EDUCATION AS A CRUCIAL FACTOR OF ECONOMIC GROWTH IN THE PROCESS OF GLOBALIZATION 1

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Abstract: *Authors focus on the role of tertiary education in the globalized world economy, especially in the process of economic growth and development. The OECD countries are used as a statistical sample and basic cross-country analysis has been carried out. Consequently, the Czech Republic, Germany, Japan, and the United States have been chosen for a deeper regression analysis of relationship between economic growth and tertiary education.*

Keywords: *Globalization, Economic Growth, Education, Expenditures on Education, Science and Research and Development*

1. Introduction – Globalization Trends, Economic Growth, and Knowledge

The term "globalization" was used for the first time at the beginning of the 60's in context with the reflections of new qualitative as well as quantitative changes in the world development. It began to be used widely and often not only in scientific, but also in popular literature and other mass media in the 90's and nowadays it has been one of the most frequently used and at the same time most repeatedly debated expressions. Not even after so many years, there has been a unified and exact definition of the content, characteristics, and direction of processes hidden under the term of globalization (see e.g. [5], [8], [16], [17], or [18]). Generally, the globalization has been characterised as a group of many considerably heterogeneous processes including economic, technological, social, cultural, political, ecological, security, and many other aspects. These processes are interconnected and interdeterminated.

According to the International Monetary Fund (IMF), the globalization constitutes a "growing economic interdependence of countries in the global measure in consequence to ever growing volumes and sorts of cross-border transactions of goods and services and of flows of international capital as well as faster and wider technology diffusion" [8:10]. Further, the IMF understands the globalization as a "historical process, result of human innovation and technological progress bringing increasing world economic integration, especially through international business and financial flows" [1:826]. The way the IMF perceives globalization underlines especially its economic side. However, a very crucial part of such perception of the process of globalization relies on knowledge with its multidimensional overlaps (esp. to technological, social, and political sphere).

In these consequences, a validity of general hypothesis can be tested. The hypothesis states: The higher qualification and level of education together with research and development (R&D), the higher economic growth. But at the same time: The higher standards of education and research are conditional to economic growth. This hypothesis will be in the following paragraphs tested in both directions of relationship on selected member countries of the Organization for Economic Co-operation and Development (OECD).

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2. Economic Growth and Knowledge

Success and proliferation of globalization tendencies, but also of national economic policies is usually measured by macroeconomic indicators corresponding to the economic performance of the country or of the economic integration. The economic growth as a process leads to larger capacities of an economy to produce goods and services. The economic growth is expressed as a growth of the real gross domestic product (GDP) or another macroeconomic aggregate measuring the performance or the output of an economy [4]. "Under the economic growth we understand increasing the production capacities of an economy in time, therefore, to all intents and purposes, it expresses the growth of the potential domestic product. The potential product constitutes the highest possible level of real product constantly reached by the economy under the conditions of the natural rate of unemployment and of stable price level." [4:376]

If we understand the economic growth as a growth of the potential product, it seems obvious we need to increase the production capacities of the economy not only quantitatively, but especially qualitatively. And one of the critical qualitative sources of economic growth therefore is and must be the growth of knowledge together with investment to research and development. The current stage of social evolution is often called "knowledge society", "knowledge economy" or even "e-economy". In the consequence to the rapid technological progress, the necessary level of knowledge is gaining increasing importance. The traditional view of the labour force as an easily substitutable factor of production is gradually becoming a history. The process of globalization together with fast and revolutionary changes in technology is bringing a new phenomenon to traditional economy: the necessity of continuous and never-ending renewal of human capital (knowledge).

The changes in economic reality in the recent couple of decades have been reflected by the economic theory as well. Among the typical examples of new approaches applied to the traditional economic theories of growth belong e. g. models of P. Romer [10], [11], [12], R. Lucas [7], or G. Grossman and E. Helpman [2]. Their common basic task is to implement investment to human capital, knowledge, or to science and research into the economic theory. Theories of endogenous growth also embody influences of positive external effects on knowledge, technical changes, and on capital. Investments to tangible capital and to human capital both result in increased productivity; however, this increase is thought to be larger than their individual contributions. When the external effects are intensive enough to neutralize the impacts of decreasing returns, then the positive relation between knowledge and investment can lead to permanent positive effects on the rate of economic growth. The authors of endogenous models of growth presume the technological progress – perceived as an accumulation of human capital, scientific and technical knowledge – rises from conscious investing into these fields of economy.

The continuous calls for higher expenditures on education, research and development is supported by the argument of direct proportionality between the pace of economic growth and the quality of education in each economy.

It has been a well-known fact, the importance and value of knowledge is most prominently manifested in a situation when the economy approaches its production frontiers (sometimes called technological frontier). The shift or expansion of such a frontier is determined by the long-run economic growth whose fundamental sources lie in innovations (for detailed studies on innovations see e.g. Schumpeter [13], [14], [15] or Hlásný [3], Švejda [19], or Valenta [21], [22]).

Nevertheless, the relationship between investment to education and innovations is far from simple. The trends in the recent development seem to indicate the expenditures on primary

and secondary education promote and simplify the application of existing technologies in the economy, but only the tertiary education has the potential to foster the process of generating or designing new innovations. Such process brings higher added value and at the same time constitutes a new quality of economic growth. That is why the economists recommend to the policy makers to increase the share of investment to the tertiary level of educations and to R&D. Unfortunately, such investments generally yield returns in long periods of time, while political will changes with every electoral term.

3. General Tendencies in the Expenditures for Education in OECD Countries in the Period 1995 – 2005

The indicator of total expenditures of and for education as a share on gross domestic product (GDP) reflects the importance each country attributes to education compared to other allocation targets for the total sum of sources. It is self-evident, the different systems of financing, scholarships, as well as financial resources coming from private subjects expose the total values in each country to remarkable and sometimes crucial influences. The share of total financial sources ascribed to education remains upon each country and its government, industries, businesses, and even individuals. These expenditures support economic growth, increase productivity, contribute to personal and social development, and fight the social unbalances. As such, these financial means raise the returns and benefits of education and stimulate the enrollment rates.

All the OECD members with available comparable data devote on average to tertiary education almost one third of their total education expenditures, which accounts for approximately 2 % of their total GDP. In the USA and in Canada the tertiary education receives as much as 40 % of total expenditures for and of education.

Canada, Korea, Mexico, Poland, and the Slovak Republic allocate for tertiary education more than 2 % of their GDP, while in Korea, in the USA, and in OECD partner country of Chile the share of private expenditures on tertiary education reached the highest share in comparison with all other OECD countries.

In years 1995 – 2005 a remarkable increase in the numbers of people completing their upper secondary and tertiary education has been recorded. „For all levels of education combined, public and private investment in education increased in all countries by at least 8 % between 1995 and 2005 in real terms and increased on average by 42 % in OECD countries. In two-thirds of these countries, the increase is larger for tertiary education than for primary to post-secondary non-tertiary levels combined.“ [9:227] In the years 1995 – 2000 however the pace of growth of the GDP exceeded the increase of total education expenditures, while in the following years (2000 – 2005) the situation changed and the expenditures for and of all levels of education grew by 21 % compared to 14% real GDP growth. „Expenditure on educational institutions for all levels of education as a percentage of GDP increased in both of these 5-year periods in 7 of the 28 OECD and partner countries with comparable data,“ [9:227] while the tertiary education expenditures rose in the years 2000 – 2005 faster than GDP in nearly two thirds of the 28 monitored countries.

3.1 The OECD Countries and Selected Indicators in 2005

The Table 1 shows values of selected indicators of thirty OECD countries in 2005. The last row aggregates values for those nineteen OECD countries that are members of the EU as well (labelled as EU19). The fourth column of the table records the total expenditures of and for tertiary education in local currency units (LCU), while the sixth column calculates these expenditures in U.S. Dollars (USD). The exchange rate used corresponds to the purchasing

power parity of particular currency, where the OECD average (not the U.S. Dollar) is considered for the basis.

Table 1: Comparison of Selected Indicators in OECD Countries in 2005

Subject		Gross Domestic Product	**Real GDP Growth**	Total Tertiary Education Expenditures	Purchasing Power Parity for Education	Total Tertiary Education Expenditures	**Share of Tertiary Education Expenditures on GDP**
Country		bil. USD	%	mil. LCU	to OECD USD	bil. USD	%
Australia	AUS	696,83	**2,95%**	14436,60	1,11	13,01	**1,87%**
Austria	AUT	275,78	**2,87%**	3179,65	0,85	3,74	**1,35%**
Belgium	BEL	335,83	**1,85%**	3738,45	0,82	4,56	**1,36%**
Canada	CAN	1131,00	**2,88%**	32598,54	1,09	29,91	**2,64%**
Czech Republic	CZE	208,43	**6,32%**	31133,10	8,49	3,67	**1,76%**
Denmark	DNK	179,89	**2,45%**	26300,76	7,90	3,33	**1,85%**
Finland	FIN	161,00	**2,84%**	2721,86	0,87	3,14	**1,95%**
France	FRA	1869,39	**1,90%**	22571,80	0,76	29,62	**1,58%**
Germany	DEU	2587,68	**0,77%**	24552,69	1,02	24,07	**0,93%**
Greece	GRC	276,80	**2,90%**	2792,64	0,51	5,53	**2,00%**
Hungary	HUN	171,06	**3,96%**	244021,87	71,30	3,42	**2,00%**
Iceland	ISL	10,36	**7,46%**	12564,36	79,30	0,16	**1,53%**
Ireland	IRL	160,53	**6,37%**	1867,86	0,92	2,03	**1,26%**
Italy	ITA	1648,16	**0,55%**	14187,93	0,81	17,43	**1,06%**
Japan	JPN	3872,84	**1,93%**	6242873,59	122,00	51,17	**1,32%**
Korea	KOR	1027,37	**4,20%**	19305418,97	642,00	30,07	**2,93%**
Luxembourg	LUX	31,73	**5,19%**	..	1,31	..	**..**
Mexico	MEX	1290,79	**3,20%**	109757,61	3,61	30,40	**2,36%**
Netherlands	NLD	572,90	**2,05%**	6506,46	0,77	8,44	**1,47%**
New Zealand	NZL	102,18	**2,69%**	2344,07	1,22	1,92	**1,88%**
Norway	NOR	218,71	**2,74%**	25392,00	8,24	3,08	**1,41%**
Poland	POL	526,08	**3,62%**	16252,80	1,01	16,09	**3,06%**
Portugal	PRT	217,91	**0,91%**	1984,93	0,77	2,58	**1,18%**
Slovak Republic	SVK	87,14	**6,55%**	13585,23	7,17	1,89	**2,17%**
Spain	ESP	1188,10	**3,61%**	10273,70	0,60	17,09	**1,44%**
Sweden	SWE	291,65	**3,30%**	44893,60	8,17	5,49	**1,88%**
Switzerland	CHE	265,75	**2,50%**	..	1,84	..	**..**
Turkey	TUR	781,24	**8,40%**	..	0,42	..	**..**
United Kingdom	GBR	1968,81	**2,06%**	16121,65	0,64	25,03	**1,27%**
United States	USA	12364,10	**2,94%**	309790,81	1,34	231,19	**1,87%**
European Union – 19	EU19	12758,87	**3,16%**		0,71	180,25	**1,41%**

Source: [http://stats.oecd.org/] [author's calculations]

The data computed and highlighted in the Table 1 are illustrated in the Figure 1. The figure has been divided to four quadrants to simplify the description: Most of the OECD countries are located in the first quadrant with the lowest values of both real GDP growth and share of tertiary education expenditures on GDP. Greece and Hungary are standing right at the 2-per-cent upper horizontal border of the first quadrant. Canada, Mexico, and Poland exceed these 2 % of tertiary education expenditure share, but their real GDP growth rates remain under the 4-per-cent upper vertical border of the first and second quadrant. Only Korea and Slovakia recorded higher values in both monitored indicators which ejected them to the third quadrant of the graph. The Czech Republic, Iceland, and Ireland are the three OECD members with

high paces of real GDP growth despite lower shares of tertiary education expenditures on GDP.

The Figure 1 has been appended with two regression functions. The first, solid parable line is the regression function showing the dependence of the tertiary education expenditure share on the values of real GDP growth. This function indicates an ambiguous relation, while increase of lower values of real GDP growth might bring higher expenditures for tertiary education, whereas countries growing at paces higher than some 4 – 5 % must generally make do with lower shares of tertiary education expenditures.

The parable regression function starts close to the point illustrating Germany (DEU), runs up along Japan (JAP) and the United States (USA) and then bends down to the Czech Republic (CZE). These four countries have been selected for further research.

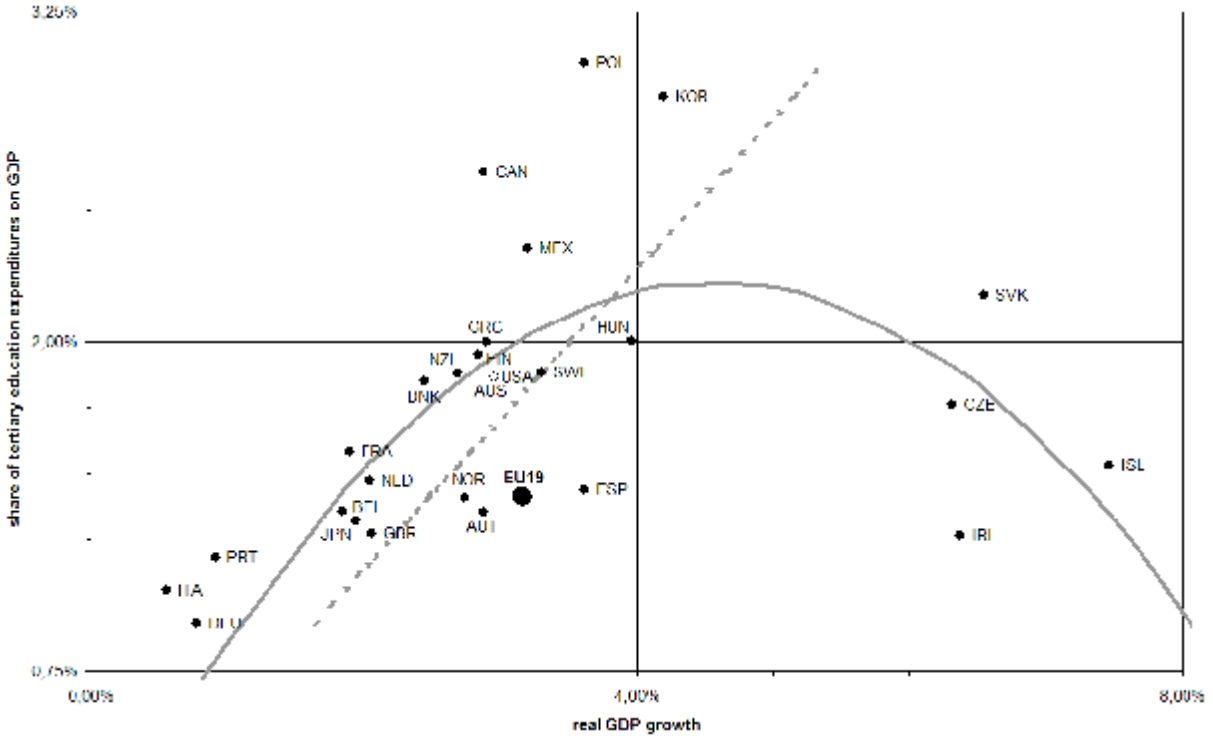


Figure 1: Comparison of Selected Indicators in OECD Countries in 2005 and Multiple Regression Analysis
Source: [http://stats.oecd.org/] [author's calculations]

The second, dashed straight line illustrates the real GDP growth as a function of the share of tertiary education expenditures on GDP. Since this function is linear, one can judge the higher expenditures of and for the tertiary education, the higher real GDP growth. The chapter 5 of this article will deal more carefully with this issue.

4. Comparison of Selected Indicators for the Czech Republic, Germany, Japan, and the USA in 2006

Table 2 provides a general information on selected indicators of the Czech Republic, Germany, Japan, and the United States in the year 2006. Unfortunately, these data were mined from a different source (from the United Nations Educational, Scientific, and Cultural Organization (UNESCO) database), and may therefore differ slightly from the previous and following ones published by the OECD. The UNESCO database represents the newest data available. The Table 2 offers a possibility of a quick and easy comparison of basic

macroeconomic proportions of the analyzed foursome of countries. It indicates, the Czech Republic was the fastest growing country among these four (6,1 %), while Japan was only slowly recovering from tedious recession with almost three times lower rate of real GDP growth (2,2 %).

When it comes to primary education, the most favourable conditions dominate over Germany and the United States (14 pupils per one teacher). The whole sector of education disposes of the highest expenditures in the United States, where expenditures to this sector of economy reach up to 5,7 % of the U.S. GDP. Japan records in primary education number of pupils per one teacher comparable to the Czech Republic, but the expenditures flowing to educational system are even lower (3,5 % of GDP) than the Czech ones (4,6 %). Analyzing the public expenditures on education as a percentage share on total government expenditures helps to understand how high priority has been assigned by particular government to education. In this comparison, the Czech Republic stands – maybe a little bit surprisingly – above Germany and Japan, but the United States devote to education from public budgets even more (not mentioning the fact the American system of education receives a reasonable proportion of its financial means also from private sources).

The Table 2 offers data on distribution of expenditures among different levels of education sector only for Germany and the Czech Republic. The highest share on education expenditures was determined for secondary educational institutions in both countries and nearly the same is also the share of tertiary education (26 % in the Czech Republic, 24 % in Germany). When comparing the number of researchers per one million inhabitants, the differences in research capacities in the four countries arise most distinctively. The Czech Republic in this sense recorded as little as a half value compared to the USA and even less than half compared to Japan. Only the same can be unfortunately said also about the expenditures on research and development (R&D) calculated as a percentage share of GDP.

Table 2: Comparison of Selected Indicators in 2006

	Czech Republic	Germany	Japan	United States
Total Population (in thousands)	10 186	82 599	127 967	305 826
GDP per Capita (USD; PPP)	22 118	32 322	31 947	43 968
Real GDP Growth Rate	6,1 %	2,8 %	2,2 %	2,9
Pupil per Teacher Ratio (Primary Education)	19	14	18	14
Public expenditure on education – as % of GDP	4,6 %	4,0 %	3,5 %	5,7 %
– as % of total government expenditure	10,5 %	9,7 %	9,5 %	14,8 %
Distribution of public expenditure per level				
– pre-primary	9 %	8 %	…	…
– primary	13 %	15 %	…	…
– secondary	49 %	50 %	…	…
– tertiary	26 %	24 %	…	…
– unknown	2 %	2 %	…	…
Researchers per 1 000 000 inhabitants	2 578	3 386	5 546	4 651
Expenditure on R&D as a % of GDP	1,5 %	2,5 %	3,4 %	2,6 %

Source: [http://stats.uis.unesco.org/unesco/]

5. Statistical Analysis of Long-run Development in the Czech Republic, Germany, Japan, and the USA

After the cross-country analysis, the authors continued with the four chosen countries from the group of OECD members: the Czech Republic, Germany, Japan, and the United States. The aim of the following part of the research was to prove or refuse the hypothesis of tight relationship between economic growth and education, especially the education of tertiary level. The hypothesis reckons with both directions of possible dependence between growth

and education: Education is said to promote economic growth, however, higher paces of economic growth should also result in higher support for educational institutions.

All the used data are available at the OECD statistical web http://stats.oecd.org/. The total gross domestic product (GDP) and the real GDP growth were chosen for indicators of economic growth, total expenditures on primary, secondary, and tertiary education were used as a measure of education development in the foursome of countries as well as the total numbers of enrolled students at the corresponding levels of education.

Unfortunately, the published indicators were found rather incompatible, since the data on GDP published by the OECD were enumerated in U.S. dollars (conversion via purchasing power parities) in current prices, while the expenditures on education were recorded in LCU and in current prices. The first step of the analysis therefore consisted of converting all the data to one standard. All the local currency units were converted to U.S. dollars (USD) via GDP purchasing power parities. All the nominal indicators were afterwards recounted to a fixed price level of the year 2000 using appropriate GDP deflators.

Also the available time series of education expenditures start as late as in the second half of the 90's. The reason for this fact is a new International Standard Classification of Education adopted by UNESCO in 1997 (see [20]). Since the length of the time series used in this research is limited, also the variety of applicable methods and above all the results of the analysis remain a subject of further research and discussion. Wide and rapid political, economic, and social changes in two of the analyzed countries (the Czech Republic and Germany) at the beginning of the 90's also make use of longer time series impossible.

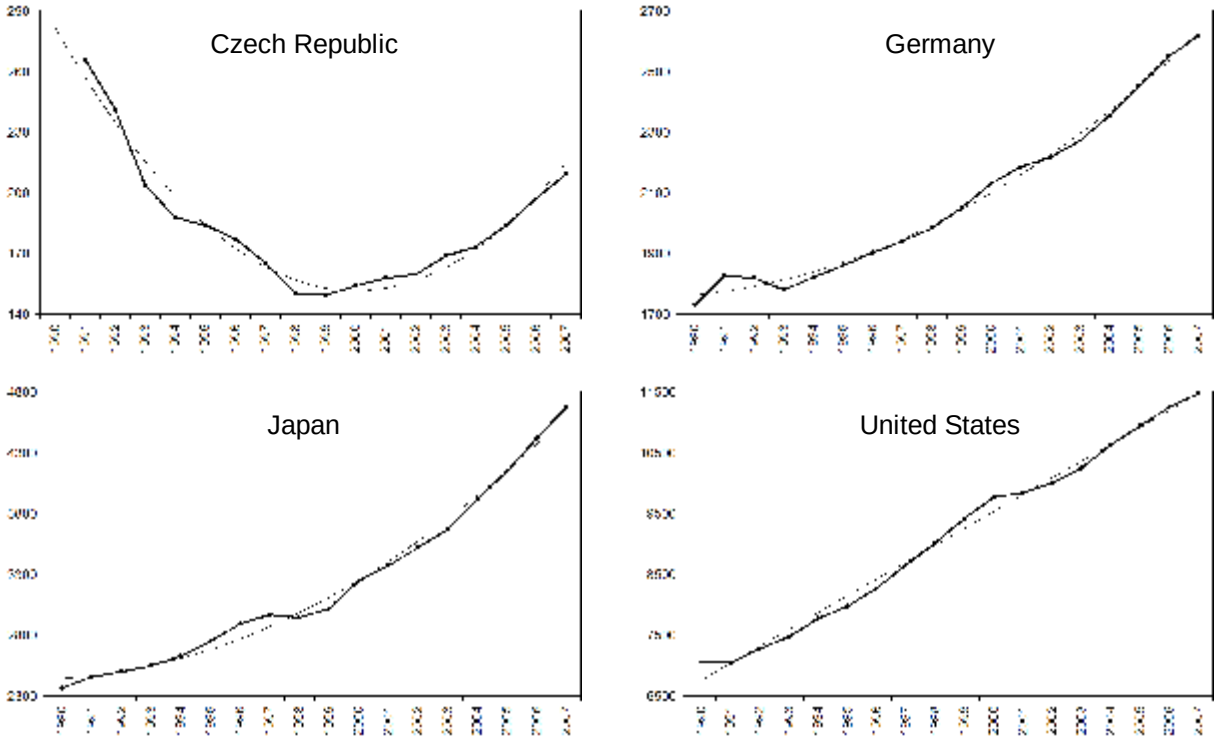


Figure 2: Trend Analysis of Time Series of Gross Domestic Product in Constant Prices of 2000 in billion USD and Purchasing Power Parity
Source: [author's calculations]

The second step of the research rested in identification of statistically significant trends in the time series. For this purpose, the statistical software packet Statgraphics was used. Only the trend functions with the highest values of the R-Squared statistic, with the highest F-Ratio of analysis of variance statistically significant at 0.05 level, and with all the estimated

parameters statistically significant at the same level (0.05) were chosen. Identified trend functions for the time series of real GDP are shown in the set of graphs in the Figure 1.

The trend functions were calculated for two reasons: First, they can help us to identify the long-run changes in economies of the analyzed countries. One can easily see the difference among the linear development of the U.S. economy growing approximately at the constant pace, among the nearly text-book parabolic trend of the Czech gross domestic product, and among the parabolic trends of German and Japanese economies growing by increasing rate. One also has to be very careful when making judgments about these four economies. Their economic results shown in the Figure 2 are distinctively affected not only by their economic performance itself, but also by changes in the purchasing power parities of their national currencies. For example: While Czech purchasing power parity fell from some 5,39 CZK per USD at the beginning of the 90's to some 14,23 CZK per UDS in 2000 and has remained basically the same since then, the Japanese purchasing power parity is continuously rising (from 187,85 JPY per USD in 1990 to 116,32 JPY per USD in 2008) despite the poor performance of Japanese economy in the last two decades. But since the aim of this analysis is to identify the relationships among economic development and education across countries and within them, the various side causes affecting long-run trends of the analyzed indicators remain if not off, then only at the very edge of our focus.

The long-run trends in total tertiary education expenditures fit less and explain the long-run trends less successfully as shows the Figure 3. All countries recorded ascending linear trends over the analyzed period, but the R-Squared statistics fell well under 90 %, indicating the trend functions fit the observed values only from less than 90 %.

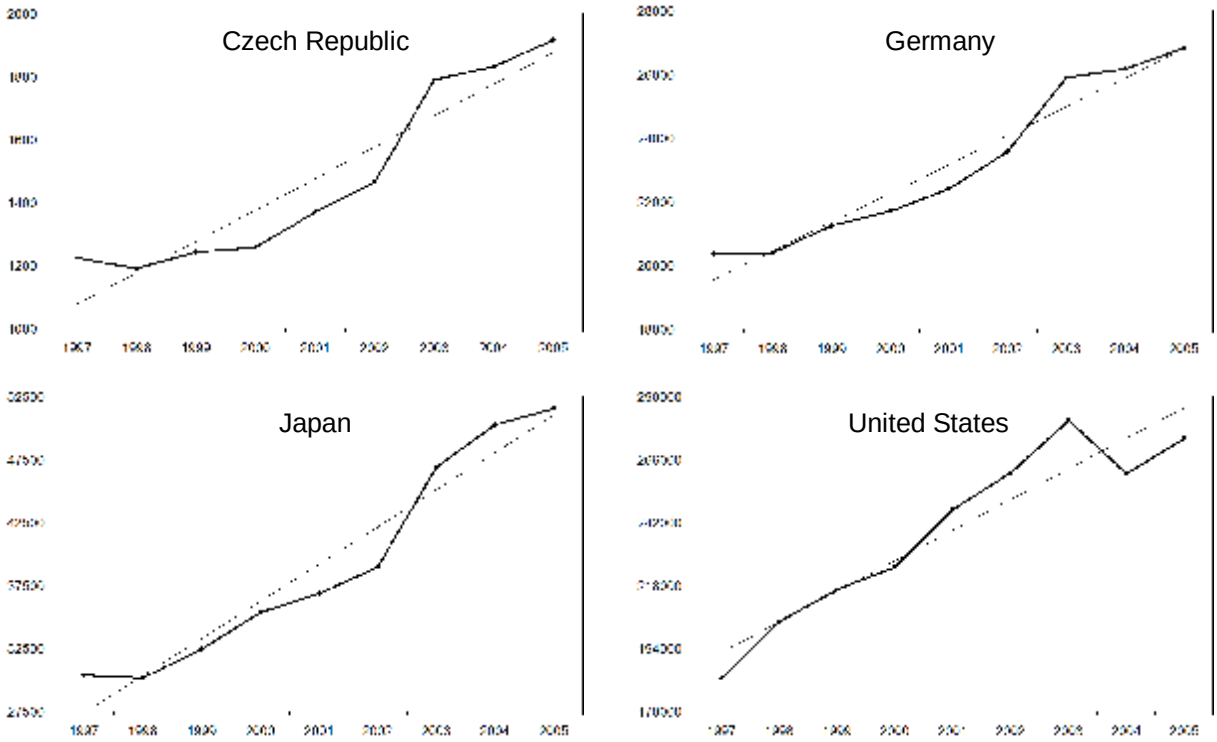


Figure 3: Trend Analysis of Time Series of Total Tertiary Education Expenditures in Constant Prices of 2000 in million USD and Purchasing Power Parity
Source: [author's calculations]

The same methods described for the two indicators (GDP and total tertiary education expenditures) were applied to all the other indicators as well. The full list of computed variables follows:

GDPtot	Total Value of Gross Domestic Product in Constant Prices of 2000 and in Purchasing Power Parity to USD
GDPpC	Gross Domestic Product per Capita in Constant Prices of 2000 and in Purchasing Power Parity to USD
yR	Real GDP growth per Annum
yRpC	Real GDP growth per Capita per Annum
Ptot	Total Expenditures for and of Primary Education in Constant Prices of 2000 and in Purchasing Power Parity to USD
Stot	Total Expenditures for and of Secondary Education in Constant Prices of 2000 and in Purchasing Power Parity to USD
Ttot	Total Expenditures for and of Tertiary Education in Constant Prices of 2000 and in Purchasing Power Parity to USD
PpS	Expenditures for and of Primary Education in Constant Prices of 2000 and in Purchasing Power Parity to USD per Student
SpS	Expenditures for and of Secondary Education in Constant Prices of 2000 and in Purchasing Power Parity to USD per Student
TpS	Expenditures for and of Tertiary Education in Constant Prices of 2000 and in Purchasing Power Parity to USD per Student
PEn	Total Enrollment for Primary Education
SEn	Total Enrollment for Secondary Education
TEn	Total Enrollment for Tertiary Education

All the values come from the OECD statistical database or were computed using data from this source. For the purpose of this article, the total of lower-secondary, upper-secondary, and post-secondary non-tertiary education is covered by the term secondary education and all types of tertiary education are summed up under the term of tertiary education.

Second, it is obvious, the particular time series have significant relationship with time. When analyzing the ties between different time series, this common relationship with time would bias the results. Thus, it is critical to carry out the decomposition of the series and search for the relationships between the residual time series, rather than between the original time series. The residual can be defined as a difference between the original value and the value predicted by the trend function.

Since it would be rather obscure if the education-growth relationship was immediate, the whole correlation analysis was divided to five steps in accordance with the number of years of delay: If the GDP was delayed by one or two years after the expenditures to education or after the enrollment rates (i.e. the GDP delay is +1 year or +2 years), one could simply state, the stimuli education provides for economic growth were statistically significant. If education expenditures or enrollment was delayed by one or two years after the GDP (i.e. the GDP delay is –1 year or –2 years), the expenditures to education (or enrollment rates) are dependent on the economic growth in the country.

Unfortunately, the limited length of the time series prevents us from considering and testing longer delay; the series would be extremely short to result in any serious and defendable judgements then.

While the main task of this article was to prove or reject the hypothesis of relationship between tertiary education and economic growth, the following comments are focused mainly on this highest level of education. The Table 3, Table 4, and Table 5 show all the computed correlation coefficients (on the first line in each of the cells) and their critical treshold of significance (the second line of each cell). The treshold expresses the measure of risk of considering the correlation between the two particular variables for statistically significant.

The higher number the treshold reaches, the more probable is the insignificancy of the correlation. All the 0.05 treshold statistically significant correlations were highlighted.

Already at the first glance it is obvious only a few correlations were found statistically significant at the 0.05 level (esp. in Table 3 and in Table 4) and even among these the positive correlation is much rarer than expected. In Table 3, a two year delay of total tertiary education expenditures after the real GDP was identified in the USA. This fact can be most probably credited to the fact, American tertiary education (especially their research and development), are tightly linked with private sector. If the companies are doing well one year, they can afford to support the tertiary education in the following years. The situation is quite the opposite in Germany and especially in the Czech Republic, where higher expenditures in tertiary education lead to rather lower GDP in the following two years. These quite strong and significant correlations could be a good argument for a reform of the Czech system of tertiary education and its financing.

Table 3: Table of Pearson Product Moment Correlations between Total Expenditures to Different Levels of Education and Total GDP and/or Real GDP Growth

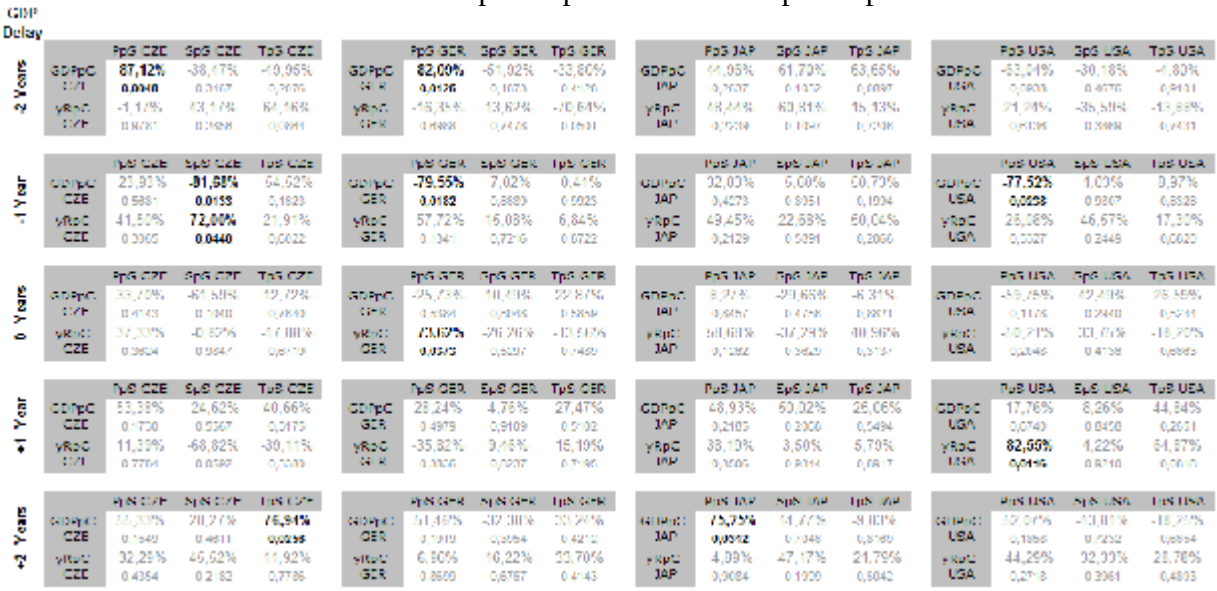
GDP Delay		Ptot CZE	Stot CZE	Ttot CZE		Ptot GER	Stot GER	Ttot GER
-2 Years	GDPtot CZE	1,11%	-18,08%	55,84%	GDPtot GER	-50,90%	-5,41%	-1,76%
		0,8086	0,6116	0,1101		0,1646	0,8880	0,9612
	yR CZE	-52,03%	12,83%	45,47%	yR GER	-33,63%	40,47%	-38,44%
		0,1510	0,7421	0,2186		0,3762	0,2480	0,3070
-1 Year	GDPtot CZE	44,64%	40,70%	39,01%	GDPtot GER	7,89%	59,00%	65,74%
		0,2284	0,2780	0,2993		0,8401	0,0889	0,0543
	yR CZE	**74,96%**	51,58%	26,49%	yR GER	21,22%	64,68%	**-76,55%**
		0,0200	0,1552	0,4909		0,3006	0,0597	**0,0162**
0 Years	GDPtot CZE	23,16%	**77,49%**	-3,48%	GDPtot GER	44,11%	58,75%	**76,06%**
		0,5488	**[illegible]**	0,9292		0,2347	0,0967	**[illegible]**
	yR CZE	-3,30%	-9,86%	-10,00%	yR GER	8,10%	5,70%	-30,32%
		0,9329	0,8007	0,8417		0,8359	0,8842	0,4278
+1 Year	GDPtot CZE	**-68,44%**	14,55%	**-80,99%**	GDPtot GER	10,14%	9,59%	26,32%
		0,0420	0,7000	**0,0001**		0,7951	0,0061	0,5109
	yR CZE	-27,50%	-30,64%	2,48%	yR GER	3,39%	-1,07%	31,63%
		0,4722	0,2908	0,9491		0,9310	0,9477	0,2613
+2 Years	GDPtot CZE	**72,10%**	-14,02%	**68,07%**	GDPtot GER	-47,19%	-46,10%	42,00%
		0,0284	0,7055	**0,0436**		0,1957	0,1239	0,2606
	yR CZE	2,70%	4,04%	52,00%	yR GER	4,24%	29,05%	41,09%
		0,9451	0,9178	0,1513		0,9137	0,4352	0,2618

GDP Delay		Ptot JAP	Stot JAP	Ttot JAP		Ptot USA	Stot USA	Ttot USA
-2 Years	GDPtot JAP	-66,17%	0,96%	10,28%	GDPtot USA	**95,61%**	-6,32%	**68,49%**
		0,0500	0,9801	0,7824		**0,0001**	0,8715	**0,0419**
	yR JAP	-0,54%	35,93%	-6,44%	yR USA	22,37%	-3,75%	3,85%
		0,9880	0,3453	0,8696		0,5639	0,9057	0,9215
-1 Year	GDPtot JAP	32,70%	36,33%	23,07%	GDPtot USA	56,12%	11,57%	30,33%
		0,3901	0,3365	0,5504		0,1007	0,7668	0,4276
	yR JAP	37,12%	32,12%	27,08%	yR USA	58,42%	22,17%	47,28%
		0,3254	0,3990	0,4810		0,0986	0,5660	0,1987
0 Years	GDPtot JAP	6,63%	34,48%	42,71%	GDPtot USA	-3,66%	57,41%	-27,59%
		0,8651	0,3636	0,1888		0,9256	0,1060	0,4695
	yR JAP	55,06%	11,60%	41,60%	yR USA	**71,91%**	37,16%	56,46%
		0,1180	0,8683	0,2620		**0,0290**	0,3248	0,1135
+1 Year	GDPtot JAP	49,82%	28,49%	39,09%	GDPtot USA	57,31%	32,74%	33,78%
		0,1720	0,4575	0,2900		0,1030	0,3090	0,3739
	yR JAP	30,67%	-27,55%	-13,30%	yR USA	-59,10%	-27,85%	-5,81%
		0,2905	0,4730	0,7301		0,0800	0,4600	0,0015
+2 Years	GDPtot JAP	60,17%	-17,10%	22,16%	GDPtot USA	**75,00%**	-15,50%	-27,43%
		0,0885	0,6604	0,5668		**0,0199**	0,6690	0,4751
	yR JAP	42,72%	14,09%	19,54%	yR USA	25,70%	49,40%	0,59%
		0,2514	0,7021	0,6145		0,5030	0,1757	0,0275

Source: [author’s calculations]

Another clue for such a reform indicates the Table 4. The Czech Republic is the only one from the foursome of analyzed countries with a statistically significant correlation between tertiary education expenditures per student and GDP per Capita. If the expenditures per student grew, it would lead to a significantly higher GDP per Capita in the Czech Republic in two years. But the result is a double-edge one. In case of decrease of tertiary education expenditures per student, the economy should count with probable decline of the GDP per Capita. The reform should therefore lead to increase of tertiary education expenditures per student.

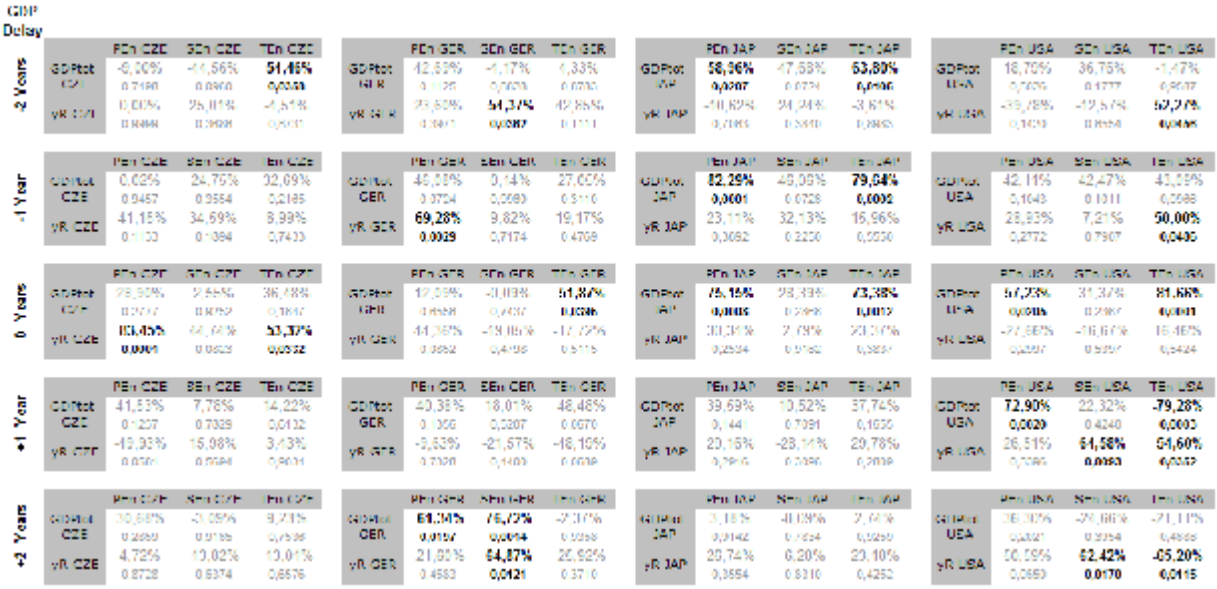
Table 4: Table of Pearson Product Moment Correlations between per Student Expenditures to Different Levels of Education and per Capita GDP and/or per Capita Real GDP Growth



Source: [author's calculations]

The last table (Table 5), shows another extremely interesting point for the upcoming reform of the Czech tertiary education. Increases in the GDP of the Czech Republic generally lead to lower enrollment for Czech universities and tertiary educational institution. As if the richer the Czechs are getting, the less attractive the Czech universities seem to them (which is quite the contrary to the situation in Japan and in the U.S.). Although the United States indicate a negative relation between the tertiary education enrollment and total GDP as well as real GDP growth in the following years, this may be only a short-run effect of opportunity costs devoted to the education, research and development.

Table 5: Table of Pearson Product Moment Correlations between Total Enrollment for Different Levels of Education and Total GDP and/or Real GDP Growth



Source: [author's calculations]

6. Final Remarks

Unfortunately, the limited length of available data and of analyzed time series made it impossible to identify the long-run effects of education on growth. Especially for this reason, the results of our analyses must be considered preliminary and shall be a subject of further research. Nevertheless, the authors believe their work contributes to the general debate on the role, position, and importance of education in the process of promoting economic development. The epoch of globalization exposes all economies to increasing pressure of technological progress. Knowledge became the critical value and education the critical tool for every subject struggling to succeed in the global markets.

References:

[1] BREINEK, P. Procesy globalizace ve světové ekonomice. In *Politická ekonomie*, 2005, roč. 53, č. 6, s. 826-884. ISSN 0032-3233.

[2] GROSSMAN, G., HELPMAN, E.: *Innovation and Growth in a Global Economy*. Cambridge: MIT Press, 1991. ISBN 0-262-57097-1.

[3] HLÁSNÝ, J. a KOL. Technika a technologie. Praha: VŠE, 1996. ISBN 80-7079-103-9.

[4] HOLUB, A., FOLTÝN, J. a ORDNUNG, N. Rozvojová ekonomika. 1. vyd. Praha: Vysoká škola ekonomická v Praze, 1993. ISBN 80-7079-423-2.

[5] LEHMANNOVÁ, Z. a KOL. *Aktuální otázky globalizace.* 1st Ed. Praha: Oeconomica – Fakulta mezinárodních vztahů Vysoké školy ekonomické v Praze, 2003. ISBN 80-245-0621-1.

[6] LISÝ, J. a KOL. Ekonómia v novej ekonomike. 1st Ed. Bratislava: IURA EDITION, 2005, s. 376. ISBN 80-8078-063-3.

[7] LUCAS, R. On the Mechanics of Economic Development. In *Journal of Monetary Economics*, 1988, roč. 22, č. 1, s. 3-42. ISSN 0304-3932.

[8] MEZŘICKÝ, V. (ed.) *Globalizace.* Praha: Portál, 2003. ISBN 80-7178-748-5.

[9] OECD *Education at a Glance, 2008.* Paris: OECD, 2008. ISBN 978-92-64-04628-3. [cit. 25/05/2009] Dostupné na WWW: <http://www.oecd.org/dataoecd/23/46/41284038.pdf>

[10] ROMER, P.: Increasing Returns and Long-Run Growth. In *Journal of Political Economy*, 1986, roč. 94, č. 5, s. 1002-1037. ISSN 022-3808.

[11] ROMER, P.: Growth Based on Increasing Returns due to Specialization. In *American Economic Review*, 1987, May 1987. ISSN 0002-8282.

[12] ROMER, P.: Endogenous Technological Change. In *Journal of Political Economy*, 1990, roč. 98, October, part 2, s. 71-102. ISSN 022-3808.

[13] SCHUMPETER, J. A. *Capitalism, Socialism and Democracy*. 3rd Ed. New York: Harper Perennial, 1962. ISBN 978-0-061-33008-7.

[14] SCHUMPETER, J. A. *Business Cycles*. Eastford: Martino Publishing, 2005. ISNB 978-1-578-98556-2.

[15] SCHUMPETER, J. A. *Theorie der wirtschaftlichen Entwicklung*. Berlin: Duncker & Humblot, 2006. ISBN 978-3-428-11746-8.

[16] SIRŮČEK, P. Nové aspekty globalizace aneb megatrendy 2000 – 2010. In *Marathon*, 2004, roč. 8, č. 5, s. 3-10. ISSN 1211-8591. [cit. 25/05/2009]. Dostupné na WWW: <http://www.valencik.cz/marathon>

[17] SIRŮČEK, P., HECZKO, S. Globalizace – vybrané teoretické aspekty. In *E+M: Ekonomie + Management*, 2006, č. 4/2006, s. 32-49. ISSN 1212-3609.

[18] STIGLITZ, J. E. *Globalization and Its Discontents.* 1st Ed. New York: W. W. Norton, 2003. ISBN 0-393-32439-7.

[19] ŠVEJDA, P. a KOL. *Základy inovačního podnikání.* Praha: Asociace inovačního podnikání ČR, 2002. ISBN 80-903153-1-3.

[20] UNESCO *International Standard Classification of Education 1997.* Re-edition. Montreal: UNESCO, 2006. ISBN 92-9189-035-9. [cit. 25/05/2009] Dostupné na WWW: <http://www.uis.unesco.org/TEMPLATE/pdf/isced/ISCED_A.pdf>

[21] VALENTA, F. *Tvůrčí aktivita – inovace – efekty.* Praha: Svoboda, 1969.

[22] VALENTA, F. *Inovace v manažerské praxi.* Praha: Velryba, 2001. ISBN 80-85860-11-2.

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