of firms as HGFs. The merit on the other hand is that this situation provides us researchers an opportunity to further investigate HGFs and their determinants in different economic and institutional structures. However, it is important to note that the choice of growth indicator will influence the selection of firms and thus the result. For example, Daunfeldt et al. (2013) showed there are trade-offs between HGFs defined in terms of employment growth and productivity growth. Moreover, as has been underlined by Delmar

[4] Birch index is a growth index that measures the change in absolute and relative numbers of employees. (E_t-E_{t-k}) (E_t/E_{t-k}) where E_t is the number of employees in year t.
[5] See, Mason and Brown (2013) for more detail.
[6] See, Henrekson and Johansson (2010) for a thorough analysis.

et al. (2003) using employment growth presents resource growth whereas sales growth presents product (or service) sales in the market, i.e. market share.

Table 1. Some Studies on HGFs[7]

Author(s)	Findings
Acs and Mueller (2008)	Gazelles and regions are important for employment growth.
Arrighetti and Lasagni (2013)	HGFs are small firms and financial constraints and profitability are not associated with HGFs.
Birch (1979)	Small firms contribute to job generation.
Birch and Madoff (1994)	Small firms contribute to job generation and there is no link between HGFs and high tech industries.
Brown et al. (2017)	There is a clear mismatch between how policy makers perceive HGFs and what they are in reality
Coad et al. (2014)	Different growth indicators leads to the selection of different sets of firms; small number of HGFs create a large share of new jobs; HGFs tend to be young but are not necessarily small; HGFs are not more common in high-tech industries; high growth is not to be persistent over time; and difficult to predict which firms are going to grow.
Daunfeldt et al. (2016)	HGFs are overrepresented in knowledge-intensive service industries, such as, service industries with high share of human capital.
Henrekson and Johansson (2010)	Even though small firms are overrepresented among HGFs in general HGFs are of all sizes.
Keen and Etemad (2012)	HGFs are mainly small-sized and medium-sized enterprises.
Schreyer (2000)	HGFs are overrepresented in some of the medium tech-industries such as pharmaceutical, electronics, and rubber. The probability of a HGFs being in the service sector is significantly higher than manufacturing sector. R&D activities contribute to the growth performance of firms.
Sena et al. (2013)	Spillovers generated by nearby firms are important for HGFs.

Despite the controversy on the definition of HGFs there have also been attempts to establish a common definition. For example, as an attempt to bring a common definition OECD has

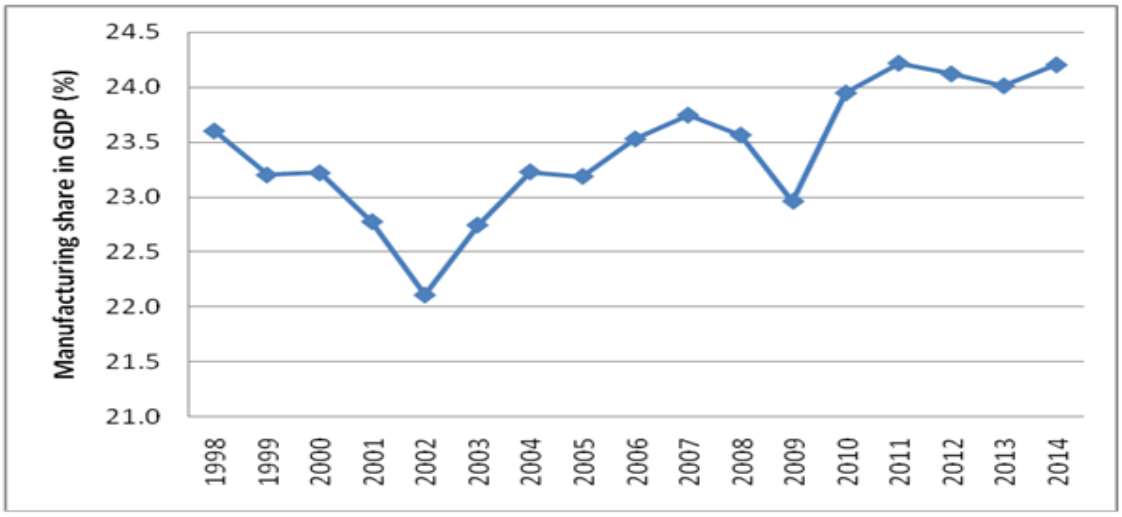
[7] It is important to note that there is an enourmous amount of research in this area and since our aim was to draw attention to conflicting results in this literature only few studies are presented in this table.

defined high-growth firms as "firms with 10 or more employees that have average annualized growth greater than 20 percent per year over a 3-year period, as measured by employment levels or employee turnover" (OECD, 2008: 61).

3. The Manufacturing Sector of Turkey

Manufacturing sector is one of the major drivers of the economic growth performance of Turkey. Factors such as geographical proximity to export markets, developed infrastructure and communications technology (ICTs), availability of young skilled human capital and a large domestic market contributes to the competitive strength of the manufacturing sector. The share of manufacturing sector in Gross Domestic Product (GDP) has been generally above 23% with the exception of crisis periods, such as 2001-2 and 2008-09. In 2014, the manufacturing sector accounted for 24.2% of total GDP (see Figure 1).

Figure 1. Share of Manufacturing Sector in GDP (%)



Source: Prepared by the authors using the information in www.tüik.gov.tr.

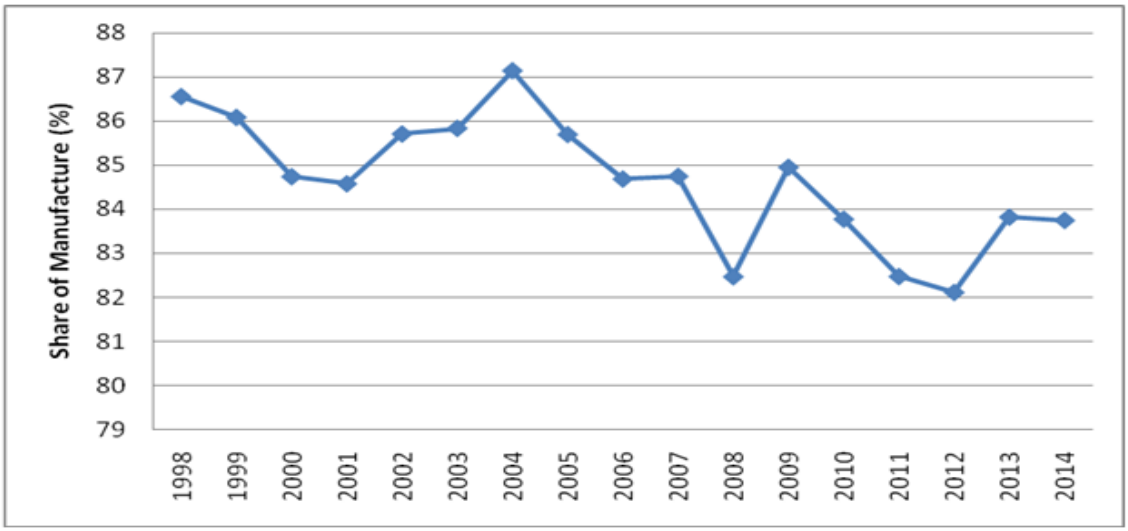
The manufacturing sector has the largest share in foreign trade. As can be seen from Figure 2 even though the share of manufacturing in total trade has slightly decreased from approximately 87% (1998) to 84% in 2014, its share is still very high. At this point it is important to note that in 2017 the share of manufacturing sector in total exports was 93.7% and 81.6% in total imports. Thus, this sector has been and still continues to be the main engine of the Turkish economy.

From 1996 onwards there has been substantial transformation in the sub-sectors of the manufacturing sectors.[8] The main cause of this transformation has been competition pressure coming from India and China. As a result of this pressure there has been a decrease in the share

[8] The manufacturing sector has transformed from low technology driven sectors to relatively higher technology driven sectors.

of garments, textile products and food sub-sectors in the manufacturing production while the share of automotive, machinery, home appliance goods, electronics, petroleum and rubber-plastic sub-sectors have considerably increased. However, garment and textile sub-sector is still important in the economy due to its high share in GDP, employment and exports. For example, Turkey was among the world's top ten exporters of garment and textile products in 2016. The share of this sub-sector in total exports was 19.3% in 2016.

Figure 2. Share of Manufacturing Sector in Foreign Trade (%)



Source: Prepared by the authors using the information in www.tüik.gov.tr.

The greatest increase has been in the automotive production. Turkey is the 14th biggest producer of motor vehicles in the world and 5th and in Europe. The electronics sub-sector with its intensive R&D efforts and export (market) oriented production has made it another important sub-sector its share in Turkey's exports was 6.5% in 2017. The machinery and equipment sub-sector is another sector that has continued its progress throughout the years. During the last 15 years, by adapting international manufacturing standards and using high quality inputs it has almost doubled its production and its share in Turkey's total export reached 6% in 2017 (Ministry of Trade, 2018).

However, even though the share of the manufacturing sector in foreign trade there is a crucial point that needs to be underlined. The sub-sectors of the manufacturing sector have high dependence on imported inputs, that is, the share of domestic inputs used during the production process is very low. So in actual fact one needs to be aware of this reality while praising the high share of the manufacturing sector in the total foreign trade.

4. Data, The Model and Empirical Results

4.1. The Data

Our data set is obtained by matching and merging the Structural Business Surveys (SBS) and the R&D Surveys of Turkish Institute of Statistics (Turkstat) from 2003 to 2014. The two surveys were matched at firm level for the 2003-2014 period.

There are basically two reasons for using this time period: first, the R&D survey starts from 2003 and secondly, TurkStat recently has started to compile the data on Structural Business from the administrative records (only available from 2009 to 2015) and it is impossible to merge it with the previous Structural Business Surveys. As can be seen from Table 2 our data set includes a total of 452,604 firms.

Table 2. Distribution of Firms by R&D and by Ownership

Year	R&D performers		State firms		Foreign firms		Total*
	Number	%	Number	%	Number	%	
2003	551	2	129	0.41	489	1.4	31381
2004	572	2	98	0.29	607	1.8	33723
2005	803	2	90	0.26	639	1.9	34558
2006	731	2	80	0.23	736	2.1	34431
2007	852	3	69	0.20	751	2.0	33703
2008	970	3	88	0.25	761	2.2	34660
2009	1140	3	80	0.21	764	1.9	37244
2010	1319	4	63	0.19	820	1.9	33890
2011	1458	4	61	0.15	939	2.0	41194
2012	1604	4	63	0.15	933	2.1	43281
2013	1593	3	152	0.32	1016	2.2	47024
2014	1623	4	150	0.33	1067	2.4	45316
Total	**13216**	**3**	1123	**0.25**	9522	**2.1**	452604

*the difference between state and foreign firms equals the number of domestic Private firns

Source: Prepared by the authors using the Structural Business Survey and the R&D Survey of TurkStat.

When we analyze our sample in terms of firms engaged in R&D activities and ownership, during the sample period, the total number of firms engaged in R&D activities have increased from 31,381 (2003) to 45,316 (2014). Out of 452,604 firms only 0.25% are public firms. The number of firms owned by foreigners have increased from 489 (2003) to 1067 (2014) and the share of foreign firms in total is approximately 2%. Even though the number of firms engaged in R&D activities have more than doubled from 551 (2003) to 1623 (2014) and the share of firms conducting R&D in total is 3% (Table 2).

In terms of percentage share of employees in total manufacturing employment (Table 3) with 33.3% textile and leather sector is the biggest sub sector followed by metal (10.8%), food (9.8%), machinery (8.7%), mineral (6.8%), transport and plastic (5.8%), paper and publishing (5.5%), electrical (4.3%), chemicals (3.1%), coke and petroleum (0.2%) and recycling (0.1%). When we look at the distribution of foreign firms, the largest concentration is in textile and leather (15%) followed by chemicals (13%), food (12%) and transport (12%). Similarly, with 34% textile and leather sub-sector has the highest share of domestic firms followed by metal (11%) and food (10%).

Table 3. Percentage Share of Employees in Sub-Sectors

Sectors	Domestic	Foreign	Total
Food	9.8	11.7	9.8
Textile and Leather	34.0	14.6	33.3
Paper and Publishing	5.6	4.9	5.5
Coke and Petroleum	0.1	0.4	0.2
Chemicals	2.7	12.8	3.1
Plastic	5.7	8.0	5.8
Mineral	6.8	5.9	6.8
Metal	10.9	9.5	10.8
Machinery	8.7	7.7	8.7
Electrical	4.2	7.7	4.3
Transport	5.6	11.6	5.8
Furniture	5.7	4.0	5.6
Recycling	0.1	0.1	0.1

Source: Prepared by the author using the Structural Business Survey and the R&D Survey of TurkStat.

Since size of firms are one of the most debated issues in the literature of HGFs we also wanted to analyze the firms in our data set in terms of firm size. In order to do so, we have used Eurostat's definition of firm size. Eurostat's groups firms as follows:

- Micro enterprises are firms with less than 10 employees
- Small enterprises are firms with 10-49 employees
- Medium-sized enterprises are firms with 50-249 employees
- Large enterprises are firms with 250 or more employees[9]

According to our sample majority of the firms in the manufacturing sector are small firms (43%) followed by micro firms (36%), medium firms (19%) and large firms (3.7%) (Table 4). The number of micro firms in total has decreased gradually from 47% (2003) to 29% (2014). In

[9] In addition to these classifications Eurostat also provided a classification of small and medium sized enterprises (SMEs), defined as firms with 1-249 persons employees.

contrast to micro firms the share of small firms in total has increased from 33% (2003) to 46% (2014).

As has been mentioned previously Delmar and Davidsson (1998) emphasize that when measuring firm growth one should attach importance to following issues: selection of the indicator of growth; choosing relative or absolute change as measurement of growth; the period studied; and the process of growth.

The widely use growth indicators in the literature are sales or employee. Daunfeldt et al. (2013) found that results did not seem to be sensitive to the selection between these two indicators, i.e. sales or number of employees. In our analysis we chose sales as the indicator of growth.

Table 4. Distribution of Firms in by Size

Year	Large		Medium		Micro		Small		Total
	Number	%	Number	%	Number	%	Number	%	
2003	1057	3	5396	17	14636	47	10292	33	31381
2004	1124	3	5588	17	14871	44	12140	36	33723
2005	1165	3	5622	16	13702	40	14069	41	34558
2006	1223	4	6165	18	12111	35	14932	43	34431
2007	1294	4	6441	19	11862	35	14106	42	33703
2008	1323	4	6793	20	12576	36	13968	40	34660
2009	1189	3	6265	17	16738	45	13052	35	37244
2010	1292	4	6888	20	12138	36	15771	47	36089
2011	1457	4	7691	19	13695	33	18351	45	41194
2012	1571	4	8387	19	12965	30	20358	47	43281
2013	1668	4	9018	19	14471	31	21867	47	47024
2014	1776	4	9739	21	13084	29	20717	46	45316
Total	**16139**	**4**	**83993**	**19**	**162849**	**36**	**189623**	**42**	**452604**

Source: Prepared by the authors using the Structural Business Survey and the R&D Survey of TurkStat.

Unlike the case in the selection of growth indicator the choice of measurement -relative or absolute terms – does change the result. Thus, in order to capturing absolute and relative value of the growth indicator and to reduce the impact for firm size on the growth indicator we used the Birch index. This index weights the absolute growth with relative growth to smooth out the probability of classifying either the large or the small firms as HGFs.

The Birch index is defined as:

$$(E_t - E_{t-k})(E_t / E_{t-k}) \quad (1)$$

where E_t is the number of employees in year t.

Since our indicator of growth is sales we will revise and use the index as follows:

$$(S_t - S_{t-k})(S_t / S_{t-k}) \quad (2)$$

where S_t is sales in year t.

The decision of selection of the time horizon to calculate growth rate is another issue that has not been resolved yet. This is due to nature of the growth process of firms, i.e. it is not a continuous process. Daunfeldt and Halvarsson (2014) have shown that smoothing the growth process over years to decrease the amount of statistical noise -resulting from the uneven growth trajectories of HGFs- is not a solution since majority of HGFs experience the high growth event in one year. However, in general three or four consecutive years have been used in majority of the studies and since our data set is between 2003-2014 we decided to divide our data into three periods, Period 1: 2003-2006, Period 2: 2007-2010 and Period 3: 2011-2014. This means that firms should have at least four consecutive sales data during periods to be included in the sample.

In terms of the process of growth there are internal and external factors that contribute to the growth process of firms. There are two types the internal (organic) and external (acquired) growth. Internal growth basically refers to new employment while external growth refers to increase in employment that arises as a result of mergers. In our data set we do not have information on whether the increase in the number of employees are due to internal or external growth so we are not in a position to make this type of distinction. Moreover, Spearot (2012) indicates that this distinction is not crucial since firms use decision process on both internal and external growth.

The main variables that are used in this study are growth of firm (G), size of the firm (S), human capital (H), capital stock (K) and R&D (RD).

Growth of firm (G) as explained above is calculated growth of firm (G) and is calculated using equation (2).

Size of the firm (S) is determined by using the number of employees that are working in the firm. In the literature there are varying results concerning the effects of this variable on the growth performances of firms therefore we do not have a priori expectations about this variable.

Human capital (H) is measured using the expenditure on employees which gives an indication on the total expenditures of the firm (in TL) on its human capital. The results in the literature indicates that investment in human capital increases the growth performances of firms therefore we expect a positive influence.

Capital stock (K) is measured using the gross total investment on machinery and equipment by the firm in TL. Similar to human capital we expect positive effect of this variable on the growth performance of the firm.

R&D (R) is measured using the R&D expenditure of the firm in TL. In terms of the risks it entails it is not so easy to predict the impact of R&D on the growth performances of the firms.

Table 5 provides the descriptive statistics of the variables used in the analysis and the following table (Table 6) presents the correlation matrix of the variables.

Table 5. Descriptive Statistics of the Variables

Variable	Observation	Mean	Std. Dev.	Min	Max
Growth	112689	15.41222	2.112782	2.4	34.96
Size	441405	57.43521	8.334	1	17229
Capital Stock	434669	660683.6	5.63E+00	0	241,000,0000
Presence	441405	5.879532	4.389906	1	13
Human Capital	434669	997494.7	7.806234	0	907,000,000
R&D	13216	1976049	6.60E+00	0	816,000,000

Table 6. Correlation Table

	Growth	$Growth_{n-1}$	Size	Capital Stock	Human Capital	Presence	R&D
Growth	1						
$Growth_{n-1}$	0.0067*	1					
Size	0.5923*	0.0016	1				
Capital Stock	0.3971*	0.004	0.6595*	1			
Human Capital	0.5852*	0.0039	0.9405*	0.6592*	1		
Presence	0.1607*	-0.0098*	0.7383*	0.4626*	0.6552*	1	
R&D	0.4978*	0.0368*	0.5154*	0.4593*	0.6040*	0.1289*	1

Note: * indicates 5% significance level.

4.2. The Model and Empirical Results

As indicated previously there are no common ground for either the definition of HGFs or the explanatory variables that helps us to understand the changes in growth of firms. Thus, we started our analysis with the specification used by Coad et al. (2009). So our base model is:

$$G_{i,t} = \alpha_0 + \alpha_1 G_{i,t-1} + \alpha_2 S_{i,t} \quad (3)$$

where Gi,t is the growth of firm i in year t, Gi,t-1 is growth of firm i at t-1 and Si,t is size of firm i at time t.

In this model the constant term (α_0) gives us the average growth rate The second term, α_1, shows the effect of previous years' growth performance. If $|\alpha_1| > 0$ this means that previous year's growth influences the growth performances of firms. Otherwise we can conclude that previous year's growth performance has no effect on firm's future growth. The last term α_2 gives us the effect of firm size. If $\alpha_2 = 0$ this means that size does not affect firm's growth performance; if

$\alpha_2 > 0$ this means that as firms size increases firm growth faster; and if $\alpha_2 < 0$ this means that small firms grow faster.

Then we will see the impact of other factors such as capital structure, human capital (measured as expenditure on employees), age and R&D first each in turn then all of them together to see their impact on the performances of firms in the manufacturing sector of Turkey. That is, we extend equation 1 and used the following models

$$G_{i,t} = \alpha_0 + \alpha_1 G_{i,t-1} + \alpha_2 S_{i,t} + \alpha_3 K_{i,t} \quad (4)$$

where $K_{i,t}$ is the capital stock of firm i in year t and rest of the variables are as defined before.

$$G_{i,t} = \alpha_0 + \alpha_1 G_{i,t-1} + \alpha_2 S_{i,t} + \alpha_3 P_{i,t} \quad (5)$$

where $P_{i,t}$ is presence (age) of firm i in year t and rest of the variables are as defined before.

$$G_{i,t} = \alpha_0 + \alpha_1 G_{i,t-1} + \alpha_2 S_{i,t} + \alpha_3 H_{i,t} \quad (6)$$

where $P_{i,t}$ is the human capital stock of firm i in year t and rest of the variables are as defined before.

$$G_{i,t} = \alpha_0 + \alpha_1 G_{i,t-1} + \alpha_2 S_{i,t} + \alpha_3 RD_{i,t} \quad (7)$$

where $P_{i,t}$ is the R&D expenditure of firm i in year t and rest of the variables are as defined before.

After analyzing the individual impacts of each variable on the growth performance of firms we also wanted to see how they influence the growth performance of the firm when they are introduced together as follows:

$$G_{i,t} = \alpha_0 + \alpha_1 G_{i,t-1} + \alpha_2 S_{i,t} + \alpha_3 K_{i,t} + \alpha_4 P_{i,t} + \alpha_5 H_{i,t} + \alpha_6 RD_{i,t} \quad (8)$$

where all of the variables are as defined before.

We then have transformed the above model in log-log form and then used te following stochastic forms in our empirical analysis:

$$\ln G_{i,t} = \alpha_0 + \alpha_1 \ln G_{i,t-1} + \alpha_2 \ln S_{i,t} + \alpha_3 \ln X_{i,t} + \varepsilon_{i,t} \quad (9)$$

where $\varepsilon_{i,t}$ is the disturbance term and all of the variables are as defined before but in log form and $X_{i,t}$ presents the factors mentioned in equations (4) –(7) for firm i in year t. Please note that for our final model pesented in equation (8) $X_{i,t}$ will become $\sum X_{i,t}$.

Then we estimated each model separately using fixed eand random effects panel data estimations methods. Apart from the difference in the values and signs of the coefficients the most interesting result between the fixed (Table 8) and random (Table 7) effects panel data estimations was that the presence of the firm had been omitted in fixed panel analysis. Nevertheless, based on both the results of the coefficients and Hausman test we selected the fixed effect robust estimated models which are presented in Table 7.

Table 7. Estimation results for all models, random effects panel analysis

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Log Growth	0.000*	0.000*	0.000*	0.000	0.000**	0.000**
Log Size	1.203***	1.098***	1.222***	0.457***	0.990***	0.335***
Log Capital Stock		0.070***				0.099***
Log Presence			-0.230***			-0.417***
Log Human Capital				0.617***		0.542***
Log R&D					0.150***	0.069***
Constant	10.400***	10.077***	10.841***	5.110***	9.833***	5.684***
Observations	82,249	54,367	82,249	81,813	6,694	5,711
Number of id	22,412	15,256	22,412	22,183	2,175	1,842

Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Table 8. Estimation results for all models, fixed effects panel analysis

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Log Growth	0.147***	0.170***	0.147***	0.137***	0.139***	0.122***
Log Size	1.098***	1.052***	1.098***	0.594***	1.007***	0.582***
Log Capital Stock		0.013*				0.046*
Log Presence			-			-
Log Human Capital				0.402***		0.338***
Log R&D					0.089***	0.075***
Constant	8.653***	8.402***	8.653***	5.435***	8.250***	5.122***

Observations	73,343	48,750	73,343	73,020	6,124	5,235
Number of id	21,152	14,430	21,152	20,975	2,075	1,758

Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

Model 1 is the benchmark model - specification used by Coad et al. (2009) and Models (2)-(5) gives us the estimation results when we introduce each variable separately to our benchmark model. Model (6) on the other hand presents the estimation result of our fully specified model, i.e. all explanatory variables of firm growth are introduced together to see their joint impact on growth rate of firms. With the exception of presence (Model 3) the coefficients that represent the endogenous growth ability of firms are statistically significant at conventional critical values and theoretically consistent. This result does not change whether the explanatory variables are introduced by themselves or all together (Table 8).

Since all of our models -with the exception of Model (3)- are both statistically significant and theoretically consistent we selected our fully specified model (Model (6)). That is, all of the explanatory variables increases the growth of the firm.

$$g_{i,t} = 5.122 + 0.122\ G_{i,t-1} + 0.582\ S_{i,t} + 0.046\ K_{i,t} + 0.338\ H_{i,t} + 0.075\ RD_{i,t} \qquad (10)$$

In terms of the effect of previous year's growth performance it is positive. This means that previous year's growth does influences the growth performances of firms in the manufacturing sector. Thus, a one percent increase in previous year's growth performance increases on average the firm's growth by 0.1%. The positive coefficient on the size of the firms ($\alpha_2 = 0.582$) indicates that as the size of the firms increases by firms grow faster, more specifically, a percentage increase in the size of the firm results in approximately .6% growth of firms, holding everything else constant. The variable that has the second highest impact on firm growth is human capital. A percentage increase in human capital results in approximately .3% growth. Interestingly R&D expenditure ($\alpha_5 = 0.075$) contributes more to a firm's growth performance compared to capital stock ($\alpha_3 = 0.04$).

Next we wanted to check whether these results would change when we analyze firms separately in terms of their size using Model 6 which is presented in Table 9.

Table 9. Estimation results of fixed panel analysis for different firm size

	Large	Medium	Small	Micro
Log $Growth_{n-1}$	0.186***	0.052	0.050	-0.138**
Log Size	0.549***	0.870***	1.306**	0.600**

Log Capital Stock	0.057	0.033	-0.091	0.189*
Log Presence	-	-	-	-
Log Human Capital	0.355***	0.308***	0.390*	0.402***
Log R&D	0.064*	0.097**	0.032	
Constant	3.727***	5.346***	5.268**	5.435***
Observations	2,237	2,220	775	1,057
Number of id	622	925	421	644

Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

The most interesting result is that while the previous year's growth performance has had a negative effect on micro firms the same variable has positively contributed to the growth performances of large in the Turkish manufacturing during the 2003-2014 period. Capital stock seems to have a positive but statistically insignificant effect for large and medium firms and negative in case of small firms. In terms of R&D it has positive statistically significant effect for large, medium and positive but statistically insignificant effect for small firms. R&D does not seem to be relevant in the case of micro firms. Size and human capital seems to be the main variables that affect the growth performances of all types of firms in the Turkish manufacturing sector.

The overall results on the high growth firms in the manufacturing sector, seems to support the arguments that size, human capital, capital stock, R&D and presence of the firms in the industry contributes to the growth of these firms. Furthermore, as has been suggested by Audretsch (2012) larger firms in the manufacturing sector of Turkey seem to have higher potential for growth compared to other firms.

5. Conclusion

This study has examined the characteristics of HGFs and tried to identify factors that stimulate HGFs in the Turkish manufacturing sector using firm level data during 2003-2014.

The results of our analysis on the determinants of firm growth are largely in line with the existing literature and thus with our expectations. One important insight that we have observed from our empirical analysis is that, all else equal, size seems to influence the growth performance of firms much stronger compared to the other factors. At the same time, we found that the previous growth performance of the firms (at sector level) also significantly influenced the future growth potential of the firms. But the same analysis on firm types suggested that only the large firms seemed to be affected by previous growth levels. This contradicts the results of Brich (1979) who argues that high growth was more dependent on being small sized firm.

Another important result of our empirical analysis is that HGFs tend to have more highly educated and trained human capital that contributes to its growth performance.

There are mainly two policy implications that this study suggests to policy makers. In encouraging high growth of firms in the manufacturing sector the first implication policy makers should take into account is the importance of differences in firm-specific factors (i.e. size). For the firms in the Turkish manufacturing sector it seems that large firms have higher growth potential. Thus, a thorough analysis should be conducted to find the obstacles that prevent medium, small and micro sized firms from accomplishing high growth levels. The second implication is that human capital among other factors seems to have the highest contribution to the growth performance of all types of firms. Thus, policy makers should invest in public measures that would increase the capabilities of human capital in the manufacturing sector of Turkey.

The main limitation of this study is that it is concerned with the analysis of HGFs in the overall manufacturing sector. Hence, future studies should analyze the performance of HGFs in sub-sectors to see whether the results differentiate between high-tech and non-high-tech manufacturing sectors. Another future research avenue could include the analysis of HGFs in terms of ownership (foreign and domestic) and foreign trade.

References

Acs, Z., Parsons, W., Tracy, S. (2008). High-impact firms: Gazelles revisited. United States. Small Business Administration. Office of Advocacy. No. 328.

Acs, Z. J. and Mueller, P. (2008). 'Employment effects of business dynamics: mice, gazelles and elephants,' Small Business Economics, 30, 85–100.

Almus, M. (2002). "What characterizes a fast-growing firm?" Applied Economics, 34 (12), 1497–1508.

Audretsch, D. (2012). "Determinants of High-growth Entrepreneurship." Report prepared for the OECD/DBA International Workshop on "High-growth firms: local policies and local determinants", Copenhagen, March 28.

Birch, D. L. (1979). The job generation process. Cambridge, Massachusetts Institute of Technology.

Birch, D. L, Madoff, J. (1994). "Gazelles", in: Solmon LC, Levenson AR (eds) Labor markets, employment policy, and job creation. Westview Press, Boulder

Brown, R., and Mawson, S. (2013). "Trigger Points and High-growth Firms." Journal of Small Business and Enterprise Development 20 (2): 279–295.

Brown, R., and Mason, C. (2014). "Inside the High-tech Black Box: A Critique of Technology Entrepreneurship Policy." Technovation 34: 773–784.

Coad, A. (2007). "A Closer Look at Serial Growth Rate Correlation." Review of Industrial Organization 31: 69–82.

Coad, A. (2009), The Growth of Firms: A Survey of Theories and Empirical Evidence. Edward Elgar: Cheltenham, UK.

Coad, A., Frankish, J., Roberts, R. G. and Storey,D. J. (2013). "Growth Paths and Survival Chances: An Application of Gambler's Ruin Theory." Journal of Business Venturing 28 (5): 615–632.

Coad, A., Daunfeldt, S.-O., Holzl, W., Johansson, D., and Nightingale, P. (2014). "High-growth Firms: Introduction to the Special Section." Industrial and Corporate Change 23: 91–112.

Dalton, S., Friesenhahn, E., Spletzer, J., and Talan, D. (2011). "Employment growth by size class: comparing firm and establishment data," Monthly Labor Review, December 2011, pp. 3–12,

Daunfeldt, S.-O., Elert N. and Johansson D. (2013). 'The economic contribution of highgrowth firms: do policy implications depend on the choice of growth indicator?' Journal of Industry, Competition and Trade.

Daunfeldt, S. O., Elert N., and Johansson D. (2014). "The Economic Contribution of High-growth Firms: Do Policy Implications Depend on the Choice of Growth Indicator?" Journal of Industry, Competition and Trade 14: 337–365.

Daunfeldt, S. O., Elert N., and Johansson D. (2015). "Are High-growth Firms Overrepresented in High-tech Industries?" Industrial and Corporate Change: dtv035.

Daunfeldt, S. and Halvarsson, D. (2014). Are High-Growth Firms One-Hit Wonders? Evidence from Sweden, Small Business Economics, 44(2). 10.1007/s11187-014-9599-8.

Davidsson, P., and Delmar F. (1997). "High-Growth Firms: Characteristics, Job Contribution, and Method Observations", Paper Presented at the RENT XI Conference. Germany: Mannheim.

Delmar, F. and Davidsson P. (1998). "A taxonomy of high-growth firms" in P. D. Reynolds and W. D. Bygrave (eds), Frontiers of Entrepreneurship Research. Babson College: Wellesley, MA, pp. 399–413.

Delmar, F., Davidsson P. and Gartner W. B. (2003). "Arriving at the high-growth firm" Journal of Business Venturing, 18(2), 189–216.

Garnsey, E., Stam E., and Heffernan P. (2006). "New Firm Growth: Exploring Processes and Paths." Industry and Innovation 13, 1–20.

Henrekson, M., and Johansson, D. (2010). "Gazelles as job creators: A survey and interpretation of the evidence", Small Business Economics, 35, 227–244.

Keen, C. and Etemad H. (2012). "Rapid growth and rapid internationalization: the case of smaller enterprises from Canada", Managing Decisions, 50(4), 569–590.

Mason, C. and Brown R. (2013). "Creating good public policy to support high-growth firms" Small Business Economics, 40(2), 211–225.

Mason, C., Brown R., Hart M., and Anyadike-Danes M. (2015). "High Growth Firms, Jobs and Peripheral Regions: The Case of Scotland", Cambridge Journal of Regions, Economy and Society, 8 (2), 359–377.

Ministry of Trade (2018). "Turkey: Discover the Potential", Republic of Turkey Ministry of Trade.

OECD (2008). Measuring Entrepreneurship: A Digest of Indicators, Paris: OECD-Eurostat Entrepreneurship Indicators Program, OECD.

OECD (2010). High-growth Enterprises: What Governments Can Do to Make a Difference, OECD: Paris, France.

Parker, S. C., Storey D. J., and Witteloostuijn A. V. (2010). "What Happens to Gazelles? The Importance of Dynamic Management Strategy", Small Business Economics, 35, 203–226.

Segarra, A., and Teruel M. (2014). "High-growth Firms and Innovation: An Empirical Analysis for Spanish Firms", Small Business Economics, 43 (4), 805–821.

Sena V, Hart M. and Bonner K. (2013). "Innovation and UK high-growth firms", Nesta Working Paper 13/12.

Senderovitz, M., Klyver K., and Steffens P. (2015). "Four Years on: Are the Gazelles Still Running? A Longitudinal Study of Firm Performance after a Period of Rapid Growth", International Small Business Journal.

Schreyer, P. (2000). "High-growth Firms and Employment", OECD Science, Technology and Industry Working Papers, 2000/3, Paris

Spearot, I. C. (2012). "Firm heterogeneity, new investment and acquisitions", Journal of Industrial Economics, 60(1), 1–45.

Storey, D. J. (1994). Understanding the small business sector, London: Routledge.