

Bockova, Nina; Meluzin, Tomas; Skapa, Stanislav

Working Paper

Europa 2020 Strategy target in R&D sector: Visegrad group countries

Institute of Economic Research Working Papers, No. 15/2017

Provided in Cooperation with:

Institute of Economic Research (IER), Toruń (Poland)

Suggested Citation: Bockova, Nina; Meluzin, Tomas; Skapa, Stanislav (2017) : Europa 2020 Strategy target in R&D sector: Visegrad group countries, Institute of Economic Research Working Papers, No. 15/2017, Institute of Economic Research (IER), Toruń

This Version is available at:

<https://hdl.handle.net/10419/219838>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



<https://creativecommons.org/licenses/by/3.0/>



Institute of Economic Research Working Papers

No. 15/2017

Europa 2020 Strategy target in R&D sector: Visegrad group countries

Nina Bockova, Tomas Meluzin, Stanislav Skapa

Article prepared and submitted for:

9th International Conference on Applied Economics Contemporary Issues in Economy, Institute of Economic Research, Polish Economic Society Branch in Toruń, Faculty of Economic Sciences and Management, Nicolaus Copernicus University, Toruń, Poland, 22-23 June 2017

Toruń, Poland 2017

© Copyright: Creative Commons Attribution 3.0 License

Nina Bockova, Tomas Meluzin, Stanislav Skapa
bockova@fbm.vutbr.cz
Department of Economics, Faculty of Business and Management, BUT
Kolejní 2906/4, Brno 612 00, Czech Republic

Europa 2020 Strategy target in R&D sector: Visegrad group countries

JEL Classification: *O11; O47; O57*

Keywords: *economic growth; Visegrad Group; comparative study; regression analysis; Europe 2020 strategy*

Abstract

Research background: This contribution analyses the relationship between Research and Development funding's and economic growth within the Visegrad Group during the period 2005-2014. The studied geographical area is regions NUTS 2 of the Visegrad Group. The indicators considered in this contribution are GDP per inhabitant, percentage of GERD performed by business sector and GERD as percentage of GDP. The econometric analysis show that R&D Intensity is an important driver of economic growth ($R = 0.64$) that is measured by GDP per inhabitant in PPS. This contribution is the result of a two-phase research fellowship funded by the Internal Grant Agency of the Brno University of Technology. The first phase project research produced a regression analyze with dependent variable GDP per inhabitant and independent variable GERD as percentage of GDP. In the second phase of the research were formulated econometric models.

Purpose of the article: This contribution answers the following question: Can the Visegrad Group Members reach the Europa 2020 Strategy target in R&D, i.e. 3% of GDP to be invested into the R&D sector.

Methodology/methods: This research uses Eurostat database for the analysis of the relationship between R&D funding by the business sector and the corresponding economic growth. The research is based on dependent variable GDP per capita and independent variables: GERD and R&D Intensity during the period 2005-2014. The fit goodness of the model is evaluated the determination coefficient, using T-test on the regression coefficients. The autocorrelation in the residuals is checked by applying the Durbin-Watson (D-W) test. The statistical analyze is performed by using Stepwise Multiple Regression in software STATISTICA 12.

Findings: Main result of research provides relationship between economic growth measured by GDP per inhabitant and R&D expenditures as percentage of GDP. The studied statistical data set is 38 NUTS 2 regions in Visegrad Group. If the Visegrad Group regions will the 3% target then GDP PPS per inhabitant in

equal to 29,276. The result of the research can be used for the Visegrad Group governments.

Introduction

The Visegrad group countries, The Czech Republic, Slovakia, Poland and Hungary, as European Union Members, belong to the second largest economy in the world (provided the European Union is regarded as a single entity) in nominal terms and according to purchasing power parity (PPP). The Visegrad Group (also known as the “Visegrad Four”, or simply “V4”) reflects the efforts of the countries of the Central European region to work together in a number of fields of common interest within pan-European integration. All the activities of the Visegrad Group are aimed at strengthening stability in the Central European region. The participating countries perceive their cooperation as a challenge and their collective success as the best proof of their ability to integrate into structures such as the European Union.

All the V4 countries had aspired to become members of the European Union, perceiving their integration in the EU as another step forward in the process of overcoming artificial dividing lines in Europe through mutual support. They achieved this goal in 2004 (1st May) when they all became members of the EU. The V4 Group Member countries approved the Europe 2020 strategy and are striving to fulfil the targets deriving from it. To measure progress in meeting the Europe 2020 goals, 5 headline target areas have been agreed upon for the EU as a whole. One of these headline target areas is Research and Development (R&D). A common target is 3% of GDP to be invested in the R&D sector.

The purpose of the research is to find the answer the following question: Can a Visegrad Group Member reach the common target of the Europe 2020 Strategy in R&D? Individual countries may adjust the targets according to their abilities and capacities.

Table 1. V4 Members’ Target in the R&D Sector (%)

Country	Target 2020 (C/EU)		Actual Result
Czech Republic	1.0*	3	1.95
Slovakia	1.2	3	1.18
Poland	1.7	3	1.00
Hungary	1.8	3	1.38

* Note: Only government sector

Source: Headline Indicators (2016); European Commission (2017a)

Objectives were reduced by Member countries of the V4 to a lower level. See Table 1.

The study was conducted using the estimated relationship between GDP per inhabitant and regional R&D Intensity for 31 NUTS 2 regions in the period 2005 – 2014. The indicators used in the analysis are GDP per inhabitant, Gross Domestic Expenditure on Research and Development (GERD) and R&D Intensity. The data were described using descriptive statistics, analysed for autocorrelation and findings were displayed as the parametric estimation of the econometric models.

Literature Review

From the standpoint of economic theory can, in principle, to distinguish the two main approaches to economic growth, which are valid both at the national and regional level. The first approach is the supply-oriented approach based on the aggregate production function. To this category belong to the neoclassical model of economic growth associated with R. Solow (Coccia, 2013, pp. 5-20). On the micro-economic level can be included in this category input-output analysis. It comes out of the Leontief production function (Čadil, 2010).

The relationship between R & D expenditures and economic growth for China analyzed Peng (2010). The conclusion was that GDP will increased by approximately 0.92% if R & D expenditures increase by 1%. No significance positive impact among R & D, productivity and economic growth show (Samimi & Alerasoul, 2009, pp. 3464-3469) in a sample of 30 developing countries. Instead, Coccia (2010, pp. 730-738); Coccia, (2011, pp. 121-130) shows, across advanced countries, that R & D expenditure financed by public funds is a complementary input to R & D expenditure supported by private funds. A study to determinate whether there is a similar relationship in terms of R & D intensity and growth between small and medium enterprises with high technology and those who lack high technology published Nunes et al.(2011, pp.36-53). According to the findings, R & D intensity, and encourages them to grow at higher levels.

However, R & D intensity restricts the growth of organizations without high technology regardless of the level of R & D level. Sadraoui et al. (2014, pp. 7-21) analyzed the causality between economic growth and R & D collaboration by using panel data of 32 developed and industrialized countries for the long-term period 1970-2012. Their results obtained support the argument that there is a strong causality between R & D collaboration and economic growth.

The relationship between R & D expenditures and economic growth in Turkey was tested and explained with Johansen co-integration tests and

vector error correction model by using the data for the period 1998 – 2013. Empirical findings obtained suggest that causality from economic growth to R & D exists (Bozkurt, 2015, pp. 188-198).

Visegrad countries are small open economy, which were accepted by the EU member countries in May 2004. Economic situation was several years after the entry unfavorable. The long-term sustainability of higher growth rates or their further increases still remain the key issue. Low productivity per hour worked remains one of the key indicators of lagging behind in the EU-4. The main source of its increase is especially an improvement in the intensity of economic activities in terms of quality-intensive processes. As far as research and development is concerned, the Visegrad countries lag behind the EU-25 average in most of the structural indicators, both in terms of inputs and outputs, i.e. R & D expenditures, the share of the business sector in these expenditures, availability of venture capital, patent applications and percentage of high-tech exports (Kadeřábková, 2008, pp. 474-487).

Nevima (2012, pp. 3-15) compared level of competitive potential in NUTS 2 regions of the selected EU V4 countries in the reference period 2000 - 2008. The level of R & D expenditure as an indicator of the EUROPE 2020 strategy was compared with the EU-28th Findings showed that Poland in particular must increase R & D expenditure (Balcerzak, 2015, pp. 190-210).

The analysis in the Visegrad Group indicated that it was possible to achieve the economic growth measured by the GDP per inhabitant while reducing CO2 emission. Trend analysis shows that the population of EU in the 2014 increased only by about 2% in relation to 2006, while the GDP grew by almost 14.6% (Bluszcz & Kijewska, 2017).

This paper is characterized using a regression analyses and estimate relationship between R & D expenditure, R & D intensity and GDP per inhabitant in case of Visegrad countries NUTS 2 regions in the period 2005 - 2015. The analysis is based on longitudinal data of Eurostat in the chosen period of time for 31 regions. The next part of the paper is structured as follows: the next section provides a theoretical introductions and proposals of an econometric regression using Ordinary Least-Squares method. Section “Results and findings” contains the analysis and parametric estimations of the econometric model. The final part performs summary of key findings.

Method of the Research

Our research analyses two datasets for the analysis of the relationship between Research and Development funding and regional economic

growth. The first is the Eurostat database – Europe 2020 indicators - Gross domestic expenditure on R & D (European Commission, 2017a), which collects one headline indicator relating to the economic system and the regional innovation system. The second database is also a Eurostat database – Main GDP aggregates per inhabitant (European Commission, 2017b). Both databases refer to 2004 and 2015. The indicator used in this research is:

GERD as a percentage of GDP

The geographical area in question is the regions of the Visegrad Four. Time series are available from 2005 to 2014. Indicators are calculated using the current EUR. Our research examines the crucial question: Can the Visegrad Group Members reach the Europe 2020 Strategy target in R & D; i.e., 3% of GDP to be invested into the R & D sector? The answer to question is based on the model within following variables:

1. Gross domestic product (GDP) at current market prices by NUTS 2 regions (Purchasing power standard (PPS) per inhabitant)
2. Regional R & D intensity

Table 2 shown describe of the variables and time series analysed in this contribution.

Table 2. Description of the variables

Indicators	Acromyns and period	Description
R & D intensity	R & D_ 2007-2011	Regional R & D intensity is defined as total intramural expenditures on R & D performed in the sub-national territory
GDP per inhabitatn in PPS	GDP_IH_PPS_2010-2015	GDP per inhabitant is a measure of average income per person in a country. The volume index of GDP per inhabitant in Purchasing Power Standards (PPS) is expressed in relation to the European Union (EU28) average set to equal 100

The model is:

$GDP \text{ per inhab} = f(R \& D \text{ Intensity, GERD as percentage of GDP}).$

The statistical data published in the Eurostat databases have been cleaned of the horizontal and vertical and descriptive statistics have been

calculated. The normal distribution has been checked by through a mean calculation of and the descriptive analysis is based on the arithmetic mean, standard deviation, skewness and kurtosis (Girone et al., 2015, pp. 481-507) in the Statistica 12; see Table 3. One of the methods used the concept of the relationship of GDP and GERD developed by Coccia (2008, pp.1-27). The parametric equations given above were estimated by means of all regions with a multiple regression analysis using STATISTICA 12 software. The endogeneity of the model is overcome by taking into consideration the time lag between dependent (GDP per inhabitant) and independent (R & D Intensity) variable; in particular the period of the explanatory variables are (a,n), while the period of the GDP per inhabitant variables is (n+1, m), where a, n and m belongs to N . N there denotes the set of all natural numbers. The fit goodness of the model is evaluated by the determination coefficient, using the T-test on the regression coefficients. The autocorrelation in the residuals is checked by applying the Durbin-Watson (D-W) test. The statistical analysis is performed using Stepwise Multiple Regression in software STATISTICA 12.

Result of empirical analysis

The descriptive statistics display the normal distribution of the variables studied. This makes it possible to provide an econometrics regression analysis. For descriptive statistics, see Table 3.

Table 3. Descriptive analysis of the variables from the Eurostat data set in Different Periods

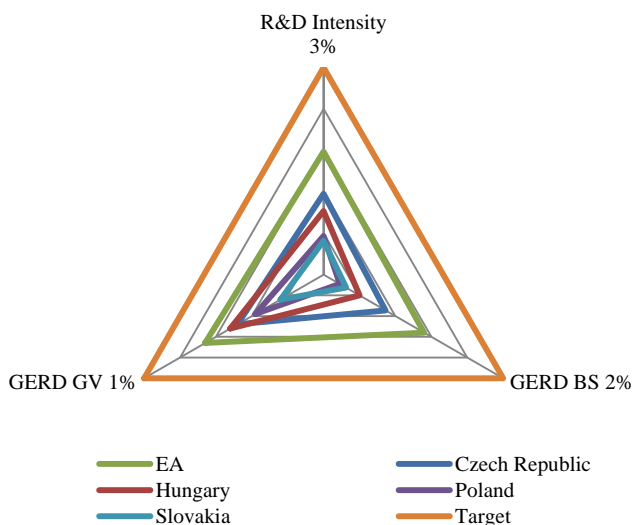
Statistics	N. valid	Mean	Std. deviation	Skewness	Kurtosis
Mean PPS 2005 -2010	38	15,880.83	7,374.07	2.478	6.885
Mean PPS 2011-2015	38	19,143.00	8,191.56	2.534	7.334
R & D In 2005-2008	38	0.66	0.47	1.336	1.856
R & D In 2009-2013	38	0.90	0.54	0.925	0.359

The expected outcomes are that all the explanatory variables are positive in their respective equations.

The situation with of the development of the indicators is shown graphically. The Europe 2020 strategy targets R & D expenditure in the economy as a whole with the distribution of R & D expenditure financed by the Government and the R & D expenditure financed by the business sector, while the Czech Republic has always been the country with the highest R & D expenditure. The Czech Republic is a Moderate Innovator. The innovation performance relative to the EU was at 83.1% in 2015. Hungary is considered as a Moderate Innovator country, its innovation performance to the EU had fluctuations, over time it had declined from almost 70% in 2008 to

68% in 2015. Slovakia is a Moderate Innovator too. Innovation performance relative to the EU reached a peak in 2014 at almost 68% of the EU mean and was at 67% in 2015. The Slovak Government has stepped up its funding of R & D expenditure in percentage of GDP. Poland's innovation performance has increased from 58% in 2008 to 59% in 2009, after that has declined to 56% in 2015. Poland is the Moderate Innovator, but seven regions are considered as Modest Innovator. (European Innovation Scoreboard, 2017) For the situation of the Gross Domestic Research and Development Expenditure and GDP per inhabitant see fig. 1 - 4.

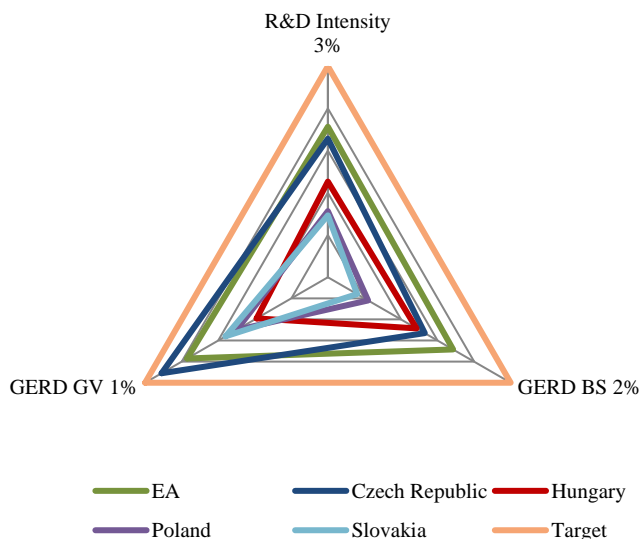
Figure 1. The Situation in 2005



Source: Authors' own calculations based on Eurostat (2017)

In order to make the figures more comparable, GERD is often expressed relative to GDP, also known as R & D intensity. This ratio increased modestly in the EA during the period of 2005 to 2009, rising from 1.78% to 1.99%. The indicator stagnated in the following two years. Between 2011 and 2014 it increased more rapidly, reaching 2.14%, despite a small decline in 2015; R & D intensity decreased slightly to 2.12% in 2015. Despite the increase in recent years, the EA's R & D expenditure relative to GDP remained well below the corresponding ratios recorded in Japan (3.59%, 2014 data) and the United States (2.73%, 2013 data), as it has for quite some time. In 2014, R & D intensity in South Korea surpassed that of the EA, with South Korea R & D expenditure equivalent to 4.29% of GDP.

Figure 2. The Situation in 2015

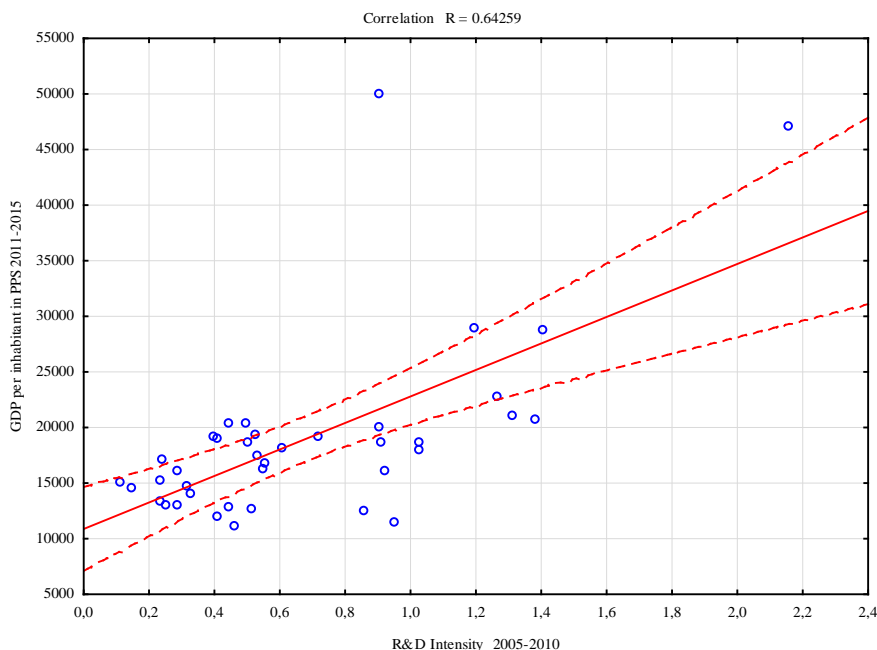


Source: Authors' own calculations based on Eurostat (2017)

Nearly all V4 Member States reported a higher R & D intensity in 2015 than in 2005. The greatest increases in R & D intensity (in terms of percentage points) between 2005 and 2015 were recorded in Slovakia, more than 140%. R & D expenditures are mainly stimulated by government spending in the Slovak Republic and in the Czech Republic. Organisational intensity of R & D spending is the most in Hungary.

It is important to note that the relationship between R & D spending and income measured as GDP per inhabitant is most likely a two-way relationship. If this is the case, the spillover approach captures the correlation between R & D spending and the increase in the productivity on the supply side of the regions; next step is increase and hopefully a positive correlation on the demand side. For the regression analysis between dependent variable GDP per inhabitant in PPS 2011 – 2015 in the V4 regions and R & D Intensity 2005 – 2010 see figure 3.

Figure 3. Regression of GDP in PPS per inhabitant in 2011-2015 on R & D Intensity in 2005-2009



* 0.95 confidence level

Table 4. Parametric estimation

X _i = GDP per inhabitant in PPS	R=0.642585*	F=26.02	t=5.839	DW=1.61	p=0.000	N=39
Y _i = R & D Intensity	R ² =0.412515					
Forecast	R & D Intensity = 3.00					
	GDP per inhabitant in PPS = 29,642.44**					

* Significant at 5 percent level, ** at -0.95%PL

Source: Authors' own calculations

The results indicate that the R & D Intensity has a positive effect on the economic growth in the V4 regions as measured by GDP per inhabitant. The regression coefficient is positive and statistically significant at the 5 percent level. This result indicates that increasing levels of GDP per inhabitant in PPS are associated with higher levels of R & D Intensity in the regions. The result from D-W serial correlation tests indicate that problem of autocorrelation is mitigated as additional independent variables are added to the model. The D-W statistic is 1.613894 for equations in table 4. For 39 observed values, the test statistic is over the critical D-W test value, and

thus no autocorrelation is shown. Taken together, the various diagnostic statistics presented in Table 4 corroborate the robustness of the results from the model.

Table 6 The best Regions of each V4 country: Development in the period 2005-2015 (%)

Name of region	The best percentage increase	
	GDP per inhabitant	R & D Intensity
CZ – Stredni Morava	46	
CZ – Jihovýchod		147
PL – Dolnolaskie	86	
PL – Podkarpackie		376
HU – Nyugat-Dunántúl	49	
HU – Közép-Dunántúl		167
SK - Stredné Slovensko	68	153

Source: Authors' own calculations

Table 6 shows the biggest increase of the explanatory variables in the V4 countries. It does not apply here that the higher R & D expenditure corresponds to a higher GDP per inhabitant.

Conclusion

Contrary to expectations and to much of the literature (Coccia, 2008), it is not true that the higher the R & D Intensity is, the higher is the economic growth. The research policy suggestions of the Europe 2020 strategy may stimulate the small, open economics such as the Visegrad Four Member States to reach a higher R & D expenditure with an increase in the GDP per inhabitant in the following period. Figure 3 shows that the Bratislava region and Prague had different R & D Intensity mean before the world economic crisis period, but had similar GDP per inhabitant in PPS as a mean in 2011-2015. The predicted forecast shows that after reaching a level of R & D Intensity of 3% of GDP; GDP per inhabitant in PPS may reach 29,642.44. The EU-28 achieved a value of 26,900 in 2016, but the advanced economies such as Norway or Sweden have a GDP per inhabitant in PPS of 67,700 or 42,500. If the results hold true, then to promote economic growth, there is a real need for policies that change the R & D policy in the V4 countries. As of now, it is clear that the achievement of a full-fledged target of Europe 2020 strategy is unrealistic for the V4 countries. In the long-term, if it is truly the case, modern government in developed countries are more prone to push R & D expenditure by the government sector beyond their optimum as one of the factors of economic growth. The driving force then must be the business sector. The organizations themselves must be cost-effective investments in R & D as the driving force to increase in

their own competitiveness and achieve higher added value on the own productions.

This study indicates that the V4 countries show positive growth consequences of higher R & D Intensity. Therefore, economic growth is one factor that needs to be considered in deciding on the optimum R & D Expenditure or R & D Intensity. However, it should be kept in mind that this is not the only factor.

References:

- Balcerzak, A. (2015). Europe 2020 strategy and Structural Diversity Between old and new Member States. Application of zero Unitarization Method for Dynamic Analysis in the years 2004-2013 [Online]. *Economics & Sociology*, 8(2), 190-210. DOI: <http://dx.doi.org/10.14254/2071-789X.2015/8-2/14>
- Bluszcz A., Kijewska A., Economic growth and the level of emission of the Visegrad Group compared to other EU countries. 20th International Scientific Conference "Enterprise and Competitive Environment", March 9–10, 2017, Brno, Czech Republic
- Bozkurt, C. (2015). R & D expenditures and economic growth relationship in Turkey. *International Journal Of Economics And Financial Issues*, 5(1), 188-198.
- Coccia, M. (2008). Science, Funding and Economic Growth: Analysis and Science Policy Implications. *World Review of Science, Technology and Sustainable Development*, 5(1), 1-27.
- Coccia, M. (2010). The Asymmetric path of Economic Long Waves [Online]. *Technological Forecasting And Social Change*, 77(5), 730-738. DOU: <https://doi.org/10.1016/j.techfore.2010.02.003>
- Coccia, M. (2011). The interaction between public and private R & D expenditure and national productivity [Online]. *Prometheus*, 29(2), 121-130. DOI: <https://doi.org/10.1080/08109028.2011.601079>
- Coccia, M. (2013). *Population and technological innovation: The optimal interaction across modern countries*. St. Louis: Federal Reserve Bank of St Louis. Retrieved from <https://search.proquest.com/docview/1698271674?accountid=17115>
- Čadil, J. (2010). Regionální ekonomie: teorie a aplikace. V Praze: C.H. Beck.
- Eurostat - Tables, Graphs and Maps Interface (2017a) table. (n.d.). Retrieved January 06, 2017, from http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=t2020_20&plugin=1
- European Commission. (2017b). Gross domestic expenditure on R & D. Retrieved from European Commission. (2017). Main GDP aggregates per capita. Retrieved from http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nama_10_pc&lang=en (25.01.2017).

- European Innovation Scoreboard - Growth - European Commission. (2017). Retrieved February 12, 2017, from http://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards_en
- Your key to European statistics. (2016). Retrieved June 22, 2017, from <http://ec.europa.eu/eurostat/web/europe-2020-indicators/europe-2020-strategy/headline-indicators-scoreboard>.
- Girone, G., Massari, A., & Manca, F. (2016). The relation between the mean difference and the standard deviation in continuous distribution models. *Quality & Quantity*, 51(2), 481-507. DOI:10.1007/s11135-016-0398-y
- Kaderábková, A. (2008). Competitiveness of Visegrad countries [Online]. *International Journal Of Productivity And Performance Management*, 57(6), 474-487. DOI: <https://doi.org/10.1108/17410400810893419>
- Nevima, J. (2012). Visegrad Four Countries – Case Study of Econometric Panel Data Model for Regional Competitiveness Evaluation. *Journal of Competitiveness*, 4(4), 3-15. DOI:10.7441/joc.2012.04.01
- Nunes, P. M., Serrasqueiro, Z., & Leitão, J. (2011). Is there a linear relationship between R & D intensity and growth? Empirical evidence of non-high-tech vs. high-tech SMEs. [Online]. *Research Policy*. DOI: <https://doi.org/10.1016/j.respol.2011.08.011>
- Statistics / OECD Science, Technology and Industry Scoreboard / 2011 /. (2016). Retrieved December 16, 2016, from http://www.oecd-ilibrary.org/sites/sti_scoreboard-2011-en/02/05/index.html?itemId=%2Fcontent%2Fchapter%2Fsti_scoreboard-2011-16-en
- Samimi, A. J., & Alerasoul, S. M. (2009). R & D and economic growth: New evidence from some developing countries. *Australian Journal Of Basic And Applied Sciences*, 3(4), 3464-3469.
- Sadraoui, T., Ali, T.B. & Deguachi, B. (2014). Testing for Panel Granger Causality Relationship between International R & D Cooperation and Economic Growth. *International Journal of Econometrics and Financial Management* 2, 1, 7-21. DOI: 10.12691/ijefm-2-1-2.
- Stoneman, P. (1979). Kaldor's law and British economic growth: 1800–1970. *Applied Economics*, 11(3), 309-319. DOI: <https://doi.org/10.1080/758531543>.