ECONOMICS OF INNOVATION IN HIGH GROWTH FIRMS THROUGH ANALYSES OF MANUFACTURING SECTOR IN TURKEY

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Abstract

High-growth firms (HGF) are given importance due to their potential to create new employment in the economy. Studies have been carried out to find the factors affecting HGFs, but these factors have not been found clearly. The purpose of this study is to examine the impact of innovative activities on HGFs in the Turkish manufacturing industry, using the data set between 2006 and 2020. While doing this, companies that were able to become HGF and those that were not were compared according to the increase in the number of employees, and the factors that had an impact on the growth of the companies were examined. **Keywords:** high growth firms, firm growth and R&D

Özet

Hızlı büyüyen firmalara (HGF), ekonomide yeni istihdam yaratma potansiyelleri nedeniyle önem verilmektedir. HGF'leri etkileyen faktörleri bulmak için çalışmalar yapılmış ancak bu faktörler net olarak bulunamamıştır. Bu çalışmanın amacı, Türk imalat sanayinde yenilikçi faaliyetlerin HGF'ler üzerindeki etkisini 2006-2020 yılları arasındaki veri setini kullanarak incelemektir. Bunu yaparken HGF olabilen ve olamayan firmalar, çalışan sayısındaki artış ve şirketlerin büyümesine etki eden faktörler incelendi. **Anahtar Kelimeler:** hızlı büyüyen firmalar, firma büyümesi ve Ar-Ge

Introduction

The study was created to create a perspective on the growth dynamics of companies in the Turkish Manufacturing sector, what will cause growth and the innovative aspects of these factors. As will be explained in detail in the following sections, the manufacturing sector is of great importance for Turkey. Based on this, examining which activities make companies grow is one of the main purposes of this study. In addition, the study divides the companies in its sample into two according to the change in their employment (High Growth Firms and Non-High Growth Firms). The growth components of the companies in these two samples were also examined descriptively in the preliminary stage of the study.

The dynamism of HGFs is important in many respects. In general, there is the possibility of job creation because it creates employment growth. High growth firms can dominate the sector's high-tech innovations and, according to many studies, are generally composed of young firms. For this reason, the perception that R&D activities are high and that they can gain export power in international markets is common. The study will review these perceptions and show that HGFs have different dynamics among themselves on a firm-by-firm basis. Understanding HGF dynamics and innovative infrastructures is also of great importance in terms of policymaking. However, these infrastructures will differ on a sectoral and regional basis.

The manufacturing sector is one of the sectors with a high return on GDP in Turkey. In addition, according to Pamukçu et al (2020), the share of the manufacturing sector in foreign trade percentage is quite high in Turkey. For example, in 2014, the share of the manufacturing sector in Turkey's foreign trade was 84%, and in 2016 Turkey was one of the top 10 exporters of clothing and textile goods worldwide (Pamukçu et al., 2020)

We think that the innovative effects of these sector dynamics, which are important in the Turkish region, are important for examining the HGF and growth dynamics. In addition, it is also important to examine the elements of growth in a sector with a significant share. Examination of HGF samples constitutes the descriptive part of the study. In addition, the study has an aspect that examines what affects growth, both in terms of employee number growth and revenue growth.

Investigating the dynamics and growth components and innovative effects of high growth firms is important for finalizing policy making. Steps taken for macroeconomic recovery should be evaluated based on these perspectives.

Literature Review

Audretsch et al.(2014) states that although the majority of the studies on the role of the innovation of hight growth firms find a positive relationship between innovation and firm growth, the complex structure of R&D studies, the diversity of growth structures and innovation strategies, requires a more versatile study on innovation and firm growth. Audretsch et al.(2014) as cited by Coad and Rao (2008), the positive effects of innovation activities can be seen mostly on high growth firms, while for others it can be negative. Similarly, in this article, it is expected that high growth firms will have high R&D activities and have a positive relationship with innovation.

According to Dalgıç et al.(2021), the theoretical literature on the relationship between innovation and firm growth shows that innovation provides firms a comparative advantage by transforming new knowledge into more market share, but empirical studies have little success in showing the strong relationship between firm growth and innovation. Also, they state that the number of literature is increasing suggesting the contribution of HGF's to job creation is proportionally large even though they constitute a minority. Moreover, because innovating firms among the high growth firms are the main factors of technological advancement, they are important. Dalgıç et al.(2021) shows that HGFs gains from innovative activities regardless of the type of innovation in Turkey.

Coad and Rao (2008) states that a firm, on average, experiences only simple growth, and there may or may not be innovative activity among the various triggers of growth. Although the relationship between innovation and sales growth varies, theoretical studies on firm growth show that innovation is a very important factor for firms that want to expand their market shares. Coad and Rao(2008) as cited by Hay and Kamshad (1994), it is seen in many studies that the most used method for firm growth in small and medium-sized enterprises (SMEs) is investment in product innovation, and this is valid in various industries. However, there are few empirical studies that find a strong link between innovation and sales growth. This is because innovative activities may increase the probability of better performance, but do not guarantee it.

According to Altuntaş et al. (2018), in order to take part in the competition in today's world and reach new markets, firms in the manufacturing sector need to increase their performance by acquiring new techniques. Altuntaş et al.(2018) as cited by Moyano-Fuentes et al. (2016), many manufacturing firms achieve their competitiveness by investing in advanced manufacturing technology (AMT) and increasing firm performance, innovation activities and exports. They underline that the use of AMTs in the manufacturing sector significantly increases the competitiveness of the firm by increasing the production speed, reducing the number of defective products produced and increasing the number of products produced. AMT mentioned here refers to various technologies, such as computer-aided design and manufacturing, which can also lead to innovation activities. Moreover, use of technology is an important factor of the number of innovation activities of a firm and affect the export performance of a firm directly. Also, innovation can increase a firm's exports because innovations in production, products, marketing and organization can make the produced product more attractive to customers abroad. Likewise, in this article, it is expected that innovative activites and exports have a positive relationship.

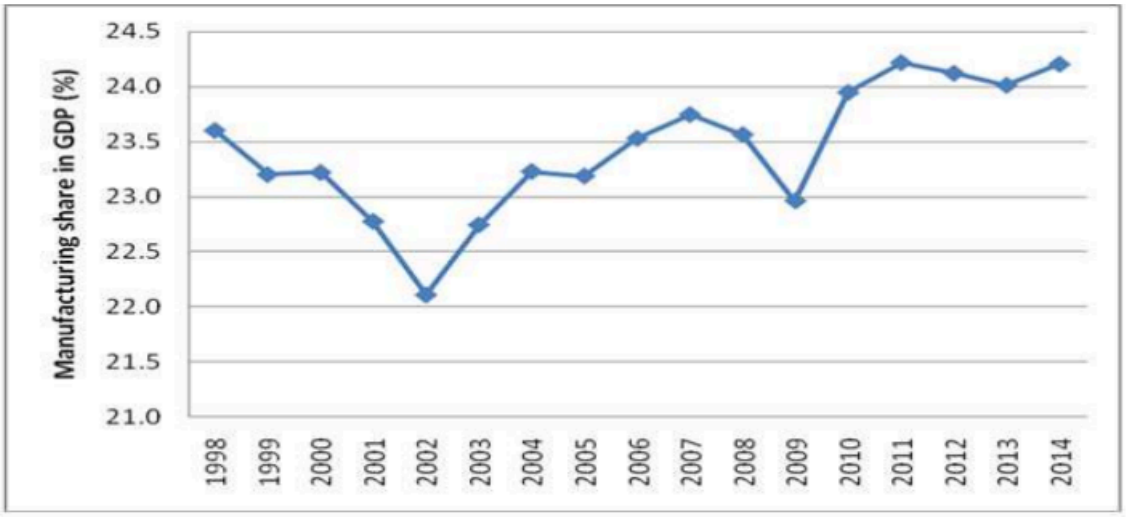
Moreno et al.(2015) states that innovation plays an important and positive role in high growth. Also, HGFs are often more likely to be innovative than non-HGFs. Moreover, as innovative activities have a positive relationship with the high growth of firms, its positive relationship with exports increases the chance of high growth. However, this relationship also depends on the state of the international market and the resources the firm needs to reach markets abroad, so the role of exports in high growth firms may vary in different countries.

Almus (2002) states that very few firms that significantly increase their employment over time form the basis of the job creation mechanism and that the employment growth experienced in most firms is either small positive or negative, or stagnates over time.

Karabulut (2015) claims that different types of innovation have a positive impact on growth performance. These innovations have the potential to positively affect financial outcomes. Karabulut (2015) concludes that Turkish manufacturing firms also innovate in order to increase their financial output and internal dynamics. Our research begins with the hypothesis that firms in the fast-growing manufacturing sector carry out innovative work in Turkey.

Pamukçu et al. (2020) emphasizes the high share of the manufacturing sector in GDP in Turkey. As seen in the chart below, although the share of the Turkish manufacturing sector in GDP fluctuated between 1998 and 2014, it had a high performance. This large share of GDP

was the drivers for starting this research, as this sector has the most significant share of innovative activities among all sectors. Although there was a decrease during the crisis years, the share of the manufacturing sector in GDP started from 23.5% in 1998 and increased to 24% in 2014, the last year covered by this research. Examining the dynamics of innovative activities in this field is important to draw a general perspective, since it is the sector that Turkey dominates the most.



Share of Manufacturing Sector in Turkish GDP (%) (Pamukçu et al., 2020)

Pamukçu et al. (2020) argue that one of the main factors in the growth performance of high growth firms is human capital and emphasizes that this factor is similar in all firm sizes except micro-level firms. Besides, Pamukçu et al. (2020) emphasize that the impact of growth factors varies according to firm size. For example, while R&D activities have a positive impact on the growth of large-scale firms, they have a negative impact on the growth of medium and small-sized firms. Based on this hypothesis, innovative effects may differ based on firm size.

Uzun (2000), in his research conducted with a sample of 2100 firms in the Turkish manufacturing sector between 1995 and 1997, finds that firms with high employment rates are more active in innovation activities. This finding is a hypothesis that will shed light on the participation in innovative activities of Turkish manufacturing sector firms that are subject to the OECD high growth firm definition, which depends on the change in the number of employees. In addition, Uzun (2000) observed that in most of the sample firms he used in 1995-1997, more than half of the total sales were from products with new technology. The author interprets this as one of the key elements in Turkey's industrial development, relying

on technology transfer. However, we do not expect this rate to be this high, especially due to the rapid development of technology in recent years and Turkey's lack of resources.

Taymaz et. al (2003) received responses on a sample survey from 2200 firms, which he classified according to size category. It has been determined that the aggregate innovation rate of these firms affiliated with the Turkish manufacturing sector is 23% and this level is well below the EU level. In addition to this research, Taymaz et al (2003) listed the descriptive statistics of firms in the Turkish manufacturing sector in the table below. The table lists the firms in the entire sample in the provincial column, the second column lists the firms reporting product or process innovation, and the last column lists the firms without innovation.

Table 1
Variable definitions and descriptive statistics

Label	Definition	All firms	Innovators	Non-innovators
EXPINT	Export/sales ratio	0.129	0.166	0.118
PRODUCT	Product innovator	0.149	0.649	0.000
PROCESS	Process innovator	0.182	0.790	0.000
INNOVATOR	Innovator	0.230	1.000	0.000
RDINT	RD expenditures/sales ratio (10^2)	0.176	0.742	0.007
RDGINN	Regional innovation intensity	0.332	0.372	0.320
SIZE	Number of employees	114	198	89
CAPINT	(ln) depreciation allowances per employee	−0.254	0.462	−0.502
TECHTRAN	Technology transfer dummy	0.038	0.076	0.026
WAGE	(ln) Real wage rate	1.952	2.501	1.764
PUBLIC	Share of public ownership	0.054	0.036	0.060
PRIVATE	Share of private ownership	0.931	0.936	0.929
FOREIGN	Share of foreign ownership	0.015	0.028	0.011
ADVERINT	Advertisement expenditures/sales ratio	0.005	0.009	0.004
SUBINPUT	Subcontracted output/sales ratio	0.042	0.036	0.045
SUBOUT	Subcontracted input/inputs ratio	0.063	0.042	0.071
ADMINSH	Share of administrative personnel	0.202	0.212	0.199
TECHSH	Share of technical personnel	0.066	0.069	0.064
FEMALESH	Share of female personnel	0.216	0.164	0.234

Source: EXPINT, PRODUCT, PROCESS, INNOVATOR, RDINT, REGINN and SIZE from SIS, Innovation; Survey, 1995–1997. Other variables, SIS, Annual Survey of Manufacturers, 1995–1997.
Note: Weighted means.

Variable definitions and descriptive statistics (Taymaz et al.,2003)

According to this table, the export/sales ratio of innovative firms in the Turkish manufacturing sector is higher than both the total sample and those that are not innovators. At the same time, firm size and innovation are directly proportional. In other words, the size of innovative firms is greater than that of non-innovators. These are the findings of a study conducted on a sample of the Turkish manufacturing sector. However, contrary to all these firm size inferences, Sagara et al. (2016) argue that the relationship between firm size and being high-growth is inversely proportional. According to this view, the larger the firm, the lower the probability of that firm being HGF. However, it is argued that the export rates of small and medium-sized firms that benefit from the opportunity to become HGF are low, as another result of this study.

In other words, although there is a directly proportional relationship between a firm being innovative and its size being innovative, a direct proportion is not observed with being HGF. While the potential of small and medium-sized firms to become HGFs is higher, the export potential of these HGFs is also lower.

H1: The R&D activities of HGFs are high.

H2: HGFs gain from innovative activities.

H3: Innovation and exports have a positive relationship.

H4: Employment growth experienced in most HGFs is either small positive, negative or stagnates over time.

H5: Firms with high employment rates are more active in innovation activities.

Authors, Date	**Main Findings**
Audretsch, Coad and Segarra, 2014	There is a positive effect of innovation activities on high growth firms.
Dalgıç and Fazlıoğlu, 2021	HGFs gain from innovative activities regardless of the type of innovation in Turkey
Altuntaş, Çınar and Kaynak, 2018	Innovation may increase firm's exports by increasing their competitiveness in foreign markets.
Moreno, Fabiana and Coad, 2015	Innovative activities have a positive effect on HGFs and exports, while this relationship also depends on the state of the international market and the resources the firm needs to reach markets abroad.
Almus, 2002	Employment growth experienced in most HGFs is either small positive or negative, or stagnates over time.
Karabulut, 2015	HGFs in manufacturing sector carry out innovative activites and Turkish manufacturing firms make innovation to increase their financial output and internal dynamics.
Pamukçu and Utku-ismihan, 2020	While R&D activities have a positive impact on the growth of large-scale firms, they have a negative impact on the growth of medium and small-sized firms.

Uzun, 2000	Firms with high employment rates are more active in innovation activites. Most of the total sales of the firms in the manufacturing sector comes from the products with new technology.
Taymaz and Özçelik, 2003	The size of innovative firms is bigger than that of non-innovators while this makes the probability of the firm being HGF lower.

The table above is a compilation of literature that points out that growth factors have a positive relationship with innovative dynamics and R&D investments. At the same time, innovative activities and R&D investments not only affect growth directly, but also cause growth indirectly by affecting the components that affect growth. For instance, unlike the employment growth and revenue growth examined in the study, it is expected to indirectly affect revenue growth by affecting components of revenue. However, the study only addressed R&D expenditures from the perspective of innovative activities. (due to the given dataset) This has caused innovative activities to be interpreted from a narrow perspective. Furthermore, employment growth is not high even in HGFs. As a result, there is a growth limit, and this is directly proportional to our findings. It is a natural consequence that firms grow rapidly up to a certain point in their growth limit and stagnate somewhere.

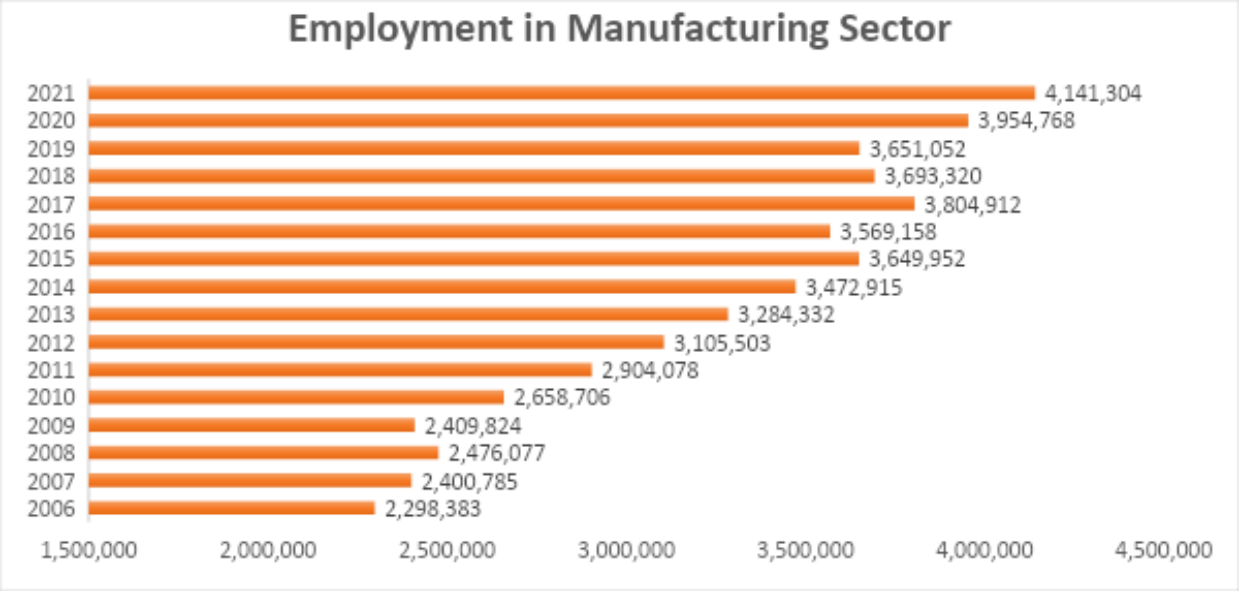
From this literature, the factors affecting the growth of the firm draw attention as employment growth, revenue change and indirectly changing revenue, which are constitute the hypothesis of this study. We expect R&D to directly affect firm growth. Although R&D effects vary depending on firm size, it generally has an important place among growth factors according to the literature. For this reason, it is another issue that should be examined when examining innovative effects on the firm.

Overview of the Turkish Manufacturing Sector

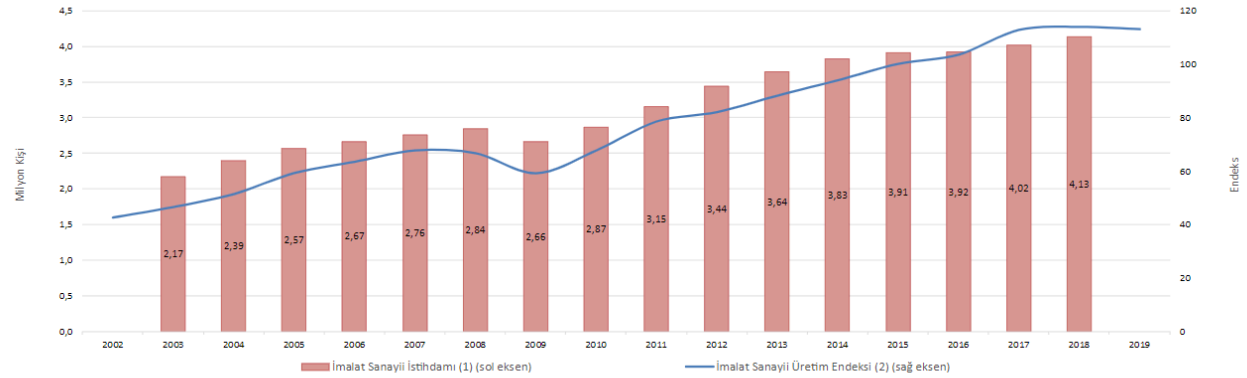
Before examining the micro-level firm findings in the study, it is important to define the manufacturing sector in Turkey and explain it in a general perspective. As mentioned in the introduction of the study, the manufacturing industry in Turkey has a large share in both GDP and foreign trade. Using the 2019 TURKSTAT General Trade System data in the report they published in 2020, the Presidency Strategy and Budget published the information that the export-import coverage ratio in the manufacturing industry increased from 90.6% in 2018 to

105.6% in 2019. In the same report, it was emphasized that the share of manufacturing industry added value in GDP reached 17.1% in 2018.

Additionally, the manufacturing sector in Turkey employs a significant labor force. The labor perspective of the sector data submitted by the Ministry of Industry and Technology Entrepreneurship Information System (EIS) in line with our study is summarized in the graph below. The graph summarizes the numbers of employees in the Turkish manufacturing sector from 2006 to 2021. In this projection, it is possible to observe that the number of employees is in an increasing trend. Besides, Presidency Strategy and Budget emphasized the labor force and production index in the manufacturing sector in the 2020 report. The number of employees in this chart and the number of employees we report through EIS are compatible. In addition to labor force, it is possible to say in the report that the production index has an increasing trend in proportion to the number of employees.



Labor force from EIS



(1) TÜİK, NACE Rev.2 Sınıflamasına Göre Çalışan Sayısı
(2) TÜİK, NACE Rev.2 Sınıflamasına Göre Sanayi Üretim Endeksi (2015=100), Arındırılmamış

Presidency Strategy and Budget Report, 2020

As can be seen from these two graphs, the Turkish manufacturing sector is a sector that is prone to show growth characteristics in terms of employment due to the increasing labor force. We shared the micro-level reflection of the growth of this sector in the following sections. Besides, it is important to examine R&D and other components examined in this study, both at the sector level and micro level, in the increase in production index and labor force basis. In the Medium-Term National Plan (2021-2023), it was emphasized that the manufacturing sector and strengthening the human and physical infrastructure for these sectors should be prioritized in areas such as R&D, digitalization and human resources. For this reason, examining the dynamics and growth elements of firms in the Turkish manufacturing sector creates a general projection to understand the applicability of policies from a macroeconomic perspective.

Data & Methodology

This study examines the innovative features of High Growth Firms (HGF) in the Turkish manufacturing sector. The classification of HGFs is based on the OECD definition. According to OECD (2010), HGF is defined depending on the change in the number of employees in

businesses with more than 10 employees. The calculation should be in the form of $\left(\frac{E_t}{E_{t-3}}\right)^{1/3} - 1$. In the formulation E_t represents the number of employees in the current year and E_{t-3} represents the number of employees in time t-3. Firms with a rate of growth higher than 0.20 are classified as HGF (OECD,2010). HGFs, can also be classified with indexes such as assets, sales, etc. Brich (1979) defines newly established and smaller-scale firms as HGF. However, according to most studies, the size and age of HGFs should be the main sources of measurement. Audretsch (2012) argues that firm growth is positively correlated with employment growth. For this reason, this study will examine the HGF classification through employment.

	Number of R&D surveys		**Empirical Data**[1]	
Year	**High Growth Firms**	**Other Firms**	**High Growth Firms**	**Other Firms**
2009	150	1173	2639	32358
2010	211	1298	3374	33992
2011	243	1409	4228	37108
2012	262	1489	4576	40558
2013	203	1479	4310	42246
2014	208	1548	4059	44375
2015	179	1505	3399	45761
2016	154	1601	2758	45634
2017	125	1674	2512	46000
2018	157	1744	2527	46034
2019	161	1760	2465	44207
2020	141	1648	2588	46961
Total	**2194**	**18328**	**39435**	**505234**

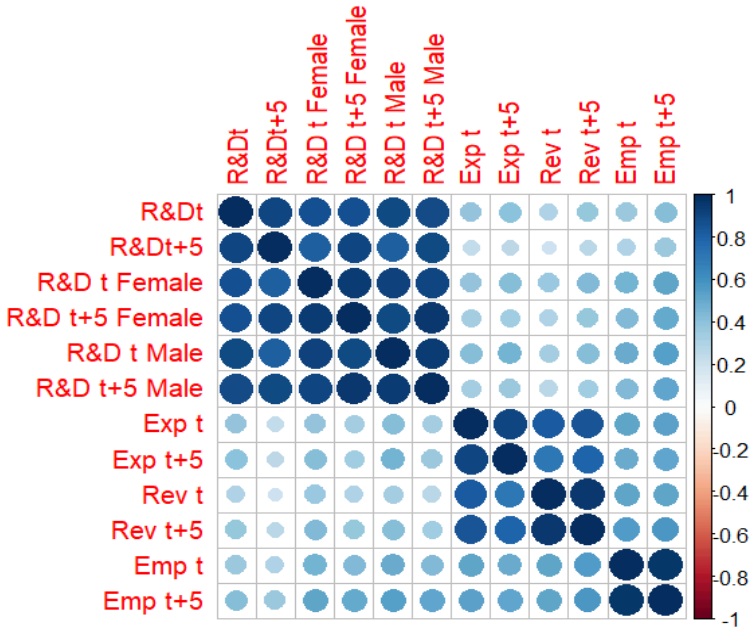
[1] Specifies the number of observations used for cases excluded from R&D surveys. In cases where R&D expenditures were not examined, analysis was made with this number of observations.

Our data set was prepared with data collected from firms at micro level from the Turkish Statistical Institute (TURKSTAT). A data set was created from micro-level data of all firms in the Turkish Manufacturing Sector between 2006 and 2020 through TURKSTAT. The descriptive part of the study divides the data set into two and examines the firms that are high-growth firms and the firms that are outside this sample. The classification of firms showing HGF features is explained in the beginning of this section. By comparing the non-HGF sample with the firms that showed HGF feature in TURKSTAT micro data, the dynamics of the firms that showed growth feature were explained. Since R&D surveys have fewer observations than other data, firms that did not participate in R&D surveys were also included in descriptive analyzes in which R&D expenditures were not examined. In this way, it was aimed to increase the number of observations.In addition, all descriptive explanations in the study were calculated in real terms and some analyzes divided into subsamples according to firm size.

It can be said that R&D activities have long-term effects and are an important factor for HGFs. We think it is important to examine the effects of long-term R&D expenditures on company growth. However, it is also a fact that there are other variables, both short-term and long-term, on the growth of the company. We argue that firms' export revenues also have a positive relationship with their growth, and we think that it is important to examine the short-term and long-term effects of these revenues. To examine both time-dependent and time-independent variables together thus looking at the factors affecting the growth of companies, panel regression was used. To apply panel regression, a separate subsample was created with 5-year data from all firms in the manufacturing sector. In this way, the number of observations can be increased by using all companies participating in the R&D survey, instead of using companies with more than 10 employees, which is required by the definition used by the OECD. Consequently, panel regression was applied in this study to observe the firms' time-dependent impacts. We selected the fixed effects model in panel regression while deciding between the random and fixed impact models.

The correlations between the panel regression models explaining growth are listed in the table below.

Correlation Plot



Correlation Table

	R&Dt	R&Dt+5	R&D t Female	R&D t+5 Female	R&D t Male	R&D t+5 Male	Exp t	Exp t+5	Rev t	Rev t+5	Emp t	Emp t+5
R&Dt	1,00	0,90	0,86	0,87	0,90	0,89	0,38	0,40	0,29	0,37	0,37	0,42
R&Dt+5	0,90	1,00	0,82	0,90	0,81	0,90	0,24	0,26	0,19	0,26	0,30	0,37
R&D t Female	0,86	0,82	1,00	0,94	0,92	0,90	0,39	0,42	0,36	0,43	0,47	0,52
R&D t+5 Female	0,87	0,90	0,94	1,00	0,89	0,96	0,33	0,35	0,30	0,37	0,44	0,51
R&D t Male	0,90	0,81	0,92	0,89	1,00	0,95	0,43	0,46	0,34	0,42	0,49	0,55
R&D t+5 Male	0,89	0,90	0,90	0,96	0,95	1,00	0,34	0,37	0,27	0,35	0,44	0,52
Exp t	0,38	0,24	0,39	0,33	0,43	0,34	1,00	0,90	0,82	0,85	0,53	0,53
Exp t+5	0,40	0,26	0,42	0,35	0,46	0,37	0,90	1,00	0,70	0,79	0,50	0,51
Rev t	0,29	0,19	0,36	0,30	0,34	0,27	0,82	0,70	1,00	0,96	0,53	0,53
Rev t+5	0,37	0,26	0,43	0,37	0,42	0,35	0,85	0,79	0,96	1,00	0,56	0,58
Emp t	0,37	0,30	0,47	0,44	0,49	0,44	0,53	0,50	0,53	0,56	1,00	0,96
Emp t+5	0,42	0,37	0,52	0,51	0,55	0,52	0,53	0,51	0,53	0,58	0,96	1,00

Descriptive Analysis

In this section, the innovation activities of high-growth firms in the manufacturing sector will be examined, its relationship with other economic factors will be investigated, and

the relationship of these firms with employment growth will be examined. As mentioned before, high growth firms are often at the forefront of innovation with significant investments in research and development activities. With this hypothesis, the relationship between R&D activities and the characteristics of high growth firms is examined.

At the same time, as the hypothesis that the R&D activities of HGFs are high is frequently seen in the literature review, many theoretical frameworks also suggest a strong relationship between R&D activities and the nature of HGFs. For example, Schumpeterian Growth Theory emphasizes that innovation is a driving force for economic growth. At this point, HGFs, which engages in innovation and technological advancements the most, especially with their investments in R&D activities, also play an important role. Another example is the Resource-Based View, which argues that firms gain competitive advantage by taking advantage of different and unique resources. R&D capabilities form these resources for HGFs and lead firms to develop new products and processes, gain market share and increase efficiency. Finally, Absorptive Capacity refers to a firm's ability to identify, assimilate and use external knowledge and technologies. HGFs, which have strong R&D capabilities, often have high absorptive capacity. Thus, they can effectively benefit from external knowledge and adapt to changing market dynamics.

It can be said that in recent years there has been an increase in the number of high growth firms in the manufacturing sector in Turkey. However, there are also some challenges for R&D activities of these firms. For example, HGFs in Turkey face difficulties in obtaining financing for R&D activities, limiting their ability to invest in innovation. Moreover, the transfer of knowledge and the industrialization of research and the diffusion of innovation suffer due to the limited interaction between firms and universities. The effectiveness of the R&D also depends on the skilled professionals, and lack of them can limit the innovation efforts. Despite all these challenges, the R&D activities of HGFs are high. Likewise, empirical studies show that HGFs invest a greater portion of their resources in R&D compared to non-HGFs. This shows that high R&D intensity is one of the common characteristics of high growth firms.

As we stated in our literature review, Uzun (2000) found that firms with high employment rates are more active in innovation activities. In addition to that, we said that we did not expect this rate to be this high, especially due to the rapid development of technology

in recent years and Turkey's lack of resources

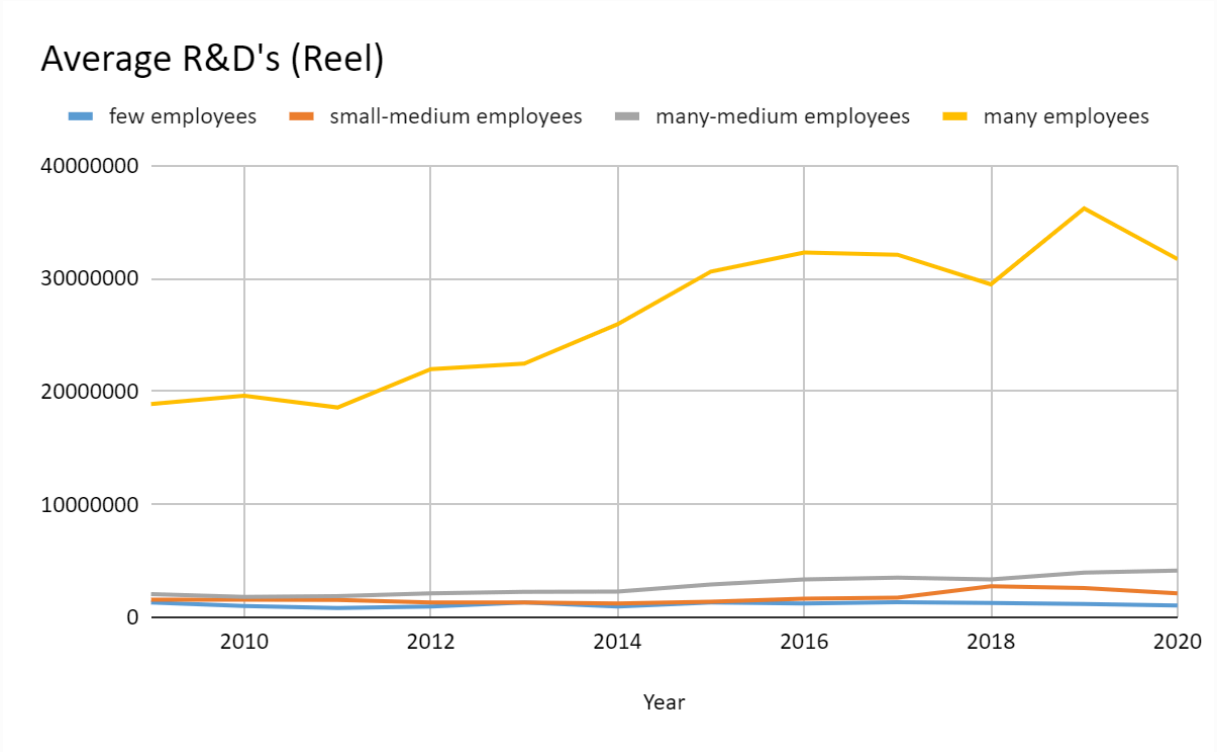


Figure 1

The first graph (Figure 1) above is to examine the R&D activities of the high-growth firms with different sizes. To examine the R&D spending of high-growth firms with different number of employees, firms in the manufacturing sector which has at least 10 workers were first divided into four by distributing the firms equally: firms with few employees, firms with small-medium employees, firms with many-medium employees and firms with many employees. Lastly, to normalize numbers and eliminate inflation effects, average numbers are divided into R&D spending of firms with few employees. The gap in R&D expenditures between large firms and small firms in terms of the number of employees is widening. While in 2009, firms with many employees spent 15 times more on R&D than firms with few employees, this rate has now increased to 30 times. However, the difference in R&D expenditure between firms with many employees and firms with many-medium employees decreased from 9 times in 2009 to 7 times in 2020. This can actually be interpreted as firms with low number of employees moving away from R&D investments as a result of the macroeconomic events experienced in Turkey between 2009-2020. To conclude, this graph shows that, as stated in many studies in the literature, firms with higher employment rates are more active in innovation activities.

Next, we first found the high growth firms in the manufacturing sector and then divided the R&D expenses of these firms by the number of employees to obtain the second graph. Our purpose in doing this is to find out the importance the firm attaches to R&D, regardless of its size. (Figure 2)

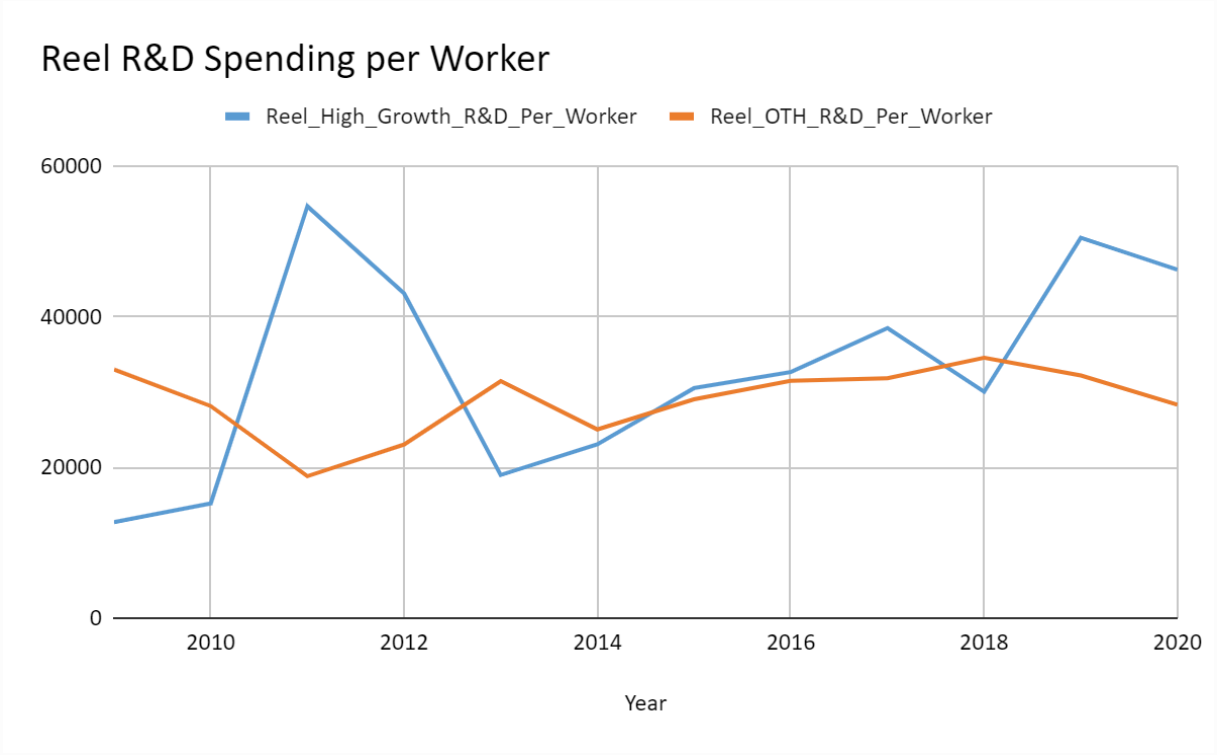


Figure 2

In the graph (Figure 2), the blue line shows the R&D expenditures per employee of high-growth firms, and the red line shows the R&D expenditure per employee of other firms. The aim is to compare the R&D activities of the high growth firms with others. As can be seen, except for 3 years, it can be said that the high-growth firms have made higher R&D expenditures compared to other firms.

Also, one of the factors that must be examined in HGFs is employment growth. As can be seen in the literature as well, HGFs' employment growth over time will not continue if it is too high and rapidly increasing. It should be noted again that the study examines High Growth Firms in terms of employment according to the OECD. The growth rate of firms is measured based on their growth in employment. For this reason, the natural implication of this definition can be interpreted as increasing employment growth for firms to grow. Besides, it is widely believed that HGFs contribute to employment growth at the macro level, which can be

considered correct. The reason for this is that firms that feed on employment and can thus be classified as HGF must constantly employ workers and thus gain growth. However, it would not be realistic to say that there is a constantly high increase in employment growth in periods when firm costs increase. Even though the firms showed HGF characteristics, we expect this increase to be small, positive, or stagnate over time.

The figure below shows the employment increase of firms in the Turkish manufacturing sector from 2012 to 2020.

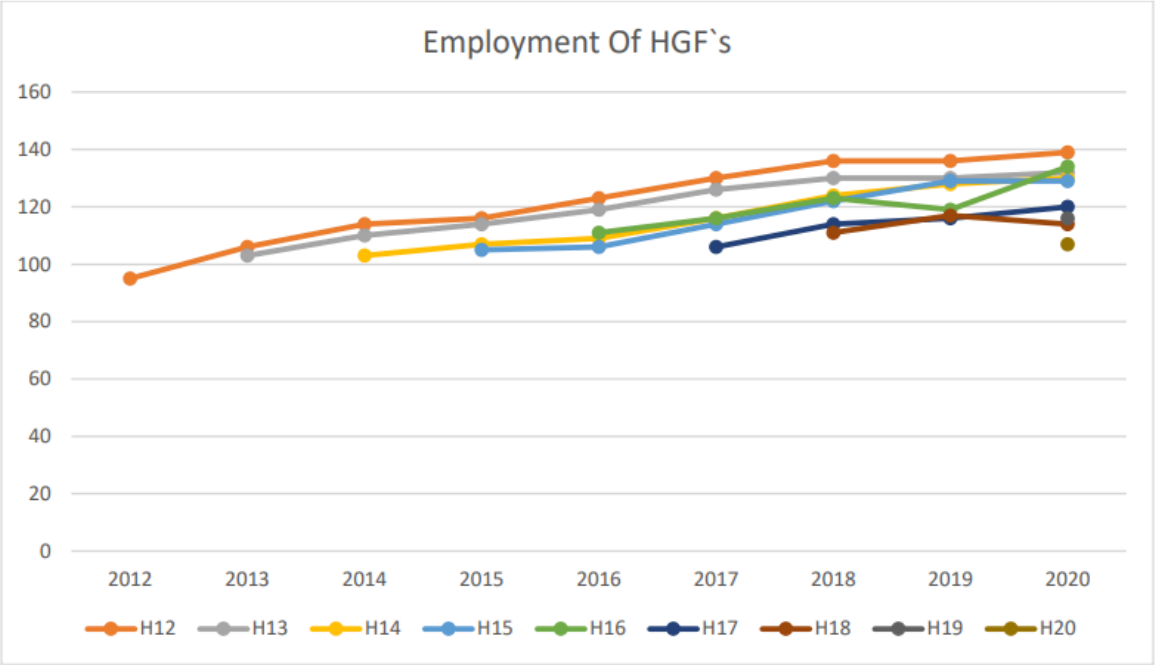


Figure 3

While examining HGFs since 2012, the graph shows the employment change of the firm that showed the potential to become HGF in that year until 2020. Here, the employment average of HGF firms in 2012 is shown with the orange line. When looking at the 8-year employment change, small positive progress and stagnation attract attention. In this progression, some small negative decreases have also been the subject of research. HGF averages of other years also confirm the proposition of the hypothesis. The employment averages of HGFs in these 8 years showed neither rapid increases nor rapid declines. There are small increases, stagnation, and small decreases. In the graph, it is necessary to note a different change from other years in the green line, which notes the employment change of the firms with HGF in 2016 over the last 4 years. A serious employment decline was observed in 2019. In other analyses, although a small negative decrease was observed in the general

situation in 2019, the sharpest decrease was observed in 2016 HGFs. Apart from this sharp exception, we can clearly observe that the proposition of the hypothesis is true in our sample. (Figure 3)

Although the firms have contributed to employment growth at the macro level, which is natural since they are HGF, a high level of employment growth has not been observed. At the same time, this graph is also proof that firms in our HGF sample in the Turkish manufacturing sector cannot maintain their potential to become HGF for many years. After firms achieved the HGF feature according to the OECD definition with their high employment and growth structures, they were excluded from this category because they could not sustain their employment growth in the long term.

A hypothesis arguing for a positive relationship between innovation and exports in high-growth firms in the manufacturing sector in Turkey is based on the premise that innovation plays an important role in increasing a firm's ability to expand into international markets, that is, increasing its competitive advantage. Considering that innovation is valued as the driving force of productivity increases, high-growth Turkish firms in the manufacturing sector can gain a competitive advantage in a highly competitive global environment with innovation and pave the way for export growth by encouraging brand recognition and loyalty. In summary, it can be said that high-growth firms in the Turkish manufacturing sector can facilitate their operations, increase supply chain efficiency, and design new export-oriented business models thanks to innovation. As a result, as high-growth firms invest in innovation, their export performance is likely to increase.

The graph below (Figure 4) examines the relationship between exports and R&D activities of non-HGFs. This sample contains those that, according to the OECD definition, are not included in the High-Growth Firms (HGF) category. The graph present the average R&D and export values for these firms. While the orange line in the graph represents the R&D spending averages from 2009 to 2020, the blue bars represent the export averages. Both R&D spendings and export values are adjusted for inflation.

The R&D expenditures have increased rapidly since 2011, but this growth has not directly translated into exports. In Turkish manufacturing sector firms that do not exhibit the HGF feature, there is a swift rise in R&D spending, yet there is no direct reflection of innovation on exports. (Figure 4)

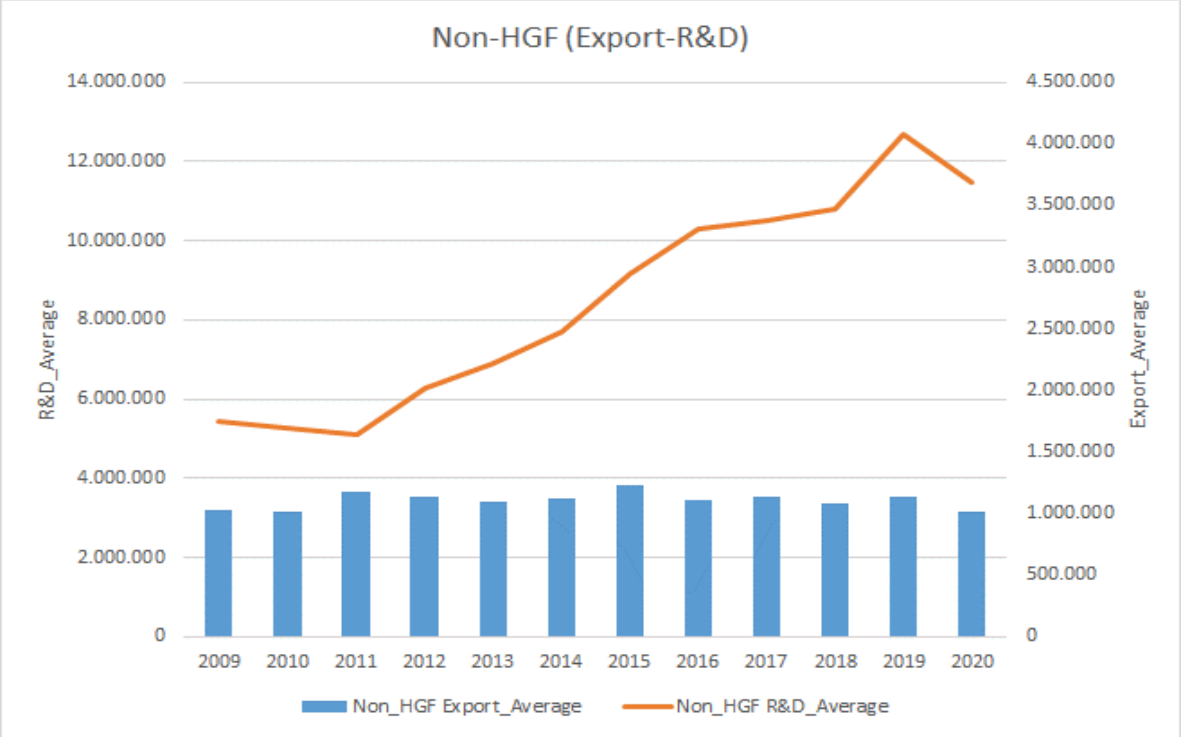


Figure 4

The same examination is applied to high-growth firms as well. The average values of firms in the HGF category from 2009 to 2020 adjusted for inflation are used in the graph below. (Figure 5) Like before, the orange line shows the average for research and development (R&D), and the blue bars show exports. There is an interesting point in 2019, some firms had export values much higher than the average. Even though the real terms are used and the inflation effect is removed, the increase in 2019 is solely attributed to that. Some firms had exports well above the average, and this was noted in TURKSTAT's micro datasets. The high export level in 2009 is a similar case. Except for these unusual years, it is found that, unlike the other example, there isn't a direct increase in R&D spending. Export values, excluding these two years, didn't show significant changes. In simpler terms, we're showing that there's no direct link, not even a positive one, between R&D spending and exports in the HGF sample. That is because innovative activities go beyond just R&D, and R&D spending doesn't directly impact exports in the manufacturing sector of Turkey. R&D activities constitute only a small part of innovation, and it is not possible to see the impact of R&D activities immediately. Therefore, the fact that no relationship was found between exports and R&D activities in the graph below may be related to the time factor. However, it is possible to

say that there is a relationship between innovation and exports, as seen in many literature studies.

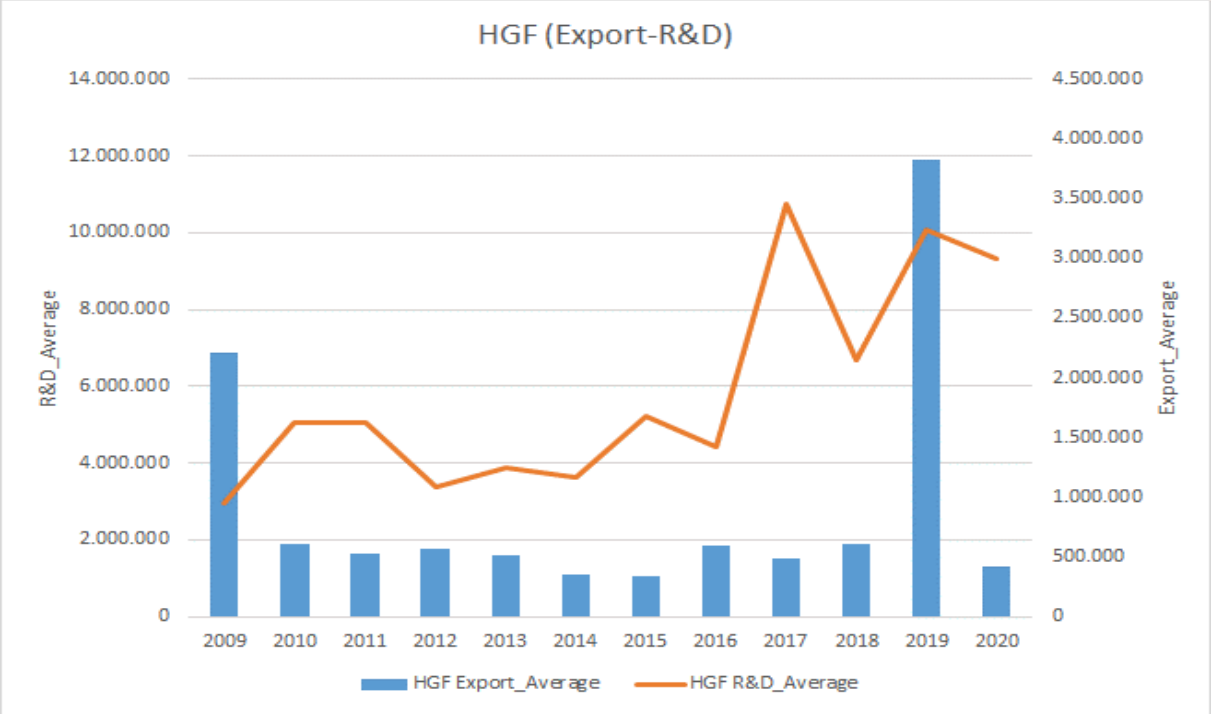


Figure 5

To continue, the relationship between R&D activities and sales of non-HGFs is examined in the graph below. (Figure 6) It cannot be said that there is a strong relationship because especially after 2011 the R&D spending of non-HGFs is increasing rapidly but the increase in sales is not parallel to R&D spending.

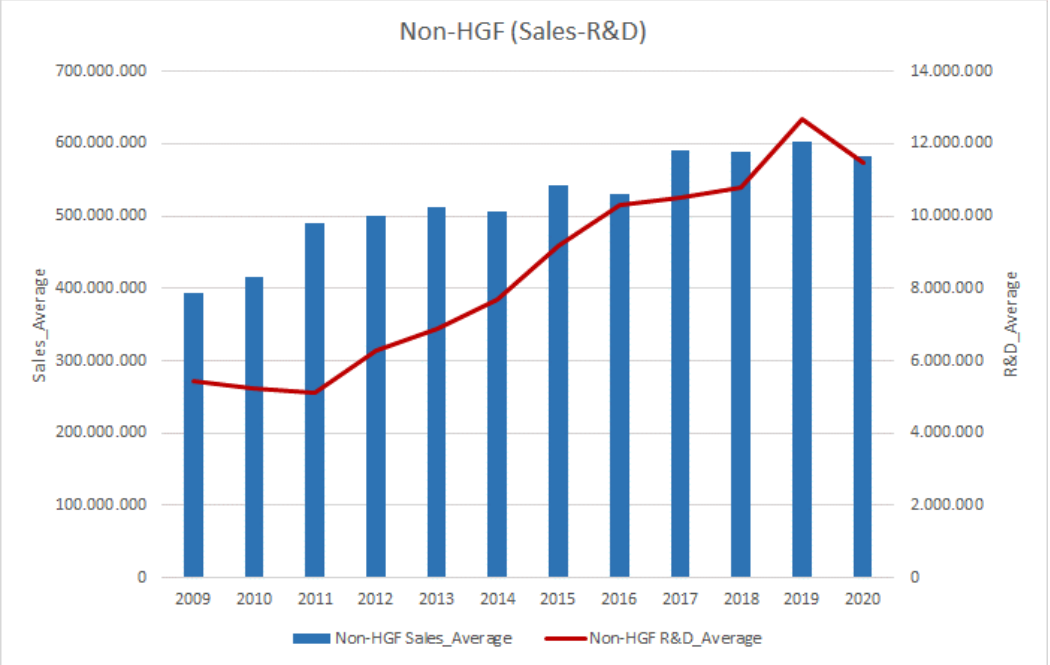


Figure 6

The same relationship in HGFs is examined as well. Overall, again especially after 2011, the relationship is more clear. Excluding the years 2009,2010 and 2017, the flows of the R&D spending and sales are moving together. Therefore, it can be said that the relationship between sales and R&D activities is stronger for HGFs than non-HGFs. (Figure 7)

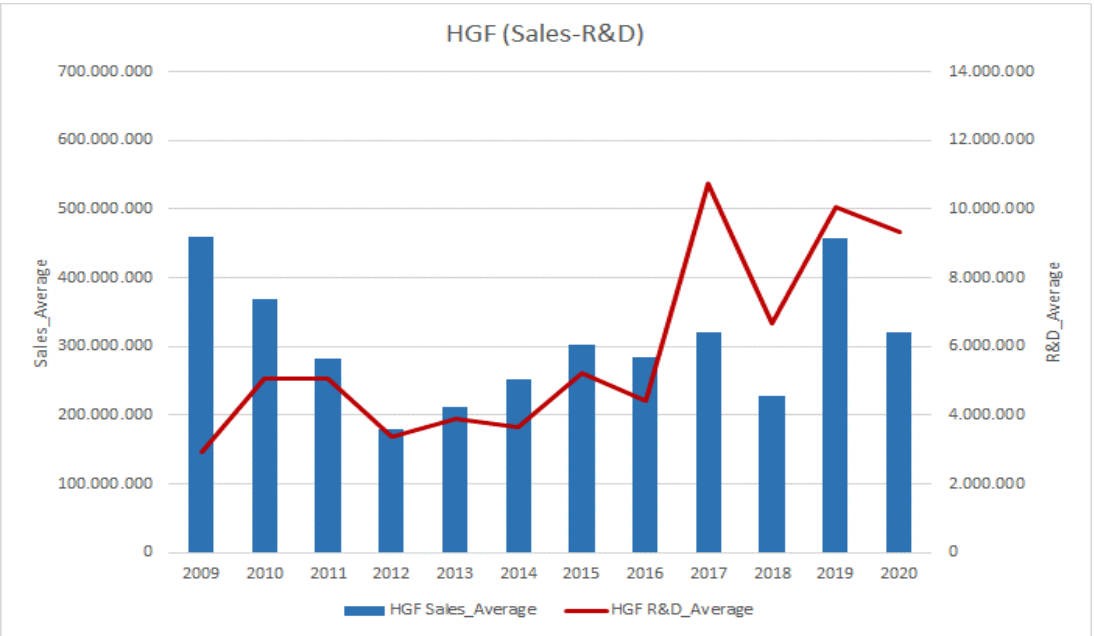


Figure 7

We can say that the literature and empirical studies we have previously examined open a window to the positive impact of innovation. When we consider innovation in general, we can say that it contributes to firms developing their product portfolios and offering new and advanced offers that can meet the evolving demands of consumers. Thanks to innovation, firms can differentiate themselves from their competitors, contribute to increased revenues, and increase demand and growth by strengthening their positions in the market. At the same time, it can be said that firms that embrace innovation can respond much more easily to developing market trends and changes and uncertainties in consumer preferences in a rapidly changing business environment. Considering that the manufacturing sector in Turkey is greatly affected by external factors such as global market dynamics and geopolitical events, it should be noted that it is significant for Turkish high-growth firms in the manufacturing sector to be able to respond easily to changes and uncertainties.

To conclude, looking at the data obtained from innovative activities in the Turkish manufacturing sector and literature, innovation has an important role in increasing sustainable growth, competitiveness, and resilience. As a result, it can be concluded that high-growth firms in the manufacturing sector in Turkey gain from innovation activities.

Growth Analysis with Panel Regression

As we stated before, in this study we are basically trying to understand the roles of R&D, exports and firms on their growth. For this reason, we created 2 base models. In the first of these, we wanted to use Employment as the explanatory variable, and in the other, we wanted to use revenue. In this way, we explained the 2 main indicators used in HGF measurements. We chose the panel regression model because the changes both over the years and between firms are important. While doing this, we chose the cities where the firms were located as a fixed effect. In this way, we thought we could eliminate the growth differences created by cities.

It is estimated that the effects of R&D activity will be observed in the long term. For this reason, we set up our model by choosing a 5-year interval. In this way, we wanted to see whether R&D expenditures at time t would have an impact on growth at time t+5.

$$Rev_{i,t+5} = \alpha 0 + \alpha 1_i + \alpha 2\, Exp_{i,t+5} + \alpha 3\, R\&D_{i,t} + \alpha 4\, Emp_{i,t+5} + \alpha 5\, Rev_{i,t} \quad \textbf{(1)}$$

Where Revi,t+5 is the revenue of the firm i in year t+5, α1i is the city effect of the firms, Expi,t+5 is the export value of firm i in year t+5, R&Di,t is value of R&D expentirues of firm i in year t, Empi,t+5 is the number of the employees of firm i in year t+5 and Revi,t is the revenue of the firm i in year t.

We create other models by adding variables to this model.

$$Revi,t+5 = \alpha0 + \alpha1i + \alpha2\ Expi,t+5 + \alpha3\ R\&Di,t + \alpha4\ Empi,t+5 + \alpha5\ Revi,t + \alpha6\ (Female/Male)i,t \quad (2)$$

Female/Malei,t shows the ratio of female and male working in R&D in firm i in year t.

$$Rev_{i,t+5} = \alpha0 + \alpha1_i + \alpha2\ Exp_{i,t+5} + \alpha3\ R\&D_{i,t} + \alpha4\ Emp_{i,t+5} + \alpha5\ Rev_{i,t} + \alpha6\ (Female/Male)i,t + \alpha7\ (Female/Male)i,t+5 \quad \textbf{(3)}$$

Female/Malei,t shows the ratio of female and male working in R&D in firm i in year t+5.

$$Revi,t+5 = \alpha0 + \alpha1i + \alpha2\ Expi,t+5 + \alpha3\ R\&Di,t + \alpha4\ Empi,t+5 + \alpha5\ Revi,t + \alpha6\ (Female/Male)i,t + \alpha7\ (Female/Male)i,t+5 + \alpha7\ Expi,t \quad \textbf{(4)}$$

Expi,t shows the export value of firm i in year t.

In the second base model, we wanted to explain the employment in year t+5 by using similar variables.

$$Emp_{i,\,t+5} = \alpha0 + \alpha1_i + \alpha2\ Exp_{i,t+5} + \alpha3\ R\&D_{i,t} + \alpha4\ Emp_{i,t} \quad \textbf{(5)}$$

As explained above Empi, t+5 is number of employees of firm i in year t+5, α1i is the fixed effect -the city effect-, Expi,t+5 is value of export of firm i in year t+5, R&Di,t is R&D spending of firm i in year t, Empi,t is number of employees of firm i in year t.

$$Emp_{i,\,t+5} = \alpha0 + \alpha1_i + \alpha2\ Exp_{i,t+5} + \alpha3\ R\&D_{i,t} + \alpha4\ Emp_{i,t} + \alpha5\ Rev_{i,t} \quad \textbf{(6)}$$

Revi,t is revenue of firm i in year t.

$$Emp_{i,\,t+5} = \alpha0 + \alpha1_i + \alpha2\ Exp_{i,t+5} + \alpha3\ R\&D_{i,t} + \alpha4\ Emp_{i,t} + \alpha6\ (Female/Male)i,t \quad \textbf{(7)}$$

Female/Malei,t shows the ratio of female and male working in R&D in firm i in year t.

Then we transformed the above variables to log versions and used the following forms in our empirical analysis:

$$\log(Rev_{i,t+5}) = \alpha0 + \alpha1_i + \alpha2\ \log(Exp_{i,t}) + \alpha3\ \log(R\&D_{i,t}) + \alpha4\ \log(Emp_{i,t}) + \alpha5\ \log(Rev_{i,t}) + \alpha6\ (Female/Male)i,t + \alpha7\ (Female/Male)i,t+5 + \alpha7\ \log(Expi,t) + \varepsilon_{i,t}$$

$$\log(Emp_{i,t+5}) = \alpha 0 + \alpha 1_i + \alpha 2 \log(Exp_{i,t+5}) + \alpha 3 \log(R\&D_{i,t}) + \alpha 4 \log(Emp_{i,t}) + \alpha 6 (Female/Male)_{i,t} + \varepsilon_{i,t}$$

where εi,t is the disturbance term.

Since;

log(Revi,t+5) = … + α5 log(Revi,t)+..., can also be written as log(Revi,t+5/Revi,t) = …+ (α5 -1)log(Revi,t)+...,

the values we estimate are also descriptive values in terms of 5-year revenue growth. Also, the same structure is valid for employment growth. We estimated each models using fixed effects panel data estimation methods. The results can be seen in the next table(s)

Table1. Estimation results for models (1-4), Fixed effects panel analysis

	Model 1	Model 2	Model 3	Model 4
Dependent Var.:	log(Rev t+5)	log(Rev t+5)	log(Rev t+5)	log(Rev t+5)
log(Exp t+5)	0.0612***	0.0619***	0.0633***	0.0928***
	(0.0076)	(0.0077)	(0.0077)	(0.0096)
log(R&D t)	0.0739***	0.0763***	0.0788***	0.0636***
	(0.0129)	(0.0131)	(0.0128)	(0.0132)
log(Emp t+5)	0.4928***	0.5015***	0.4892***	0.4007***
	(0.0381)	(0.0389)	(0.0357)	(0.0397)
log(Rev t)	0.4524***	0.4416***	0.4445***	0.5602***
	(0.0340)	(0.0344)	(0.0336)	(0.0429)
Female/Male t		0.0499***	0.0346**	0.0302*
		(0.0127)	(0.0132)	(0.0139)
Female/Male t+5			0.0610***	0.0481**
			(0.0161)	(0.0171)
log(Exp t)				-0.0481***
				(0.0106)

	Model 1	Model 2	Model 3	Model 4
Dependent Var.:	log(Rev t+5)	log(Rev t+5)	log(Rev t+5)	log(Rev t+5)
Observations	5,189	4,982	4,900	4,485
R2	0.87981	0.88034	0.90882	0.91671
Within R2	0.87573	0.87628	0.90573	0.91344

Numbers in parentheses show standard errors. *** p<0.001, ** p<0.01, * p<0.05

Table2. Estimation results for models (5-7), Fixed effects panel analysis

	Model 5	Model 6	Model 7
Dependent Var.:	log(Emp t+5)	log(Emp t+5)	log(Emp t+5)
log(Exp t+5)	0.0523*** (0.0072)	0.0366*** (0.0066)	0.0348*** (0.0066)
log(R&D t)	0.0798*** (0.0110)	0.0566*** (0.0113)	0.0562*** (0.0114)
log(Emp t)	0.7421*** (0.0217)	0.5996*** (0.0422)	0.6082*** (0.0426)
log(Rev t)		0.1561*** (0.0320)	0.1515*** (0.0326)
Female/Male t			-0.0133 (0.0128)
Observations	5,198	5,191	4,984
R2	0.82559	0.83265	0.83487
Within R2	0.81906	0.82639	0.82896

Numbers in parentheses show standard errors. *** p<0.001, ** p<0.01, * p<0.05

Model 1 and Model 5 are our benchmark models. All our models are significant except Model 7. It can be seen in our models that R&D expenditures in year t have positive effects on both revenue growth and employment growth at time t+5. This means that R&D expenditures made 5 years ago affected the growth performance of firms in the manufacturing sector. Thus, a 1% increase in R&D spending in year t increases on average the firm's growth by 0.7%. The variable that has the highest impact on Revenue is the number of employments. This is an indicator of why these two variables are accepted as growth indicators. According to our models, 1% employment increase results in a revenue increase of approximately 4%. Also, exports appear to have both positive and negative effects on growth. While exports at time t+5 have a positive effect, exports at time t have a negative effect on growth. In model 4, it is seen that $\alpha 2$ is larger in absolute value than $\alpha 7$. That is, the positive effect of exporting at time t+5 is greater than the negative effect at time t. In other words, even if a firm that has been exporting for 5 years reaches its 5th year without increasing its export level, this will have a positive impact on its revenue, which means that exports have a positive effect on the number of employees. The reason for the negative effect can be seen as firms that can export at time t approaching their growth limits. While firms that cannot export at time t grow rapidly thanks to exports at time t+5, firms that can export at time t have problems growing at time t+5 because they are already using the export effect. This can be seen as export is an important variable to become HGF. Revenues at time t also have a very high impact on employment at time t+5. A one percent increase in revenue at time t can result in a 15 percent increase in the number of employees at time t+5. From this it can be concluded that the firm's income is important at time t. In addition, the increase in the ratio of female/male employees in R&D at both times t and t+5 has a positive impact on revenue. However, at time t, the female/male ratio of employees working in R&D is insignificant for employment. This can be interpreted as women working in R&D are more productive employees.

The overall results for high-growth firms in the manufacturing sector appear consistent with our expectations. R&D expenses are an important variable for both revenue and number of employees. Although the positive effect of exports can be seen, it can be interpreted that starting to export may trigger high growth. It seems that women working in R&D are more productive than men. Although this effect does not seem to have a significant effect on the increase in the number of employees, which is the HGF indicator determined by OECD (2010) and which we preferred in this study, it has a positive effect on Revenue. The reason

for this can be interpreted as the average education of women working in R&D is higher than the average education of men working in the same department.

Panel data findings are consistent with the literature. The importance of R&D expenditure in sales and employment growth is visible. Consistent with the literature, exports positively affected firm growth. The importance of employment growth has also been observed here. In addition to the literature, the study observed the productivity of employee gender at the firm level rather than the growth of the number of employees and made an addition to the table above on productivity and gender. At this point, we agree with the positive point and importance in the literature on employment growth, but we also emphasize the importance of not only numerical growth but also productivity in firm growth resulting from employment growth.

Conclusion and Policy Recommendations

In conclusion, this study examines the innovation economy and the interaction between growth, exports, employment, and innovation in high-growth firms and growth dynamics in the Turkish manufacturing sector. The findings of the study support that high-growth firms show more interest in R&D activities than others. This shows that high-growth firms accept that innovation, especially supported by R&D studies, has an important role. Another striking finding is that HGFs stagnate over time when their employment growth is examined. For this reason, encouraging potential HGF firms to become HGF will be more beneficial for increasing employment than supporting them after they become HGF. It is also crucial that these incentives are adjusted in a way that can encourage R&D. The second finding that emerges when looking at the employment rates of HGFs is that high-growth firms with high employment rates take a relatively more active role in innovation activities. This demonstrates the importance of a skilled workforce and the interconnected nature of human capital and innovation when promoting innovation in the manufacturing sector. For this reason, it would be beneficial for companies to provide various supports to increase the education levels of their employees. All these findings contribute to a comprehensive understanding of the innovation economy for high-growth firms in the Turkish manufacturing sector.

The findings of our empirical analysis using the data we received from TURKSTAT are compatible with our literature review and hypotheses. R&D expenditure and export values are important variables for both revenue and employment. It is one of the most positive variables for the growth of R&D expenditures. At the same time, the fact that the company is currently

exporting seems to have a negative impact on its long-term revenue growth. In other words, we can say that companies that cannot yet export have a higher potential to become HGF. For this reason, supporting these companies may cause the number of HGFs to increase. In addition, the increase in the rate of female employees in R&D also has a significant impact on revenue growth but does not have a significant impact on the number of employees. This can be seen as female employees being more productive.

When we consider the entire study, we observe the positive effect of R&D activities on growth. However, while explaining the features of HGF, it is also underlined that R&D activities are not the only innovative component that affects growth. For this reason, although it is important for firms in the Turkish manufacturing sector to grow with R&D, it will not be possible to align all growth characteristics with only R&D.

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