

THE IMPORTANCE OF START-UPS IN THE PROCESS OF TECHNOLOGICAL CONVERGENCE IN THE VISEGRAD GROUP COUNTRIES

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Abstract

Countries of Central and Eastern Europe are facing the challenge of creating an economy based on innovation and knowledge. Eliminating the disproportions in economic development is the key part of the EU's regional policy, and therefore of each member state. The goal of this paper is to analyze technological convergence and to compare startup ecosystems in Poland, Slovakia, the Czech Republic and Hungary. Based on the established goal, three main theses were formulated:

- 1. The process of technological convergence in the V4 countries is occurring at a similar rate.*
- 2. The largest number of startups in Poland, compared to the countries in the region, is indicative of comparative advantage of this country over other Visegrad Group countries in the high-tech sector.*
- 3. Development of startup ecosystems contributes to forcing the pace of technological convergence in the region.*

Keywords: *startup, startup ecosystem, technological convergence, Visegrad Group*

JEL classification: *R11, R58, P25*

1.Introduction

Dynamic development of new technologies and knowledge, not only globally, but also regionally, means that the economic situation of the region is strictly

connected with the development of a knowledge-based economy. One of its parts is the ecosystem of companies, as it creates completely new and innovative products and services, the so-called 'startups'. According to S. Blank, a startup is a temporary institution looking to find a profitable business model. In the initial stage of business development, the entrepreneur bases mainly on assumptions and ideas. They do not have a book of business, and often even face difficulties in conducting market analysis due to the specificity and uniqueness of the product. Startups are usually established in startup ecosystems which are being created by various kinds of institutions of the business environment. These companies, along with organizations that support their development, usually come into existence in large urban centers that have well-developed infrastructure. The example of a startup hub the Silicon Valley became shows that institutions which introduce new products and services have a real impact on the world economic market, contributing to rapid development and popularization of new technologies, and affecting every branch of industry. Development of innovative companies is important also at the country level and is an important part of its economic development. Companies established in the region of Central and Eastern Europe contribute to an increase in competitiveness and innovativeness of the economy, and, by extension, to a reduction in developmental disparities between them and highly-developed countries.

The main purpose of this paper is to analyze the process of technological convergence in the Visegrad Group countries. Based on the formulated goal, the following research theses were put forward:

1. The process of technological convergence in the V4 countries is occurring at a similar rate.
2. The largest number of startups in Poland, compared to the countries in the region, is indicative of comparative advantage of this country over other Visegrad Group countries in the high-tech sector.
3. Development of startup ecosystems contributes to forcing the pace of technological convergence in the region.

Technological convergence was estimated using the revealed comparative advantage index as well as the revealed symmetric comparative advantage index. Based on these indices, type β regression equation was estimated. Statistical data used in this paper came from the European Statistical Office, the Polish Central Statistical Office, and from the reports prepared by institutions dealing with the subject of startups. Countries forming the Visegrad Group (V4) are facing numerous challenges created in the age of high-tech sector development. Structural

similarity between Poland, Slovakia, the Czech Republic and Hungary with respect to developmental is the reason for including them for analysis in this study.

2 Theoretical approach to estimation of technological convergence

Conditions of development of a knowledge-based economy in all countries of the world depend on the level of technological advancement. In order to determine the degree of convergence of the Visegrad Group countries with respect to the analyzed region, the technological convergence (which falls into the trend of economic convergence) was estimated. Technological convergence can be considered in two ways:

1. There is a convergence in technological development of countries;
2. If the studied countries are technologically diversified, then how this situation affects the convergence process or the process of intensification of disproportions among them.

To estimate the convergence taking place in employment in the high-tech sector and in export of commodities of this industry, the B. Balassa revealed comparative advantage index (RCA) was used, according to the following formula:

$$RCA_{ij} = \frac{x_{ij} / \sum x_{ij}}{\sum_j x_{ij} / \sum_i \sum_j x_{ij}} \quad (1)$$

$$x_{ij} / \sum x_{ij}$$

ratio of the export of commodities (employment) of the high-tech sector of country i to total export (employment) in country i;

$$\sum_j x_{ij} / \sum_i \sum_j x_{ij}$$

ratio of the total value of commodities exports in the high-tech sector in all countries of the investigated reference group to the value of total export (employment) in the group of the studied countries.

RCA is an index used in determining comparative advantages between economies. Comparative advantage in a given sector is when a given country has relatively substantial resources in a specific sector of economy and makes use of them in the process of international division of labor. When creating the revealed comparative advantage index, B. Balassa was basing on D. Ricardo's model. He claimed that if the share of export of the analyzed sector of a given country in the total export of that country exceeds the share of the studied sector in the global

export structure, this may be indicative of comparative advantage of products of a country's specific sector compared to a reference group, in other words a set of selected countries (Posłuszny K. 2011). The value of this index is always positive and within the $[0, +\infty]$ range, and, according to Hinloopen and Marrewijk, the magnitude of RCA is interpreted as follows:

- $0 < RCA \leq 1$ – no revealed comparative advantage in the sector;
- $1 < RCA \leq 2$ – weak revealed comparative advantage;
- $2 < RCA \leq 4$ – average revealed comparative advantage;
- $RCA > 4$ – strong comparative advantage of a sector (Salamaga M. 2013).

Another step in the analysis is conversion in order to standardize the RCA index into the revealed symmetric comparative advantage index (RSCA). The conversion was carried out according to the following formula:

$$RSCA = \frac{RCA - 1}{RCA + 1} \quad (2)$$

RSCA value is within the $[-1, 1]$ range, where negative values indicate no revealed comparative advantage of a sector and, analogically, positive values indicate there is comparative advantage of a sector in a country [Głodowska 2016].

The estimated RSCA values were used to create type β regression equation:

$$RSCA_{ij0} = \alpha + \beta RSCA_{ijT} + \varepsilon_{ij} \quad (3)$$

$$RSCA_{ij0}$$

revealed symmetric comparative advantage index in the initial period, estimated for export of high-tech commodities and for employment in the high-tech sector in economy i

$$RSCA_{ijT}$$

revealed symmetric comparative advantage index in the final period for the conducted analysis, estimated for export of high-tech commodities and for employment in the high-tech sector in economy i

ε_{ij} random component for country

Analysis of technological convergence based on the presented regression equation consists in interpretation of coefficient β , where:

- $\beta > 1$ indicates the divergence process between the studied group of countries with respect to the analyzed variable, resulting from strengthening of a given feature in one country in relation to the reference group;
- $\beta = 1$ is indicative of a constant level of the investigated variable in the analyzed period of time;

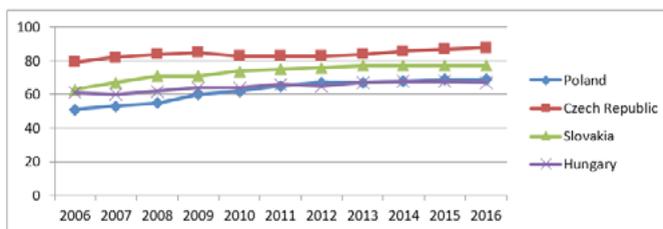
- $0 < \beta < 1$ indicates a convergence process where poorer countries are getting closer to better-developed countries in terms of the level of development of a certain feature (Głodowska A. 2013).

In this case, countries which have been included in the reference group are: Czech Republic, Poland, Slovakia, Hungary. The time period of the analysis covers the years 2010-2015.

3 Analysis of technological convergence in the Visegrad Group countries

Similarity in developmental level and in the condition of economies of individual Central and Eastern Europe countries becomes visible in different spheres of economic life, for example in values of Gross Domestic Product (GDP) per capita, or in the unemployment rate. The table below shows the GDP level per capita in the Czech Republic, Poland, Slovakia and Hungary. All the countries recorded an increase in the analyzed magnitude since 2006. The Czech Republic is ranked best in this comparison, reaching the highest GDP per capita in all the analyzed years. None of the mentioned countries showed a considerable increase in GDP. What is more, the V4 was characterized by a similar trend of appreciation of the variable.

Figure 1 **Gross Domestic Product per capita according to purchasing power parity in the V4 countries (2006-2016)**

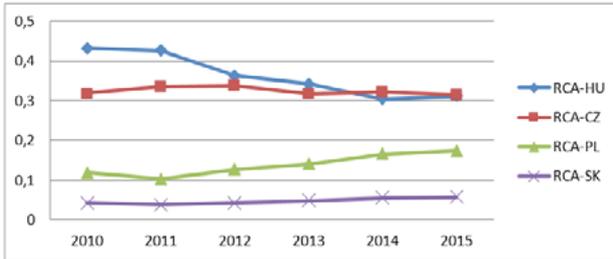


Source: Authors' own elaboration based on GUS (Central Statistical Office) database.

Economic growth of regions stimulates the development of new technologies and the increase in significance of countries on the international stage through improvement of innovativeness of economy.

The first step in assessing the convergence process is to estimate the revealed comparative advantage index, developed by B. Balassa.

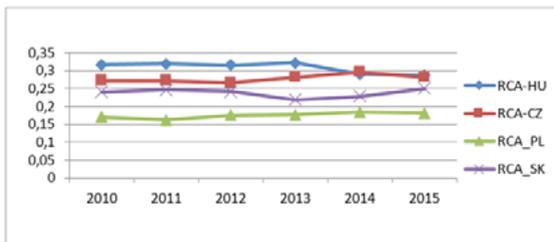
Figure 2 **Balassa's revealed comparative advantage index in individual V4 countries in export of high-tech sector commodities in the years 2010-2015**



Source: Author's calculations.

RCA values in individual V4 countries show that none of the countries has a revealed comparative advantage in exports of new technology commodities compared to the analyzed reference group. The situation for employment in the high-tech sector is similar, where the revealed comparative advantage index was at a lower level than RCA referring to the export of high-tech products, which also indicates that none of the countries of the region had a revealed comparative advantage.

Figure 3 **Revealed comparative advantage index for employment in the high-tech sector in the Visegrad Group in the years 2010-2015**

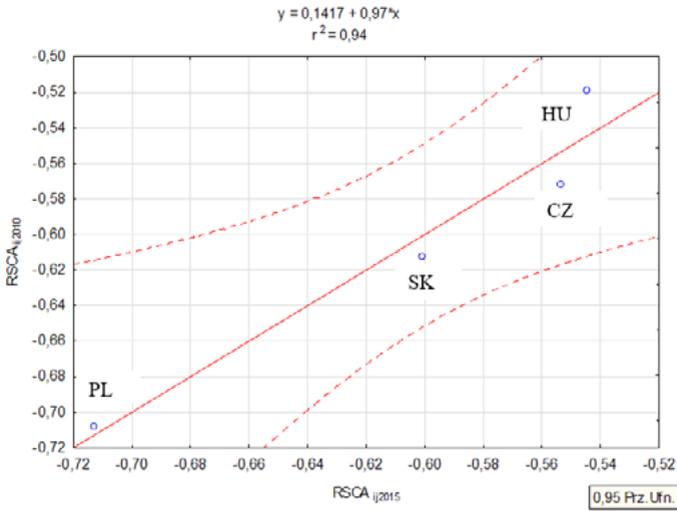


Source: Author's calculations.

Based on the estimation of the revealed comparative advantage index and the revealed symmetric comparative advantage index for exports of high-tech

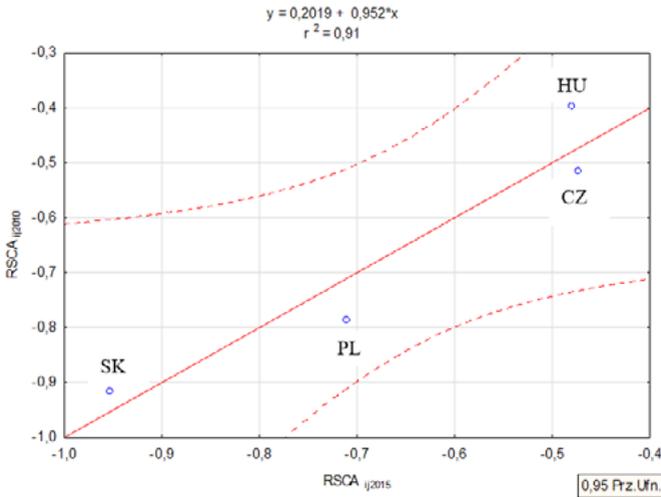
commodities and for employment in this sector, type β regression equation was estimated, and its form is presented in the breakdowns below.

Figure 4 Predicted values against the observed values. Employment convergence in the high-tech sector in the Visegrad Group in the years 2010-2015



Source: Author's calculations.

Figure 5 Predicted values against the observed values. Export convergence of high-tech sector commodities in Poland, Slovakia, the Czech Republic and Hungary in the time series 2010-2015



Source: Author's calculations.

When comparing the share of exports of high-tech commodities in the V4 countries in the years 2010-2015, an increase in value in Poland and Slovakia can be observed (Figure 4). In this respect, Hungary recorded the highest drop, and the Czech Republic recorded slightly lower depreciation. In the sphere of employment in high-tech, the V4 countries have not shown significant changes in recent years (Figure 3). The best situation is in Hungary and the Czech Republic, and the worst in Poland, where the share in employment in new technologies did not reach even 3%.

The Visegrad Group is characterized by similarity in economic development in relation to global economies. Also in the high-tech sector there is convergence in the development of new technologies or a knowledge-based economy. Value of parameter β within the $[0, 1]$ range in the above-mentioned analyses ($\beta_{\text{export}} = 0.95$; $\beta_{\text{employment}} = 0.97$) is indicative of the occurrence of technological convergence in the studied reference group. The V4 countries reached similar values of the revealed comparative advantage index, both in the share of exports of new

technology products in the total exports of the countries and in the sphere of employment in high-tech.

4 Comparison of startup ecosystems in the V4 countries

According to data of Startup Poland Foundation, there were 2677 startup enterprises in Poland in 2016. Compared to 2015, an over ten percent increase in the number of startups was recorded. The biggest ecosystem was created around the capital – Warsaw. Moreover, there is an increasing number of enterprises and institutions that affect their development in such cities as: Kraków, Poznań, Wrocław and Trójmiasto. Startup Poland conducted a study in 697 operating enterprises. Almost 60 percent of the respondents estimated the number of full-time positions offered by the company (classifying them, with respect to the number of employees, as micro-enterprise) to be between one and ten. Within the second half of 2016, more than half of startups created, on average, new workplaces for two people. In every fourth enterprise, four to ten people found a job, and about six percent of the respondents employed more than eleven people. In total, more than 80 percent of the respondents increased the number of workplaces. From the employee's perspective, it is negative that almost half the personnel of all startups do not have a permanent employment contract (Skala A. & Kruczkowska E. 2016), which results mainly from the specificity of the industry.

Startup ecosystem in Slovakia is characterized by young age of founders of these enterprises, where more than 80 percent are very well-educated people in the 20-40 age range. The unemployed who cannot find employment in institutions and enterprises operating in the market often decide to open their own business. As beginning entrepreneurs, they can get various kinds of financial aid for the development of their business. In Slovakia, it is Bratislava and Slovak Western Region that appear to create the most favorable conditions for development of startups because of their high percentage in this area. Almost half of the companies did not hire a single employee within a half-year period. On average, two employees were hired in more than 30 percent of startups, 12 percent of the entrepreneurs created workplaces for seven people, and only two percent of the companies hired about 15 new employees. Five percent of the companies created more than 20 full-time positions. Only a quarter of the startup owners did not intend to hire new employees in the next months. Compared to the Polish startup ecosystem, in Slovakia there are definitely more companies (more than 20 percent) that have patents. This may be indicative of a higher degree of innovativeness of products and services. The greatest challenges the authors of breakthrough services and

products face include: entry into a foreign market, the tax issue, complicated regulations, legislation and other administrative burdens. When it comes to company's internal environment, over half of the respondents paid attention to raising capital and to Human Resource (HR), namely the selection of competent personnel without which no business can function properly (Dzurovcinova P. 2016).

In the Czech Republic, a base of 550 startup businesses was created. About one-fifth of the subjects took part in a study whose results were presented in a report published in 2016. More than 60 percent of the respondents regard their products and services as innovative, and every fourth one improves the existing assortment. In most cases, company owners are within the 20-39 age range and they have higher education. Prague appears to be the birthplace for the largest number of Czech startups, where over half of them operate. Almost 65 percent of the respondents hired new employees in the last half year, while most created workplaces for two people, on average. Every third respondent declares the willingness to hire between four and ten employees in the coming months of their business activities, and little more than 18 percent do not intend to expand their personnel. Three and a half percent of the startups plan to make a considerable investment into human capital, forecasting employment of more than 20 people. Seven percent of the companies want to hire between 11 and 20 employees, and over 40 percent – between one and three people (Havlikova D. & Staszkiwicz M. 2016). Compared to Poland or Slovakia, the Czech Republic has the greatest number of patent enterprises, where 35 percent of the companies registered a patent or trademark. Every fourth company only modernizes its product, and in more than 60 percent of the enterprises an entirely new, innovative product or service are created. A remarkably high percentage of respondents talk about informal cooperation with research units or universities in order to obtain new ideas. Bearing in mind the constant lack of agreement between science and business, it is possible that the Czech Republic is slowly reaching a consensus on this issue.

Hungarian database of startups is the biggest collection compared to the other Visegrad Group countries. Information is gathered among 131 companies connected with technological novelties. The latest available data is from 2014. In that period, every second startup was in the early development stage, every third business was legalized, every tenth had already reached economic efficiency. The IT industry, software, and the broadly understood area of social mobility have become the main technologies of the analyzed group of companies. Target groups, to which products and services are addressed, are divided into two areas, namely business and society. As many as 81 percent of the enterprises declare they are going to create new workplaces.

Development of startup ecosystems through creation of successive companies that offer innovative products and services contributes to appreciation of the level of new technologies in national economy. Increase in the number of startups has a beneficial effect on competitiveness and innovativeness of a country. Currently the main challenge for every country in the world is the drive towards development in the high-tech sector, which can be seen also in the principles of the 2020 Strategy, announced and executed by the European Union. The aspirations to increase funds directed into Research and Development (R&D), which are expected to exceed 3% of European GDP, are supposed to result in technological development of the member states. All activities within the European Union relating to the R&D sector as well as development of innovative companies in individual countries contribute to accelerating the process of technological convergence of less developed countries towards stronger countries.

5 Conclusion

Currently, the convergence process is desired in every sector of economy of developing countries. In the era of rapid technological progress, this particularly applies to the high-tech sector, which appears to be developed best in the United States. The region characterized by relative homogeneity in the level of economic development is the Visegrad Group, consisting of Poland, the Czech Republic, Slovakia and Hungary.

After estimation and analysis of the Balassa's revealed comparative advantage index, the revealed symmetric comparative advantage index, and type β regression, the first of the research hypotheses put forth in this paper (saying about a similar level of gradual technological convergence in the Visegrad Group countries) was confirmed. Another thesis turned out to be wrong, which was indicated by the estimated values. Currently, none of the analyzed countries has a comparative advantage either in employment or in the exports of commodities of the high-tech sector. The last assumption referring to the influence of startup ecosystems on the process of technological convergence can be regarded as correct since startups have an indisputable impact on the development of innovativeness and competitiveness, and on the technological progress. Comparison of startup ecosystems in V4 showed Poland's domination with respect to the number of established companies, and domination of the Czech Republic when it comes to the number of obtained patents. Taxes are an important aspect strictly connected with hiring employees. In this extent, the Visegrad Group countries should focus on introduction of the so-called startup tax, which is a great help when it comes to employee remunerations. The future of the economy of the Central and Eastern

Europe countries is based on the development of a knowledge-based economy and on creation of new technologies, and this can be achieved through appreciation of funds directed to research and development as well as to supporting the development of startups, which actually build the competitiveness and innovativeness potential of a country.

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