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R&D IN THE CONTEXT OF EUROPE 2020 IN SELECTED COUNTRIES

Abstract*. The article deals with the issue of R&D in selected countries formulated in the Europe 2020 strategy in terms of the total volume of expenditure incurred for these activities, the structure of expenditure, their share to the GDP of countries and other partial indicators, which point to differences in R&D areas between analyzed and compared countries. The object of analysis and comparison are three countries (Czech Republic, Greece and Portugal), which have been selected based on the criteria of comparability in terms of population. Part of the article will predict the expected development of the indicator expressing the share of expenditure on R&D in GDP of countries in order to determine whether the targets set for each country are achievable by 2020. If the evolution of the indicator follow in the future according to significant linear model, the Czech Republic would continue to reach the target value related to the share of business expenditure in the GDP. However, Portugal would be the most lagging behind the national target and Greece would gradually approach the target, but it did not reach it by 2020.*

Keywords*: research, development, target, Europe 2020, prediction.*

JEL Classification: O11, O30

1. Introduction

The transition to knowledge-based economy and society for most countries is a challenge. These challenges resulted from the objectives formulated in the Lisbon Strategy, but also of the objectives defined in the currently valid

strategy Europe 2020. The development of innovation and technology is considered as the most important factor of competitiveness and the most effective means to meet its objectives (Dino. A., Sánchez. R., 2017).

Research, development and innovation are the main source of long-term profits, business success and competitive advantage. The basis of success is to know the market and its customers. However, the research, development and innovation activities do not bring value only for customers but also for company shareholders, employees, entire company and thus for society as a whole. Only the balance of these values gives a chance for long-term success (Strielkowski. W., Čábelková. I.,2016).

The European Union deals with the issue of research, development and innovation for a long time. In the past, the issue of the competitiveness of the whole economy dealt a Lisbon Strategy, whose main objective was for the EU to become by 2010 "the most competitive and dynamic knowledge based economy in the world capable of sustainable economic growth, which will be better and more jobs and greater social cohesion " (Ministry of Finance SR, p.2). This daring target could be achieved only through rapid and long-term economic growth, so that the countries will in a market economy create favorable conditions for the growth of competitiveness of the economy (DuľováSpišáková, 2016). In 2005, due to a lack of fulfillment of the objectives was the original Lisbon strategy revised and began using the name of the Lisbon Strategy for growth and jobs. The objectives of the strategy were divided into several areas, for example employment, R&D, economic reforms, social cohesion and environmental protection. Given that most of the objectives have not been achieved for the EU as a whole (also because of the current economic crisis), the European Commission decided to create a new strategy called Europe 2020.

2. Theoretical framework

Currently, research, development and innovation are one of the five objectives which form the basis of the strategy Europe 2020. These objectives are translated into national targets in each Member State, which took account of individual conditions and background of each country. The objectives allow monitoring and evaluating progress in meeting the priorities of the Strategy. For the EU, were set following values (Figure 1), which should be achieved by 2020.

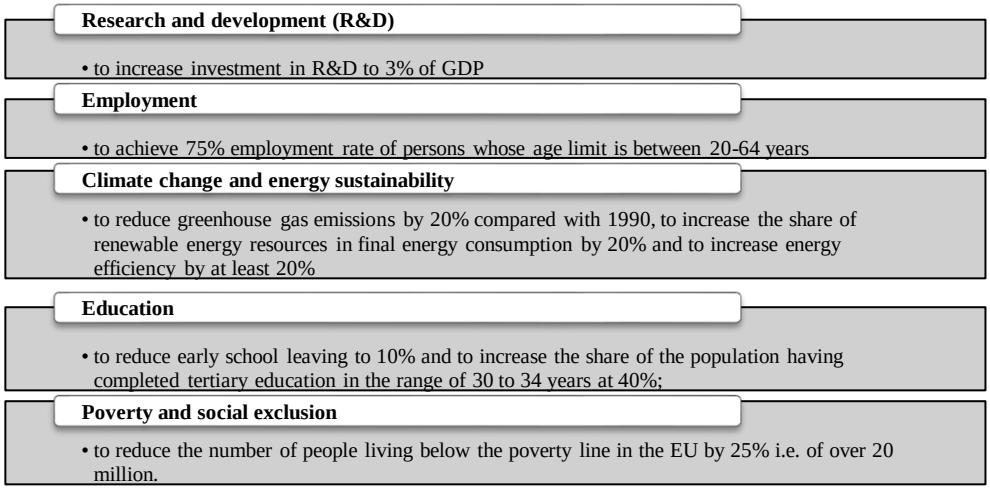

Figure 1.Objectives of Europe 2020
Source: European Commission, 2010

The validity and importance of defined objectives is criticized and their mutual interdependence is discussed. The issue of the feasibility of achieving the objectives dealt Colak and Ege (2011) but also Leschke, Theodoropoulou, Watt (2012). Colak and Ege (2011) developed their own composite indices observing the performances of member and candidate countries in a single indicator for overall strategy and for each priority of growth. Their results point out strong leadership Nordic EU countries in almost every study area, but especially in the field of R&D. Rappai (2016) proposes new, more effective comprehensive index, which measures how close are the Member States to achieve the targets, even with regards to the diversity of growth rates of individual countries. Nolan and Whelan (2011) point out that employment growth does not always necessarily lead to a reduction in the number of people at risk of poverty. They realised analyses, according to which a target for reducing poverty is not worded correctly. Marx, Vandenbroucke and Verbist (2014) used to test similar hypotheses regression analysis. Marlier and Natali (2010) provides a comprehensive view on the issue of social policy in Europe 2020. Given that the Europe 2020 strategy follows the Lisbon strategy, much attention is paid to the comparison of these two strategies in contributions that authors are Martens (2010), Soriano and Mulatero (2010). The area of research is the issue of the impact of the strategy on society (Natali, 2010), (Stubbs, Zrinak, 2010), (Frazer, MarlierNicaise, 2010), (Lundvall, Lorenz, 2012).

Despite numerous critics was the strategy Europe 2020 adopted and implemented at the national level. Attention is therefore drawn to the achievement

of the objectives in all areas by individual countries, which will ultimately contribute to achieving the objectives for the EU as a whole.

One of the indicators assessing the level of R&D in the country is an indicator reflecting the share of gross domestic expenditure on R&D in the country's GDP. This ratio indicator is used to monitor the achievement of one of the objectives of the Europe 2020 strategy, which is that the EU should increase expenditure on R&D into 2020 to 3% of GDP (European Commission, 2010). Stated target of the Strategy contains the partial target for the structure of expenditure on R&D. According to this partial objective, 1/3 of expenditure should come from the government sector and 2/3 of expenditure should constitute expenses of the business sector.

By 2010 from the member states of the European Union only two countries attained the average target value of the Union, Finland with the indicator's value of 3.73% of GDP and Sweden (3.22% of GDP). Just these two countries managed to complete the research power of South Korea (3.47% of GDP), Japan (3.25% of GDP) and other very developed countries of the world. From the group of the other member states the target value was close for Denmark (2.94% of GDP), Austria (2.74% of GDP) and Germany whose GERD was 2.74% of GDP. Considering that most of the countries were not able to meet their target values it was also necessary to set this target in the new ten-year plan.

Due to the underperformance of the original Lisbon Strategy, this article deals with the issue of R&D in selected countries formulated in the Europe 2020 strategy in terms of the total volume of expenditure incurred for these activities, the structure of expenditure, their share to the GDP of countries and other partial indicators, which point to differences in R&D areas between analysed and compared countries. Part of the contribution will forecast the expected development of the indicator expressing the share of expenditure on R&D in GDP of countries in order to determine whether the targets set for each country are achievable by 2020.

The object of analysis and comparison are three countries (Czech Republic-CZ, Greece-EL and Portugal-PT), which have been selected based on the criteria of comparability in terms of population. In 2014, Czech Republic had a population of 10.514 million inhabitants, Greece 10.788 million inhabitants and Portugal 10.413 inhabitants. The aim of the article is to point out that equally big countries are in the monitored area in a different stage of development in the area of R&D.

3. Data and methodology

During processing article were in addition to standard logic methods intended for processing data (methods of acquisition and data collection, analysis) and drawing conclusions (synthesis, induction) used mathematical and statistical methods (regression and correlation analysis).

Regression analysis was used to estimate the trends feature for predicting the expected development of the indicator expressing the share of expenditure on R&D in the country's GDP in 2020. Among the many variants of functions describing the present trend in the indicator was voted best statistically significant model. Function can meet the conditions F test, p-value and also have a significant coefficient of determination R2.

Size of the p-value refers to statistical significance, respectively insignificance of the individual regression coefficients and the constant on the significance level $\alpha = 0.05$. H0 says about insignificance of relevant coefficients and alternative hypothesis about its significance. If the p value < 0.05, regressor is statistically significant (p > 0.05 refers to the statistical insignificance).

The result of F test shows the statistical significance of the model as a whole on the significance level $\alpha = 0.05$. We tested hypothesis H0, that the model chosen to explain dependence is not suitable (alternative hypothesis says otherwise). If the result of F test is less than 0.05, H0 is rejected, i.e. model has been selected correctly and is statistically significant.

The coefficient of determination, which talks about the probability of achieving the predicted values in the future, also plays an important role in choosing the appropriate model In case that two or more of tested models is statistically significant, we select one with the higher coefficient of determination.

Used functions have the following mathematical descriptions:

Linear function: $y'_j = b_0 + b_1 x_j$ (1)

2nd order polynomial function: $y'_j = b_0 + b_1 x_j + b_2^2 x_j^2$ (2)

Logarithmic function: $y'_j = b_0 + \ln x_j$ (3)

Exponential function: $y'_j = b_0 \cdot b_1^{x_j}$ (4)

Power function: $y'_j = b_0 \cdot x_j^{b_1}$ (5)

Where: b_0 - constant, b_1, b_2 - the regression coefficient, y'_j - the value of the dependent variable, x_j – the value of the independent variable.

By correlation analysis was found the relationship between the resources that each sector spent on R&D funding. Results of the analysis in the form of graphs and tables have been processed in Microsoft Office Excel. Another used method was the comparative method. Spatial comparison was used for comparison of selected indicators in three EU countries (Czech Republic, Greece and Portugal). The trend comparison was used to examine development of the indicators over time.

In the article it was used the latest available data published in database of the EU statistical office (Eurostat) on the date 30-04-2017. Important observed and compared indicator were gross domestic expenditure on research and

development (GERD) indicating the total amount of expenditure on R&D coming from domestic and foreign sources that are incurred during a period of time on the territory of the countries.

4. Expenditure on research and development in selected countries

Based on the last accessible data from the Eurostat, in 2015 the first five countries with the highest value of expenditure on R&D of GDP are Sweden, Austria, Denmark, Finland and Germany. On the other side, the lowest share on the expenditure on R&D of GDP in 2015 was recorded mostly among the southern states of the European Union, for example Cyprus, Romania, Croatia, Malta and Latvia.

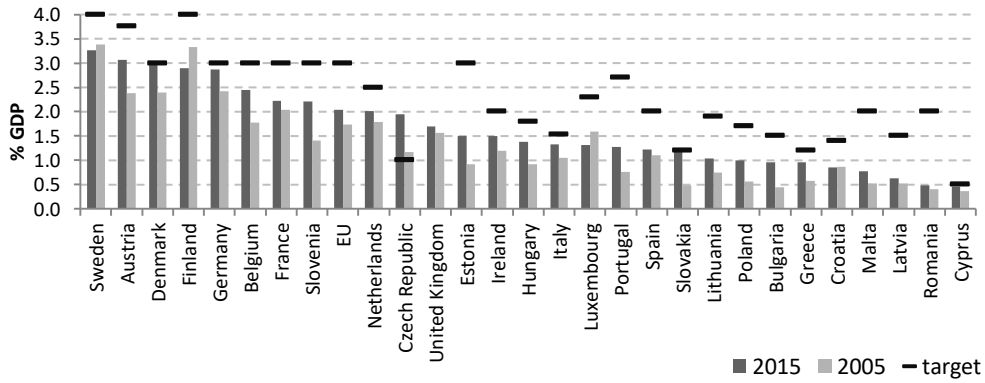

Figure 2. Expenditure on R&D in 2005 and 2015 compared with the target values

Source: Eurostat, 2017

The size of the monitored indicator in the member states of the European Union in 2005 and 2015 are on Figure 2, together with the target values for the individual countries.

As it is depicted, six countries have the target of increasing their share of expenditure on R&D of GDP by 2020 at 3%, three countries (Finland, Sweden and Austria) have set it even more even more than 3%. The only member country of the European Union that exceeded its target value in 2015 by 0.03% is Denmark. Slovakia is behind its target only by 0.02% and Cyprus by 0.04%. To the contrary, Romania, Estonia and Portugal are the most behind their national target in the area of R&D (Romania by 1.51%, Estonia by 1.5% and Portugal by 1.42%).

A specific case is the United Kingdom with no target value set and the Czech Republic whose target value is on the level of 1% of GDP. Contrary to all the other member states this target relates only to the expenditure

of the business sector spent on the R&D activities. For other countries the share of expenditure of all the sectors on R&D of GDP is evaluated. In four member states the value of the indicator dropped between 2005 and 2015. They are: Finland, Sweden, the Luxemburg and Croatia. In the opposite case, the highest increase was in Slovenia (by 0.8%), the Czech Republic (by 0.78%) and Slovakia and Austria with the same value (0.69%).

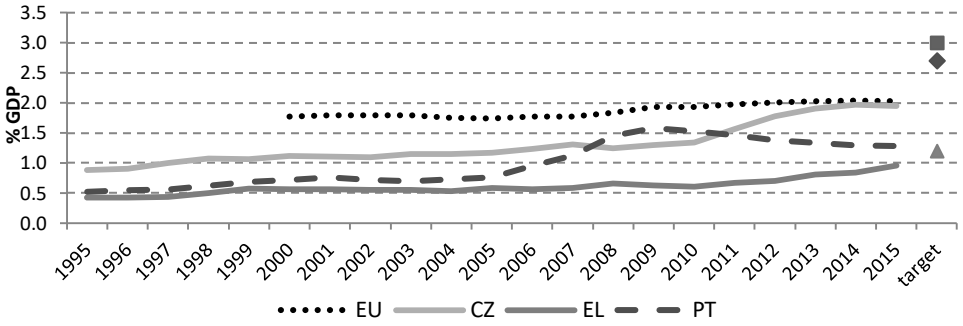

Figure 3. GERD development in selected countries and their targets, 1995-2015

Source: Eurostat, 2017

Development of the gross domestic expenditure on R&D activities of GDP of the selected countries captures Figure 3. It also shows the distance from their national targets. The value of the monitored indicator in two analysed countries (Greece and Portugal) is over the long-term under the average of the European Union which in 2015 was on the level of 2.04% of GDP. In 1995 Greece were financed R&D activities by 0.42 % GDP and in Portugal 0.52 % GDP. A more pronounced increase in the indicator is observed in Portugal, where it was even higher than in the Czech Republic in the years 2008-2010 and reached the highest value of 1.58% of GDP. Since 2010, its value has fallen steadily to 1.28% of GDP in 2015 and the country move off the national target of 2.7%. Despite the slowest trend, Greece is gradually moving closer to the target of 1.2% of GDP. The share of R&D spending in the remaining year was 0.96% of GDP. During the last years, in the Czech Republic the value of indicator has increased from 0.88 % GDP in 1995 to 1.95 % GDP in 2015 and so approached average value of the Union.

Basic descriptive statistics of the monitored indicator for the period of 21 years for all compared countries is in Table 1. It has the corresponding Box Plot (Figure 6). Based on the figure it can be established that the greatest variability of indicator's changes is in the Czech Republic with also the highest average value. On the other side, the smallest changes of the indicator during the monitored period were in Greece with the lowest average value.

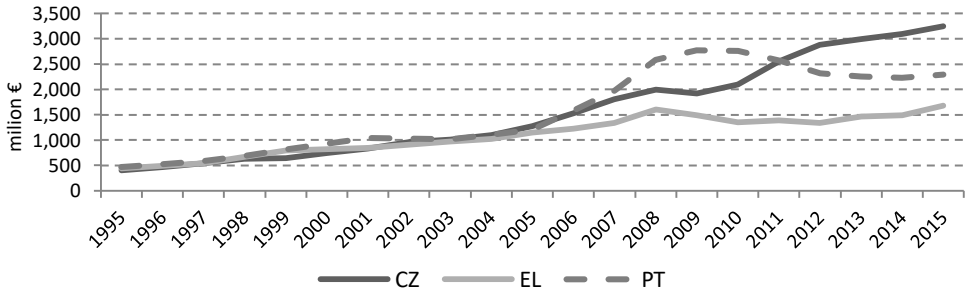

Figure 4. Total intramural R&D expenditure, 1995-2015 (million €)
Source: Eurostat, 2017

The economic crisis as a result of the mortgage crisis in the US, very negatively affected most European countries. Its effects led to a decline of basic macroeconomic indicators. Since 2008 it is possible to observe in all three countries decline in total expenditure incurred on R&D (Figure 4).

The most significant and long-term decline of expenditure was recorded in Portugal (from 2.8 billion € in 2009 to 2.2 billion € in 2014), in which has also decreased the share of expenditure on R&D of GDP (Figure 3). On the other hand, the smallest and only one-year decrease was observed in the Czech Republic. This country is a leader in financing R&D activities since 2012 and also shows the highest share of expenditure on R&D of GDP since 2011. Greece as a country with approximately the same number of inhabitant has financed R&D on average 1.1 bill. € (Table 1, Figure 6). During the monitored period, financial resources increased the less, from 403 million € in 1995 to 3.25 bill. € in 2015. An unfavourable economic development especially after the economic crisis was also reflected in a further indicator expressing the amount of R&D expenditure per inhabitant. This expenditure is well below the European Union's average expenditure, which was in 2015 at 587.7 €. In Greece it was only 155.1 € (Figure 5).

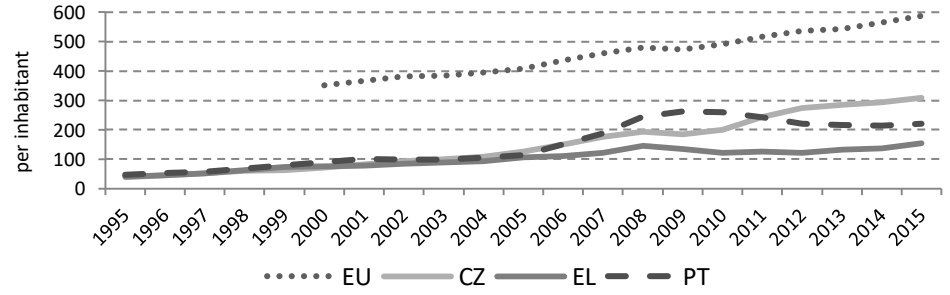

Figure 5. Total intramural R&D expenditure, 1995-2015 (per inhabitant)
Source: Eurostat, 2017

Expenditure on R&D per inhabitant in all three countries during the whole monitored period are well below the average value of the European Union. In 1995 it was only 39 € in Czech Republic, 41.5 € in Greece and 47 € in Portugal. In Czech Republic has increased expenditure almost eight times (to 308.4 € in 2015). This country shows the highest margin change and average value (Table 1, Figure 6). As in the previous indicators, in this case also Portugal had the highest values in the pre crisis period, but from 2009 expenditure decrease from 262.4 € to 220.6 € per inhabitant in 2015. Greece has the lowest margin change and average value of the indicator, with expenditure per inhabitant rising from 41.5 € to 155.1 € in 2015.

Table 1. Descriptive statistics

	GERD in %GDP			R&D expenditure in million €			R&D expenditure per inhabitant		
	CZ	EL	PT	CZ	EL	PT	CZ	EL	PT
Count	21	21	21	21	21	21	21	21	21
Minimum	0.880	0.420	0.52	403.00	436.98	470.29	39	41.5	47
Maximum	1.970	0.960	1.58	3250.24	1683.85	2771.60	308.4	155.1	262.4
Median	1.170	0.570	0.76	1280.83	1153.53	1201.11	125.6	105.2	114.4
Average	1.300	0.605	0.985	1558.79	1097.44	1559.78	149.976	100.274	149.195
Standard Deviation	0.335	0.136	0.372	950.27	381.01	814.74	89.831	33.885	76.450
Confidence Level (95%)	0.153	0.062	0.169	432.56	173.45	370.87	40.891	15.424	34.800

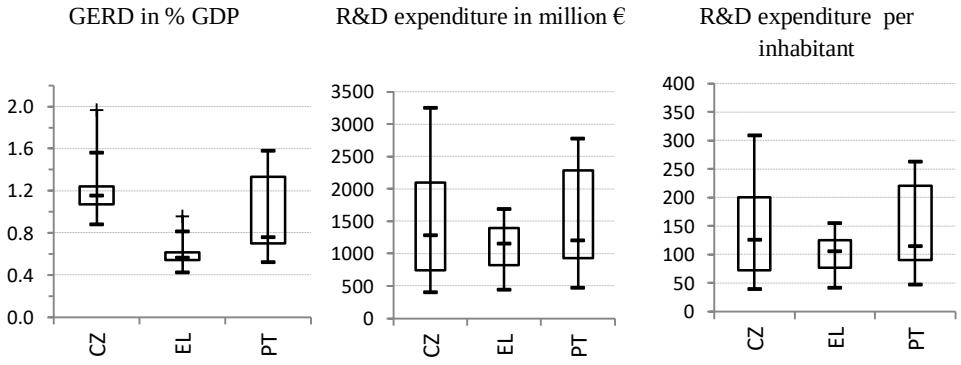

Figure 6. Box plots for R&D expenditure

4.1. The structure of GERD

Expenditure on R&D activities comes from different sources. The most important and related to the partial objective of the strategy Europe 2020 in the area of R&D are expenditure from business and government sector. According to the partial objective of the strategy would be 2/3 of expenditure from its own corporate, business resources and the remaining third

from the government sector. Other sectors funding supporting and implementing R&D activities are higher education sector, the private non-profit sector and abroad. Within the structure of expenditure some economies have traditionally had a strong base in investments from the business sector, for example Germany and Denmark and other countries with the exception of Croatia, Luxembourg and the United Kingdom increase public investment in R&D to meet the objectives of the strategy Europe 2020.

In 2015 only Slovenia fulfilled this partial target from all the member states of the Union. Germany. Finland and Sweden are gradually approaching it. A model for our percentages should be China, South Korea and Japan where the business sector funds approximately 75% of the mentioned activities.

The furthest from the target is Cyprus where financing comes predominantly from the state sector (up to 62.1% from all of the GERD) and the finances from the business sector are insufficient (12.1% of all the GERD). The lack of private sources to fund R&D is also a problem in Bulgaria (just 19.5% from all of the GERD) but contrary to other countries most of their finances come from foreign sources (48.3% from all of the GERD).

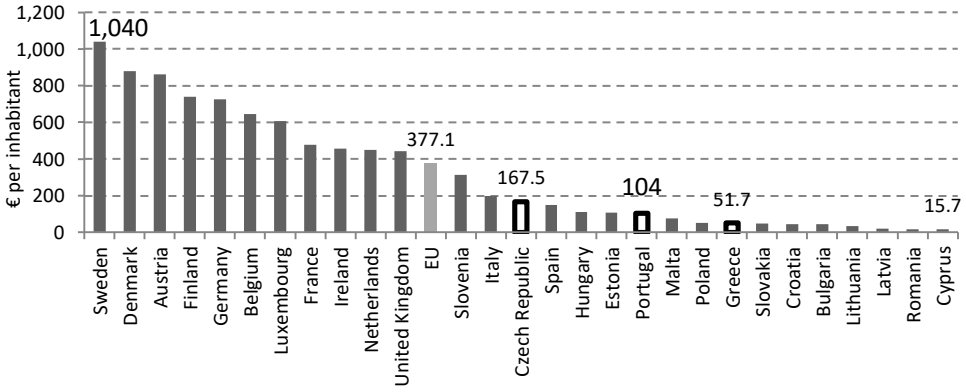

Figure 7. Business expenditure on R&D per inhabitant in the member states in 2015

Source: Eurostat, 2017

As private business sources should contribute substantially to the funding of R&D activities, here is a list of comparisons between the countries of the European Union according to the amount of expenditure per capita in 2015 (Figure 7).

While in regards to the total expenditure on R&D per inhabitant the leader was Denmark in this case the top position belongs to Sweden with 1040 €. Close behind is Denmark and in the top five positions are also Austria, Finland and Germany. These countries spend two or three-times as much finances from

business sources on the monitored area than the average in the European Union. Seventeen countries hold below-average values, among them are all the V4 countries, Cyprus, Romania and Latvia had not even attained the 20 € of business expenditure per inhabitant.

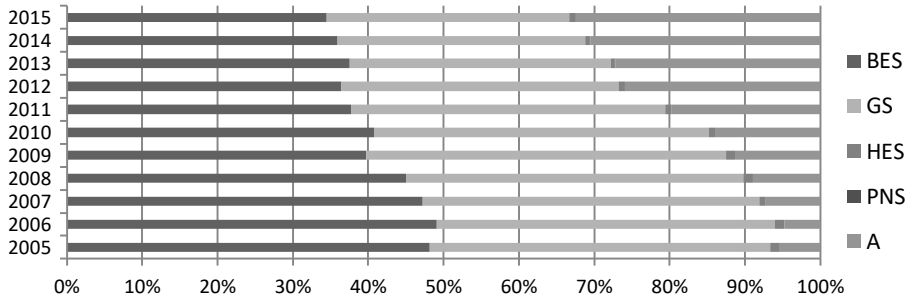

Figure 8. Structure of GERD in Czech Republic

BES - Business enterprise sector. GS - Government sector. HES - Higher education sector. PNS - Private non-profit sector. A - Abroad

Source: Eurostat, 2017

Neither compared three countries do not meet this partial objective of the strategy Europe 2020. In Czech Republic was the share of expenditure of business enterprise sector and government sector to total expenditure on R&D activities almost the same. A positive fact to be observed is the gradual decrease in the expenditure of the government sector to the total GERD from 45.2% in 2005 to the desired 32.2% in 2015 which fulfilled the target. The problem with the country is the undesired opposite development in the expenditure of the business sector. It dropped from 48.2% to 34.5% of the GERD which is markedly below the required 66%. The drop was accompanied by a fall in the university sector to a half (0.7% in 2015). The expenditure of the private non-profit sector on R&D activities during the monitored period was only slight and its share on the total expenditure was at the level of 0.1%. It is also possible to see in this country the growth of the expenditure from abroad. In this sector the Czech Republic recorded the most dynamic growth during 2005-2015 its share of the expenditure on R&D towards the total of the GERD increased six fold. In 2015 it was at the level of 32.5% which could be an explanation for the lower private business sources for the organisation of R&D activities.

Based on this data a very strong positive correlation could be expected between the expenditure from abroad and the expenditure from other sectors. It is not so. A relatively strong correlation can only be noticed with the business sector and the university sector (Table 2).

Table 2. Correlation matrix of expenditure on R&D activities incurred by sectors in Czech Republic

	BES	*GS*	*HES*	*PNS*	*A*
BES	1				
GS	0.877142	1			
HES	0.174936	0.428694	1		
PNS	0.679962	0.453363	-0.29922	1	
A	0.923525	0.792296	0.139379	0.766885	1

Partial target about the structure of GERD in Greece is not fulfilled. In this country R&D activities are supported mainly from resources of government sector (52.7% of GERD in 2015). Financial resources from business sector are lower and their share of GERD was on average 31.8%. That is well below the 66%. Decrease over the whole monitored period shows also expenditure of abroad. They decline from 19% to 12.8% of total GERD. Expenditure of other two sectors was considerably lower. The share of expenditure of private non-profit sector in total GERD was in 2015 at 0.2% and the higher education sector only 2.5%. Data for 2006 and 2007 are unavailable for this country.

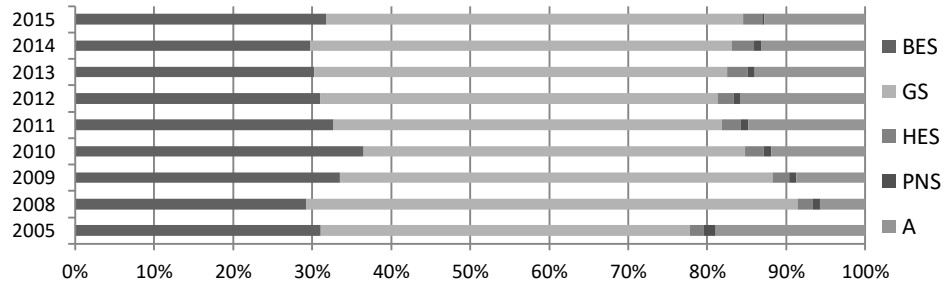

Figure 9. Structure of GERD in Greece

Source: Eurostat, 2017

Table 3. Correlation matrix of expenditure on R&D activities incurred by sectors in Greece

	BES	*GS*	*HES*	*PNS*	*A*
BES	1				
GS	0.63845	1			
HES	0.683378	0.61823	1		
PNS	-0.65603	-0.47006	-0.65897	1	
A	-0.3638	-0.59665	0.019751	-0.2697	1

Based on the results from the table 3 we can state, that in Greece is not observed strong positive correlation between expenditure on R&D activities incurred by different sectors. In several cases, even a negative correlation can be observed.

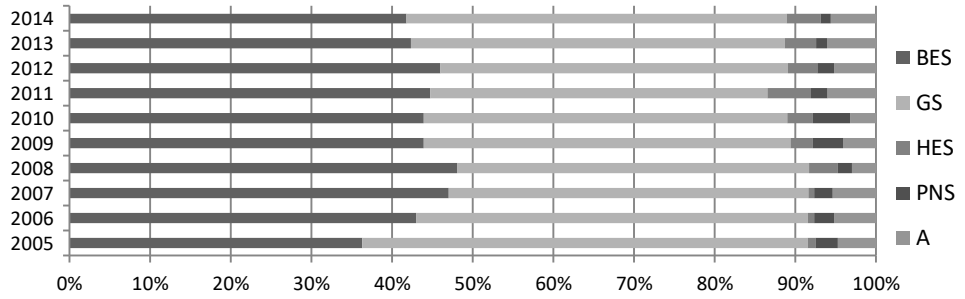

Figure 10. Structure of GERD in Portugal

Source: Eurostat, 2017

A positive fact to be observed in the structure of GERD in Portugal is that the business enterprises sector support R&D activities by 41.8% (in 2014. the last available data). In 2008 it was even 48.1% of GERD. Expenditure of government sector decreases during the monitored period from 55.2% to 47.1% of GERD. Compared with the previous two countries, R&D activities were much less supported by sources from abroad (only 5.6% in 2014). On the other hand, expenditure of other two sectors was higher. The share of expenditure of private non-profit sector on total GERD was in 2014 at 1.3% and the higher education sector only 4.2%.

In the case of Portugal, we can observe very strong positive correlation only between the expenditure of government sector and business enterprises sector.

Table 4. Correlation matrix of expenditure on R&D activities incurred by sectors in Portugal

	BES	*GS*	*HES*	*PNS*	*A*
BES	1				
GS	0.931378	1			
HES	0.749184	0.757584	1		
PNS	0.552422	0.657535	0.224245	1	
A	0.450149	0.417937	0.674153	-0.07052	1

5. The expected development of the expenditure on R&D to GDP by 2020

Present trend of the development of the indicator expressing the share of expenditure on R&D to GDP of the three countries can be described by several functions (Table 5). For each country were selected trends, where the coefficient of determination (R2) is not less than 0.7, which would mean that the probability of such future development of the indicator is at least 70%. In order to select the appropriate trend it is essential to monitor not only the coefficient

of determination, but also the p value of the regressors ($p < 0.05$), and the result of F test, that must be well below the significance level of 0.05 (Table 6, Table 7).

As stated above, the Czech Republic's target in the field of R&D does not cover the total spending on these activities, but only the share of the expenditure of business enterprise sector on the country's GDP. Therefore, in this case, we monitor the rate of achievement the target - expenditure of business enterprise sector should be 1% of GDP. On the basis of the previous development of the indicator we can state that since 2013 the Czech Republic has fulfilled its national target. Nevertheless we used several functions to describe expected evolution of indicator by 2020.

The highest increase of the indicator could be observed if the trend was governed by the polynomial function of 3rd and 2nd range. According to this trend, the indicator would reach 2.06% GDP and 1.36% GDP in 2020. On the contrary, a slight decrease could be observed if the development of the indicator in the coming years were driven by a power. With the likelihood 66.5% the share of expenditure on R&D in country's GDP reach 0.92% by 2020, so the Czech Republic did not meet the set target.

Table 5. The expected evolution of expenditure on R&D activities (% of GDP)

	Trend	Function	R^2
CZ	**Linear**	**$y=0.0224x+0.5146$**	**0.8049**
	Exponential	$y=0.5472e^{0.0283x}$	0.8456
	2nd order polynomial	$y=0.0014x^2-0.0085x+0.6328$	0.897
	3rd order polynomial	$y=0.0002x^3-0.0047x^2+0.0464x+0.5207$	0.9414
	Power	$y=0.4949x^{0.1904}$	0.6653
EL	**Linear**	**$y=0.0195x+0.3897$**	**0.7983**
	2nd order polynomial	$y=0.001x^2-0.0025x+0.4743$	0.8596
	3rd order polynomial	$y=0.0002x^3-0.0069x^2+0.069x+0.3281$	0.9578
	Power	$y=0.3659x^{0.2221}$	0.729
	Exponential	$y=0.4182e^{0.0315x}$	0.8438
PT	**Linear**	**$y=0.0532x+0.3995$**	**0.7888**
	2nd order polynomial	$y=-0.0005x^2+0.0644x+0.3566$	0.7909
	3rd order polynomial	$y=-0.0006x^3+0.0206x^2-0.1254x+0.7445$	0.8827
	Exponential	$y=0.4918e^{0.0569x}$	0.8469
	Power	$y=0.3819x^{0.4063}$	0.7515

Based on these results of testing the most appropriate function describing the indicator's development in Czech Republic is the linear function. P-value for the constant is 2.8E-12 < 0.05, for the regression coefficient is 7.55E-08 < 0.05. It proves the statistical importance of the constant and the regression coefficients. The result of the F test 7.55E-08 < 0.05 proves the statistic importance of the estimated model (Table 6, Table 7). The likelihood the country will follow this trend in future years is 80.49%.

In the case of Greece there were five functions with relatively high coefficients of determination selected for the description of the current trend of the development of the expenditure on R&D in relation to GDP of the country (Table 5). If the indicator's development follows the power trend in the future, its value will fall to 0.75% GDP until 2020. If the indicator's development follows the exponential, linear or polynomial trend of 2nd degree, the expenditure would grow slowly by 2020 and in 2020 they would reach 0.90-1.08% of GDP. The more significant indicator's growth (more than 1.6% GDP) could be achieved if the development be guided by the polynomial function 3rd degree. According to this, Greece fulfilled the target of the Strategy already in 2017. But according to the testing the most appropriate trend appears to be the one described by the linear function. Statistic importance of the estimated model was proved by the p-value and the results of the F test attaining values lower than 0.05 (Table 6, Table 7). The likelihood of the country experiencing this trend in the next years is 79.83%.

Table 6. Estimated parameters of the regression models I.

	CZ	**EL**	**PT**
Multiple R	0.88841	0.893479	0.888131
R Square	0.789272	0.798305	0.788777
Adjusted R Square	0.778181	0.78769	0.77766
Standard Error	0.073007	0.06248	0.17541
Observations	21	21	21
Significance F	7.55E-08	4.96E-08	7.73E-08

Table 7. Estimated parameters of the regression models II.

		Coefficients	*Standard Error*	*P-value*	*Lower 95%*	*Upper 95%*
CZ	Intercept	0.514905	0.033036	2.8E-12	0.445759	0.584051
	X Variable 1	0.022195	0.002631	7.55E-08	0.016688	0.027702
EL	Intercept	0.389738	0.028273	2.41E-11	0.330563	0.448914
	X Variable 1	0.019526	0.002252	4.96E-08	0.014813	0.024239
PT	Intercept	0.399524	0.079374	7.38E-05	0.233392	0.565656
	X Variable 1	0.053247	0.006321	7.73E-08	0.040016	0.066477

The several functions can be used for description of the actual trend of the indicator's development expressing the share of expenditure on R&D of GDP in Portugal (Table 5). A declining trend of the indicator reflects the polynomial function of 3rd degree, according to which expenses should decrease until 2020 to 0.86% of GDP (Tab. 5). If the trend direct by exponential, power or polynomial function of 2nd degree, the value of indicator will rise slowly, but the country will not exceed target value of 2.7% GDP until 2020.

Based on the results of testing the current and future expected development is described with the best accuracy by the linear function. In this case the p-value for the constant is 7.38E-05 < 0.05, for the regression coefficient is 7.73E-08 < 0.05. which proves the statistic importance of the constant and also the regression

coefficient. The result of the F test 7.73E-08 < 0.05 proves the statistic importance of the estimated model (Table 6, Table 7). The likelihood of the country experiencing this trend in future years is 78.88%.

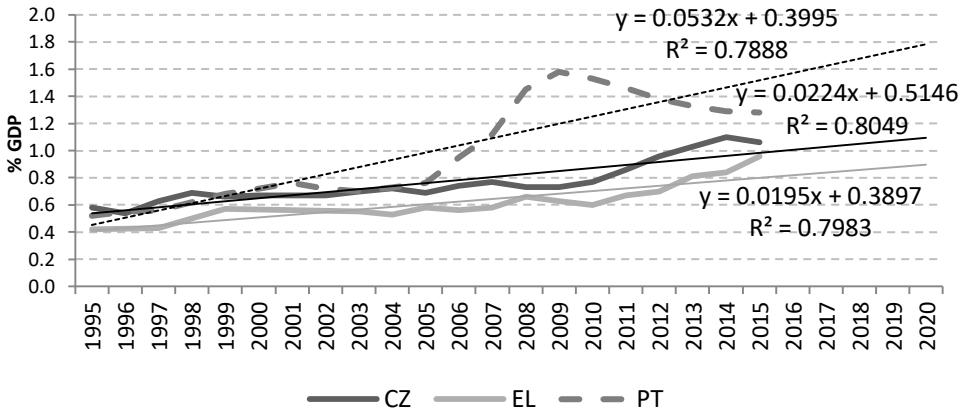

Figure 11.Expected development of the share of the expenditure on R&D of GDP by 2020

Based on the stated results it is possible to determine the predicted values of the monitored indicator in the future and then evaluate whether that country will manage to achieve its set target by 2020 (Table 8, Figure 11).

A specific case is Czech Republic, which already achieves the target. If the present development of the share of expenditure of business enterprises sector on GDP in country managed by a linear function, the Czech Republic would exceed in the future target value and in 2020 the indicator will rise to 1.097%.

Based on past indicator developments in two other compared and analysed countries and a statistically significant model describing its evolution. Neither country will be able to reach the national target value of the strategy Europa 2020 in the field of R&D by 2020.

If the development of the indicator in Greece in future managed by a linear function, the value will slowly rise, but the country will not reach target of 1.2% GDP by 2020. The indicator with the probability nearly 80% will rise to 0.897%.

Portugal has a considerably greater lag behind its target. Based on the test results, if indicator development is driven by a statistically significant model described by the linear function, it will increase to just below 1.8% GDP by 2020. This represents a lag behind the target of almost 1%.

Table 8. The expected value of expenditure on R&D activities till 2020 (% of GDP)

	2016	2017	2018	2019	2020	Target
CZ	1.007	1.030	1.052	1.075	1.097	**1.0**
EL	0.819	0.838	0.858	0.877	0.897	**1.2**
PT	1.570	1.623	1.676	1.730	1.783	**2.7**

6. Conclusion

The article deals with the issue of R&D as one of the main points of the strategy Europe 2020. There are evaluated several partial indicators that influence the achievement of the objectives of the Strategy defined for each member country. Three countries were chosen for comparison, i.e. Czech Republic, Greece and Portugal, which are comparable in terms of population.

One of the basic indicators of evaluation of the R&D level in country is an indicator reflecting the share of gross domestic expenditure on R&D in the country's GDP. This indicator is used to monitor the achievement of the objective of the strategy, which is for the European Union to increase spending on R&D in 2020 to 3% of GDP. By analysis and comparison of selected countries, it was found that Greece invests in R&D the smallest volume of financial resources; it has the lowest expenditure per inhabitant and also the lowest share of this expenditure in the GDP of the country. On the contrary, in the post-crisis period, the Czech Republic began to report the best indicator values.

Important observed and compared indicator was also gross domestic expenditure on R&D indicating the total amount of expenditure on R&D coming from domestic and foreign sources that are incurred during a period of time on the territory of the countries. This indicator is linked to the achievement of partial target of the Strategy in the area of R&D related to the structure of financial resources. None of the three compared countries has the required structure of expenditure. It is a positive fact that in the Czech Republic, the expenditures from the government sector is 1/3 of the total expenditures on R&D. but the expenditure of the business enterprise sector is also only 1/3. The rest of the resources come mainly from abroad. In Greece, more than half of the resources come from the government sector, and in Portugal. about 40% from the business enterprise sector and also from government sector.

The last part of the article focused on the fulfillment of the national target in the area of R&D. Based on the results of testing. in all three countries current and future expected development is described with the best accuracy by the linear function. If the evolution of the indicator were to follow in the future according to these linear functions, the Czech Republic would continue to reach the target value related to the share of business expenditure in the GDP. Based on the results of the testing, Portugal would be the most lagging behind the national target and Greece would gradually approach the target, but it did not reach it by 2020. According to the trend, these two countries would achieve their target after 2035.

Based on the findings, it can be said that the major problems that have arisen especially in the Greece after the outbreak of the crisis in Europe have also been reflected in R&D funding. The overall lack of funding in the country has contributed negatively to this. In order to get the country out of the crisis-induced problems, it has received three rescue packages from the European Union. Public debt reached 180% of GDP, unemployment rate 24%, that leading to high population migration. The economy has been stagnating for a long time, the private sector has been almost destroyed for several years, and public administration has been under-funded and inefficient. Everything is also negatively reflected in research, development and innovation, in which the country is also stagnating. Inadequate funding of R&D activities is a brake on innovation activity of enterprises. Innovative process requires the amount of money that businesses currently do not have a spare. In addition to finance, it is possible to consider as barriers for the implementation of R&D, production and introduction of innovations the lack of information necessary for their implementation, market factors, for example insufficient demand for innovative products.

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