

Fast-growing Tech Companies as a Driver of Regional and National Sustainable Economic Development

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Keywords: High-Tech Business, High-Growth Firms (HGFs), Fast-Growing Companies (FGCs), Exponential Technologies and Organizations, Entrepreneurial Ecosystem, Sustainable Development.

Abstract: The article deals with the analysis of the fast-growing tech companies which are proved to be a key factor in structural changes and sustainable economic growth. The intended purpose of this paper is to identify the particular traits of fast-growing tech companies and to reveal the factors which determine the extent of their development (both spatial and intensive) in various regions and countries. The paper employs multivariate analysis methods in the evaluation of the data for 29 countries in order to achieve the purpose mentioned above. A set of factors affecting the launch and growth of tech companies has been determined. The relationship between the development of fast-growing high-tech companies and the following variables was tested: the level and the dynamics of country's wealth, population's welfare, as well as the share of R&D expenditures in GDP. Based on cluster analysis 4 groups of countries have been defined depending on the indicators of fast-growing tech companies' development and the characteristics of entrepreneurial ecosystem there. The value of this paper is to provide practical tools for enhancing technology entrepreneurship. The results of the research can be used in the development and implementation of support measures for fast-growing companies.

1 INTRODUCTION

The unprecedented economic crises caused by the coronavirus pandemic highlighted the urgency of sustainable economic growth at the macro and micro economy levels. Given the ability of High-Growth Firms (HGFs) to generate sustainable and rapid growth through the use of new technologies and business models, it is fair to identify them as drivers of regional and national sustainable economic development. (Coad et al., 2014). It is believed that HGFs create more than 40% of new workplaces, although in some countries the share of such companies is approximately 5% (Bravo-Boscia et al., 2013). Moreover, FGCs might enhance the level of productivity (Autio, 2009), perform as a benchmark for potential entrepreneurs (Bosma et al. 2012), promote the diffusion of innovations (Coad, 2009), generate new knowledge (Colombelli et al. 2014), support export orientation (Mason and Brown, 2010) and stimulate industry growth (Du and Temouri,

2015). Furthermore, HGFs activities can have multiplier effects (Moreno and Coad, 2015).

HGFs are particularly well represented in high-tech industries, they are ubiquitous, but unevenly distributed in different countries and regions. According to Eurostat data, the number of high-tech companies in the EU increased by 30% between 2014 and 2017, which is much higher than the 9% growth rate of all active company's in the EU business economy. As a result, they accounted for about 11% of all entities in the business economy (European Commission, 2019). This fact demonstrates the importance of high-tech companies in the business dynamics of European countries.

The volatility of the conditions in which companies operate, as well as their macroeconomic and institutional environment, imply that HGFs - friendly policies must be tailored to the specifics of the region (Bosma and Stam, 2012). This makes the cross-country analysis of FGC differences relevant (Coad et al., 2014; Teruel and De Wit, 2011), as it takes into account both economic conjuncture and institutional

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environment, and other characteristics of the entrepreneurial ecosystem.

Despite the relevance of the problem under study and increased attention to the issue (Teruel and De Vit, 2011), inequalities remain in the ability to initiate and manage the creation and growth of FGCs, meanwhile the available knowledge is limited. (Nightingale and Coad, 2014). To fill this gap in the scientific literature, we examine the institutional and macroeconomic environment as well as the components of the entrepreneurial ecosystem that shape cross-country differences in the methods of HGFs development.

We focus on a specific type of HGFs - the fastest-growing companies (FGCs) showing exceptional growth (Lia et al., 2016). The number of such companies is rather small and is associated with high risks as they create and use new exponential technologies (Ismail et al., 2017) and new untested business models. This topic is still uncovered in the economic literature. The growth of such companies has a positive recycling dynamic and does not depend on the size of the economy and the dynamics of its development. In contrast, there is a correlation between the dynamics of economic development and the presence and growth rates of tech FGCs.

The results of this study show that the operating environment of fast-growing tech companies differ significantly in various countries and regions. The size of a country's economy, the capacity of the domestic market and the volume of domestic R&D expenditures are not the determining factors in the development of tech FGCs. These companies are concentrated in countries with a high level of technological development and population's welfare, a well-developed infrastructure, a low level of undue influence and corruption, with the available latest technologies and venture capital as well as with favorable conditions for talents and entrepreneurship development. The development of such companies (spatial and intensive) is determined by the institutional framework and the quality of the entrepreneurial ecosystem. Tech FGCs, in turn, have significant influence on them.

2 MATERIALS AND METHODS

The methodological basis of the study is the general theory of economic growth and systems analysis. The research is based on the data from the Deloitte 2016 Technology Fast 500™ EMEA rankings, which covers the largest number of countries (Deloitte, 2016) and companies' websites. The Deloitte Technology Fast 500™ EMEA program is focused on the

technology ecosystems. It recognizes technology companies that have achieved the fastest rates of revenue growth in Europe, the Middle East, and Africa (EMEA) during the past four years. In order to participate in the ranking, a company must meet the following eligibility criteria: be in business not less than of four years, be headquartered within EMEA, have base-year operating revenues of € 50 000 and a current year operating revenue of at least € 800 000, own proprietary intellectual property or proprietary technology, sold to customers in products that contribute to a majority of the company's operating revenues.

A wide range of indicators characterizing the macroeconomics and institutional environment and other framework conditions conducive to the development of tech FGCs are also used in the analysis. FGCs indicator framework aims to capture the most important factors that determine the overall quality of tech FGCs ecosystem. Priority lies with indicators that are tailored to tech FGCs and with regional-level indicators since the FGCs ecosystem is often determined by specific local circumstances

More than 90 indicators were analyzed to identify factors that explain the significant differences in the development of tech FGCs in different countries. In order to determine the variables which would have statistically significant influence on the FGCs development for the relationship analyses both correlation and regression methods were implemented.

Through the cluster analysis method 4 groups of countries have been identified, which differ in terms of concentration and growth rates of the fast-growing tech companies and in terms of characteristics of the entrepreneurial ecosystem. Cluster analysis was conducted using the k-means method. Transformation of variables and clustering was carried out using the maximum distance method. To perform calculations, processing and evaluation of the data under study the following software products were used: Excel, IBM SPSS Statistica. The results obtained at this stage of the research are presented below.

3 RESULTS AND DISCUSSION

3.1 Characteristics of the Fastest-growing Tech Companies

Technology Fast 500™ EMEA list, a ranking of the 500 fastest-growing innovation technology media, telecommunications, life sciences and energy tech companies (see Figure 1).

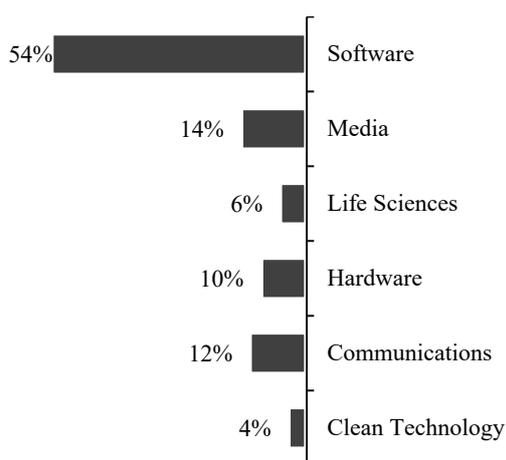


Figure 1: Sector structure of the Ranking.

The majority of fast-growing companies operates in the software industry. However, these companies demonstrate relatively low growth rates - 362% (see Table 1).

Table 1: Number and growth rates of companies in various sectors.

Sector	Number of companies	Average growth, %
Clean Technology	20	471
Communication	61	345
Hardware	49	962
Life Sciences	29	347
Media	70	644
Software	271	362

The leaders in terms of growth rates are hardware companies (962%) whose share in the rating is less than 10%.

The second place in terms of the number of companies and their growth rates is followed by the media. The share of companies in this sector is one and a half times larger than that in the hardware, but the growth rates, in contrast one and a half times lower. Average growth rate of 29 companies related to the life sciences sector is equal to 347%. The clean technology FGCs with 471% revenue growth rate have the least presence in the ranking.

Between 2012 and 2015, the companies achieved revenue growth of 212% to 28,126% (see Figure 2). The median revenue growth is equal to 967%.

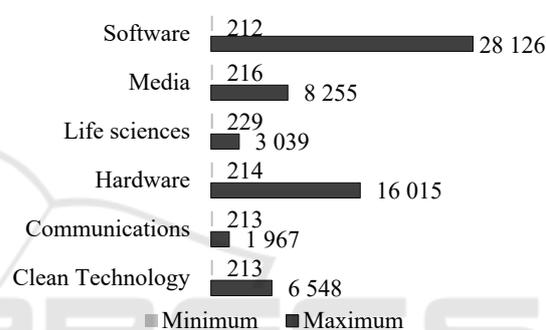


Figure 2: Four-year revenue growth.

The top-ten-ranked companies are featured below by company, country, industry sector and four-year growth percentage (see Table 2). Top companies in the ranking show extraordinary growth.

Table 2: Top-10 Technology Fast 500™ EMEA Ranking.

Rating	Country	Company name	Revenue increase, %	Activity type / product	Sector
1	Sweden	Fingerprint Cards	28 126	User friendly fingerprint biometric solutions	Software
2	Turkey	Bilgikent	16 015	IT system and infrastructure provider and integrator	Hardware
3	Poland	Codewise	13 052	Online marketing tools	Software
4	Norway	Auka	11 487	Mobile payment platforms	Software
5	France	Horizontal Software	8 339	SaaS-based HR software	Software
6	UK	Brain Labs Digital	8 255	Media agency and provider of automated marketing solutions	Media
7	Israel	Magisto	8 119	User-friendly tools for making short videos and taking photos	Media
8	France	Chauffeur-Privé	7 020	Ride-sharing application enabling licensed drivers to offer rides to clients.	Software
9	Austria	Wikifolio Financial Technologies	7 001	Social investment platform for entrusting funds with registered traders, based on their performance	Software
10	UK	GoCardless	6 661	Application for direct debit management in enterprises	Software

The average annual revenue growth of the companies amounts to 445% (from 128,8% to 655%). Thus, all tech FGCs show exponential growth. These companies meet the criteria of an exponential organization (ExO) (Ismail et al., 2017; Dzyubenko and Dzyubenko, 2018) and use this business scaling model. These companies generate high growth and take leading positions in their fields. The most important factors in their development are the creation and use of fast-paced disruptive technologies capable of providing exponential growth and exponential cost as well as new business processes. By linking their products to exponential growth and lowering costs through new technologies, ExOs offer products that are better, cheaper and more personalized at the same time, for all customers. They actively set up their own business platforms, which allow them serve almost unlimited number of direct connections with partners and customers. Platforms are becoming fertile ground for the creation and development of technology and business ecosystems based on collective production and consumption practices that blur the lines between supply chains, performers, partners, customers and the general public. Technology ecosystems create Such environment and relationships which help high-tech companies to grow and develop faster. Expanding the technological framework allows companies to pool resources and efforts, to foster exponential innovation, and to amplify the impact on cost-effectiveness. Technology, innovation and the external environment form an entrepreneurial ecosystem that is simultaneously influenced by high-tech companies and affects their growth.

3.2 Development of Fast-Growing Tech Companies in Different Countries

The Technology Fast 500 for EMEA 2016 list includes the countries of Europe and the Middle East: Austria, Belgium, United Kingdom, Germany, Israel, Ireland, Netherlands, Iceland, Norway, Finland, Sweden, Spain, Italy, Lithuania, Portugal, Slovenia, Turkey, Czech Republic, Bulgaria, Bosnia and Herzegovina, Hungary, Greece, Poland, Russia, Romania, Serbia, Slovakia and Croatia.

High-tech FGCs operate in the entire business economy of the region, although with varying concentrations. The regional structure of the rating is shown in Figure 3.

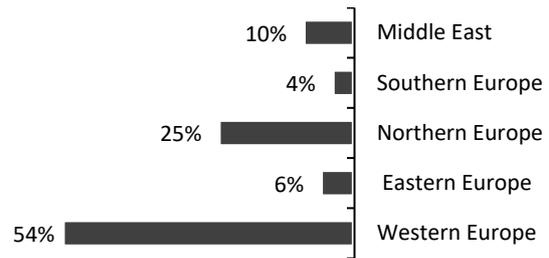


Figure 3: Regional structure of the Ranking.

France became the leader in terms of the number of companies (94 companies), followed by the United Kingdom (70), the Netherlands (54), Norway (50) and Sweden (50) (see Figure 4). More than 60% of FGCs is concentrated in the five leading countries.

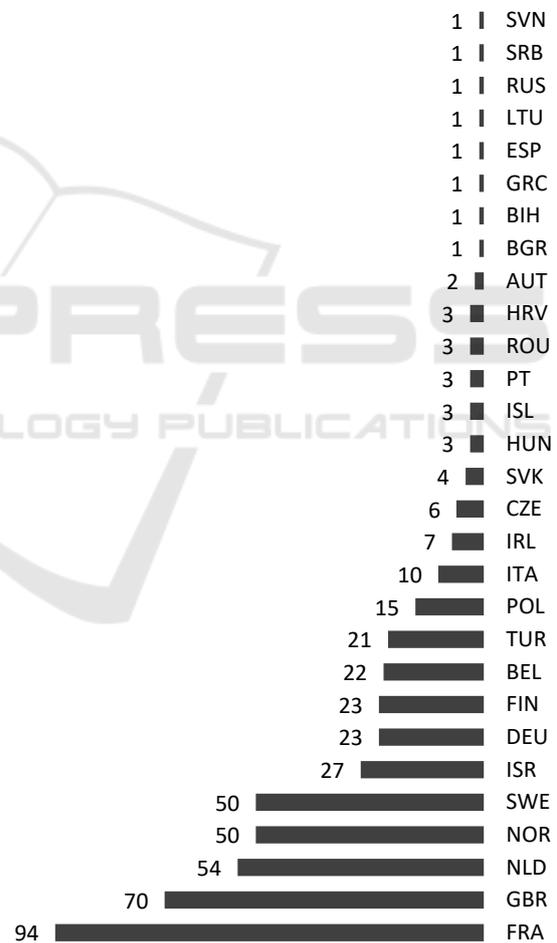


Figure 4: Ranking of countries by the number of FGCs.

The concentration of tech FGCs in countries was estimated in terms of their density (the number of FGCs per million population). As for the FGCs density, the ranking based on this indicator (Figure 5)

deviates a lot from the previous one. In the countries, leading in terms of their number of FGCs, the concentration of FGCs was lower than in the sparsely populated countries with relatively small territory. For instance, France ranks first in terms of the number of FGCs and the ninth - in terms of their density. In contrast, Iceland is 17th in terms of the number of FGCs, but the second in terms of FGCs density. The largest number of fast-growing companies per 1 million population is in Norway, Iceland, Sweden, Finland and Israel. Despite well-developed economy Germany takes the 19th place under this indicator. Despite well-developed economy Germany takes the 19th place under this indicator.

Most tech FGCs are concentrated in countries with a high level of economic development and the most favorable framework conditions.

Austria's tech FGCs are leading in terms of the average revenue growth in the country (4135%), their growth is almost 15 times higher than that of Spain (277%), which takes the last place. Austria is followed by Portugal; whose FGCs grew on average 7.3 times faster than the Spanish ones. Turkey took the third place with a small margin. United Kingdom, Germany, France and Norway are middle-ranking. Such results might be explained by the large number and Norway are middle-ranking of companies in these countries represented in the ranking and the wide range of values of their growth indicators. Thus, in the countries of the region, there is not only an uneven distribution, but also an uneven growth of tech FGCs.

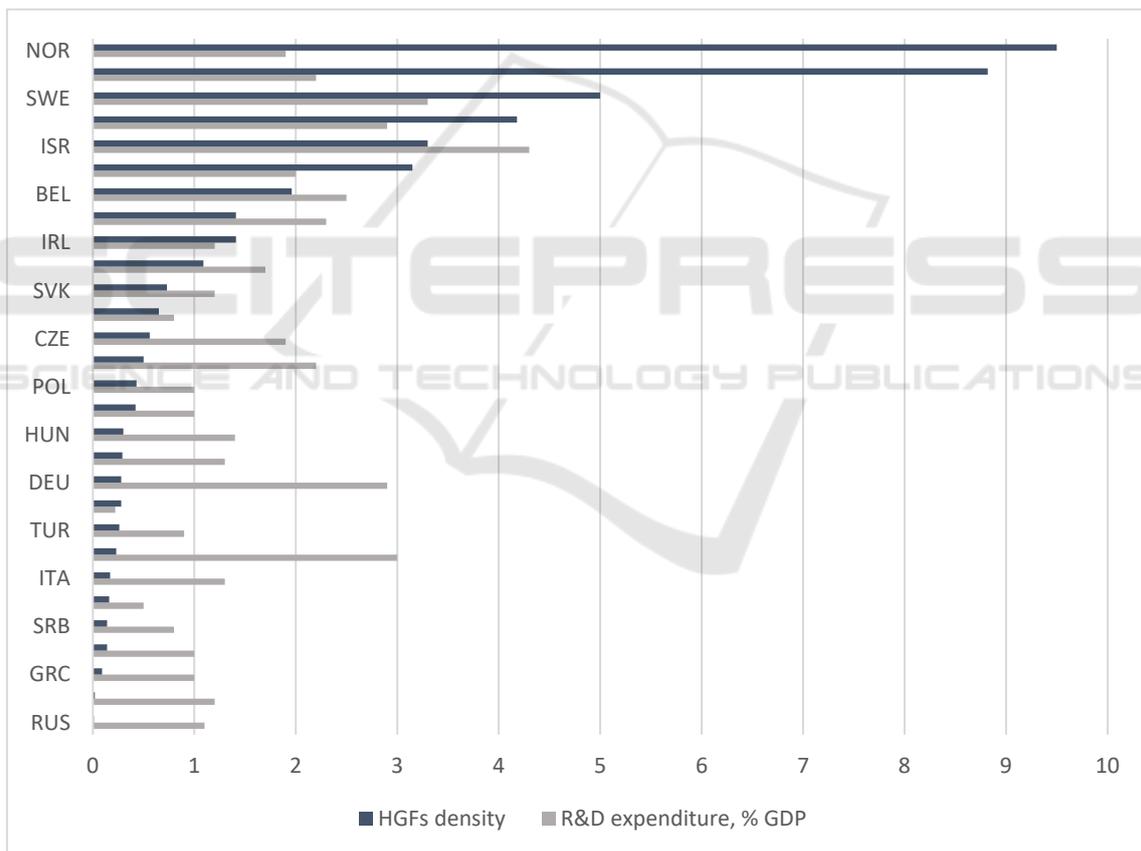


Figure 5: FGCs density and R&D expenditure in different countries.

3.3 Relationship between the Development of Fast-growing Tech Companies and the Level and Dynamics of the Country's Wealth, Population's Welfare

The growth in the number and the development of high-tech companies is undoubtedly a positive factor for the economy of each country. However, it is necessary to estimate, on the one hand, how the economic environment contributes to the formation and development of these companies and, on the other

hand, to find out if there is statistically significant relationship between the number and growth rates of high-tech companies, the country's wealth and the level of population's welfare.

Correlation analysis showed a moderate relationship between the number of technological FGCs and a country's wealth level as measured by GDP (PPP). The correlation of the number of technological FGCs with the welfare of the population, measured by GDP (PPP) per capita, is low (Table 3).

Table 3: Correlation table entrepreneurial ecosystem elements and output.

	GDP (PPP)	GDP (PPP) per capita	GDP growth rate	GDP growth rate per capita	R&D expenditure
Number of FGCs	0,6	0,57	-0,18	-0,03	0,42
FGCs density	-0,11	0,75	0,07	0,1	0,44
FGCs growth	-0,02	-0,04	0,07	-0,19	0,08

Population welfare level in the sample, in general, has greater influence on the FGCs density. Correlation between FGCs density and GDP (PPP) is low. However, the picture differs significantly across groups of countries, depending on the level of their economic development. Correlation coefficients between the number of techs FGCs and the size of the economy range from 0.98 for developed economies to 0.12 for countries with economies in transition, most of which are represented by one company. In the group of developed economies with a high concentration of FGC, their density correlates with the level of population's welfare (correlation coefficient 0.85), and in the group of developing countries, it does not (the correlation coefficient 0.14). Moreover, groups of countries with a high level of economic development are also heterogeneous in terms of the analyzed relationship. For instance, in economically developed countries with a relatively low concentration of FGC, the relationship between the density of FGCs and the level of the country's wealth and the population's welfare is negative (correlation coefficients -0.5 and -0.3, respectively). In general, the presence of tech FGCs in most countries does not depend on the size of the economy, domestic R&D costs, correlates with the level of population's welfare and is determined by other factors related to the specifics of the business environment of each country, the technological and entrepreneurial ecosystem. It can also be associated with the episodic and rather uncertain and unpredictable nature of high growth in companies.

The analysis showed that there was no linear relationship between the growth rates of tech FGCs and the level of the country's wealth, population's welfare. In high-wealth countries (excluding

Austria), tech FGCs grow at a lower rate than in relatively low-wealth countries, and vice versa. In the group of countries with the highest level of population's welfare (Norway, Ireland, Iceland, Sweden), the average growth rates of FGCs are the lowest. The correlation between the growth rates of companies' revenue and GDP (PPP) is weak positive, and between the growth rates of FGCs and GDP per capita it is weak negative (correlation coefficients are 0.07 and -0.19, respectively).

In practice there is no connection between the indicators of FGCs development and gross domestic expenditures on R&D. In countries with a high FGCs density, indicators of domestic R&D expenditures % GDP are relatively low, and vice versa (Figure 5). The analysis shows a low correlation between these indicators (see Table 3).

However, here, too, the picture is not uniform and ambiguous. Countries leading in terms of GDP (Italy, Russia, Turkey) are not experiencing fast growth of FGCs. High-tech companies develop and grow better in countries with a high level of GDP and population's welfare - Germany, United Kingdom, Sweden. In some countries, not only high-tech companies are growing rapidly, but also the country's wealth and the population's welfare. The growth rate of tech FGCs is simultaneously an organic consequence of the country's economic development

and at the same time actively affects the dynamics of economic growth but is largely determined by the internal factors of companies and the characteristics of the entrepreneurial ecosystem.3.4

Relationship between the Development of Fast-Growing Tech Companies and Entrepreneurial Ecosystem

To identify the factors explaining the varying levels of tech HGFs development in different countries, a cluster analysis was carried out. HGFs indicator framework are covers HGFs demographics and key factors that broadly support or obstruct the development of HGEs. It supports deriving country-specific insights related to framework conditions conducive to the development of HGEs, based on the findings in the academic literature. Due to the limited sample, ten indicators were used in the cluster analysis. Therefore, the indicators do not cover every single relevant framework condition but relies on highly correlated indicators: HGFs density, GDP (PPP) per capita, ICT infrastructure, degree of customer orientation, technological adoption, country capacity to retain talent, availability of latest technologies, venture capital availability, geographical concentration, undue influence and corruption. The higher the value of the latter indicator, the lower the level of corruption in the country. The cluster analysis results are shown in Table. 4, graphic visualization in Figure 6.



Figure 6: Countries distribution by clusters.

Clusters represent the positions of countries in terms of the level and dynamics of technological and economic development, institutional environment and regulations, infrastructure, efficiency of resource markets and, as a result, the prevalence and dynamics of FGCs growth. Figure 7 shows the medians of the development indicators of FGC in a normalized, way which permits cross-country comparison.

Table 4: Results of cluster analysis.

Cluster 1 (9 countries)	Cluster 2 (8 countries)
Bulgaria Greece Hungary Poland Russia Romania Serbia Croatia Bosnia and Herzegovina	Spain Italy Lithuania Portugal Slovenia Turkey Slovakia Czech Republic
Cluster 3 (7 countries)	Cluster 4 (5 countries)
Austria Belgium United Kingdom Germany Ireland Netherlands France	Iceland Norway Finland Sweden Israel

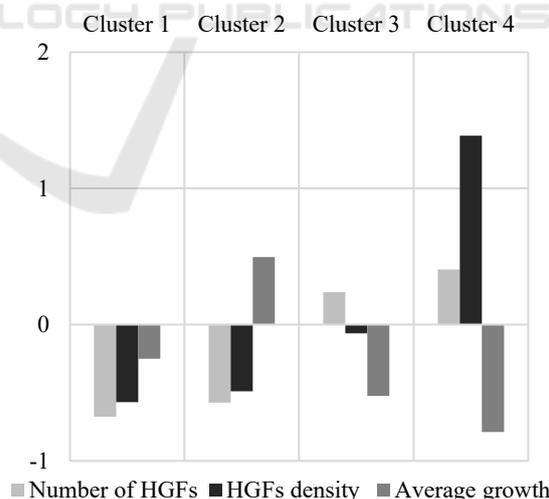


Figure 7: Development indicators of FGC by clusters.

The curves of the standardized average values of the indicators included in the analysis for the obtained clusters are shown in Figure 8.

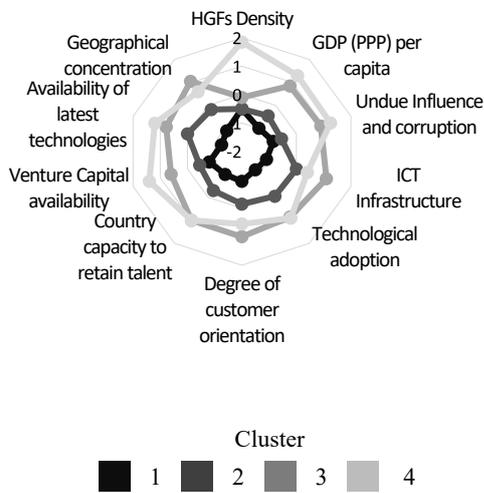


Figure 8: Standardized average values of the studied indicators by clusters.

Clusters 3 and 4 take similar positions. The leader is cluster 4, which includes the Israel and Nordic countries with a high level of economic development and an institutional environment favorable for FGCs development. The number of technological FGCs and their density in this cluster is the highest. Cluster 3 leaves the leading position in terms of the analyzed indicators, with the exception of infrastructure, geographic concentration and degree of customer orientation. This cluster joins well developed countries of Central Europe, which have the highest rates of economic growth, but the lowest average annual R&D expenditures. As it was mentioned above, the gap in growth rates between companies in clusters 3 and 4 is explained by the large number of ranking companies from these countries and a wide range of values of their growth indicators. TOP 10 companies operate in the countries included in the 3rd and 4th clusters.

Clusters 1 and 2, which represent the countries of Southern, Eastern Europe and Turkey, differ significantly in all analyzed indicators. In cluster 2, the values of all indicators are lower than the average values for the sample - the GDP per capita is one and a half times lower, the FGCs density is five times lower. The countries of this cluster have the lowest share of R&D expenditures in GDP, the lowest value of population's welfare and the highest inflation rate. The level of corruption is raising concerns. The lowest positions of all indicators are in cluster 1. GDP indicators are two times lower than the average for

the sample, the level of population's welfare is almost three times lower and, as a result, the number and density of technological FGCs is more than 5 times lower.

With a high level of technological development and the population's welfare, a well-established infrastructure, a low level of undue influence and corruption, with the available latest technologies and venture capital as well as with favorable conditions for talents and entrepreneurship development. Thus, the differences in the prevalence and growth dynamics of tech FGCs in different countries are explained by the conditions of the institutional environment and the characteristics of the entrepreneurial ecosystem.

4 CONCLUSIONS

Tech HGEs bring together a unique group of characteristics and circumstances and so require a particular set of framework conditions to support their development.

A cross-country analysis of the fast-growing tech companies have shown that such companies are more prevalent in countries with favorable economic and institutional conditions than in countries that are competitive in terms of GDP.

Such companies grow faster in countries with high rates of economic growth, but there is an interdependence: higher GDP growth leads to more growth opportunities for companies and vice versa, higher growth rates of companies contribute to higher GDP growth, which confirms the findings of previous studies (Bosma at al., 2012).

Different groups of countries perform above or below the sample average; the correlation between indicators differs significantly across groups of countries. Certain natural and socio-economic conditions favor the emergence of fast-growing companies, but the size of the economy, the level of the country's wealth, domestic R&D costs, and the dynamics of the country's economic development are not the determining factors for the emergence and growth of tech FGCs. In contrast, there is a link between the dynamics of the high-tech companies' growth and the dynamics of the country's wealth growth, measured by the rate of GDP growth. This may lead to the conclusion that the growth rate of high technologies and companies that create and distribute them, on the one hand, is an organic consequence of the economic state of the region, on the other hand, it actively influences economic.

The results of the cluster analysis confirmed the conclusions mentioned above. The conclusions mentioned above environmental factors such as macroeconomic stability, the quality of institutions, the degree of trust in politicians, ethics and corruption, infrastructure development, innovation potential, and the ability of countries to maintain favorable environment for talents have a significant impact on the development of the fast-growing tech companies.

The presented analysis shows the exceptional importance of tech fast-growing companies, their role as a dynamic element of the economy. The level of FGCs development, on the one hand, corresponds to the local economic environment and the level of economic well-being and, on the other hand, the intensity of FGCs actions reflects the dynamics of economic growth. Tech FGCs are the drivers of regional and national sustainable economic development. The underdevelopment (both spatial and intensive) of these companies means the weak development of the regional economy.

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