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HIGHER EDUCATION AND GROWTH PERFORMANCE OF EASTERN EUROPEAN COUNTRIES

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Abstract

This study investigates the causal relationship between higher education and GDP in the Eastern European countries including Bulgaria, Czech Republic, Hungary, Lithuania, Poland, Romania, and Slovenia for the period of 1980-2012. Toda and Yamamoto (1995) causality testing method is applied to determine causal relationship between higher education and GDP. The empirical results show evidence of bidirectional causality between higher education and GDP in Czech Republic and no causality for Bulgaria, Lithuania, and Poland. For Hungary and Sloveniathe causality is unidirectional, running from higher education to GDP. In the case of Romania, it appears that the causality runs from GDP to higher education.

Keywords: Higher education, GDP, Eastern European countries

1. INTRODUCTION

The nature of relationship between human capital and output has been one of the most studied issues in the economic growth literature. Theoretical models of economic growth, such as those of Nelson and Phelps (1966), Lucas (1988), Becker *et al.* (1990), and Rebelo (1992), among others, have stressed the contribution of human capital measured by education level. According to this view education increases productive capacity of workers and in turn promotes economic growth.

The empirical studies of growth for a broad range of countries, such as those by Denison (1985), Barro (1991), Mankiw *et al.* (1992), Levine and Zervos (1993), Barro and Lee (1993), Agiomirgianakis *et al.* (2002), Gylfason and Zoega (2003), Gyimah-Brempong *et al.* (2006), and Danacica (2011) have used the years of schooling attained by individuals to measure human capital. The relationship between different levels of education and growth ranges between positive, none, bidirectional causality, and unidirectional causality in the reported empirical studies for various countries. Therefore, the role of education in economic growth is far from conclusive in the literature. Motivated by this fact, this study aims at presenting further evidence to the results obtained so far in the literature, using a different set of countries.

The main objective of this study is to explore empirically the causal relationship between higher education and economic growth in the selected Eastern European countries (EEC) from 1980 to 2012. The empirical approach of this study is based on the bivariate Vector Autoregression (VAR) model and Toda-Yamamoto (TY) Granger causality approach.

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Rest of the study is organized as follows. Section 2 provides a brief review of previous studies, Section 3 presents the data description and methodological framework used, Section 4 reports the empirical results and Section 5 concludes the study.

2. LITERATURE REVIEW

Solow (1957) in his seminal paper, describes three sources of national income growth namely physical capital, labor, and a residual representing technological progress. In the Solow's growth model no special role is given to human capital. In endogenous growth models, human capital has a central role as an endogenous factor of production to explain economic growth. Existing growth literature accept education as one of the most important components of human capital. There is an abundance of empirical literature linking education and growth rate of income. For example, Denison (1985) finds that increase in level of education of the workers contributes about one fourth of the rise in per capita income in the USA from 1929 to 1982. Barro (1991) shows that education has a significant contribution to growth of per capita income in a sample of 98 countries from 1960 to 1985. Similarly, the empirical results by Mankiw *et al.* (1992) for 98 countries between 1960 and 1985; Knight *et al.* (1993) for 98 countries between 1960 and 1985; and Levine and Zervos (1993) for 98 countries between 1960 and 1985 support the positive significant relationship between education and growth rate of income.

Barro and Lee (1993) find that levels of primary, secondary, and higher education have positive and significant contribution to economic growth in a sample of 129 countries from 1960 to 1985. Agiomirgianakis *et al.* (2002) report that primary, secondary, and tertiary levels of the education have significantly positive effect on economic growth in a sample of 93 countries. Gylfason and Zoega (2003) find that secondary-school enrolment ratio for both females and males have significantly positive impact on economic growth in a sample of 87 from 1965 to 1998. Gyimah-Brempong *et al.* (2006) report that higher education has positive and significant contribution to economic growth in a sample of 34 African countries from 1960 to 2000.

Some of the researchers investigate the causal relationship between education and growth rate of income. For example, Islam *et al.* (2007) find bidirectional causality between education and growth in Bangladesh. Chaudhary *et al.* (2009) report a unidirectional causality running from economic growth to higher education enrollment ratio for Pakistan from 1972 to 2005. Huang *et al.* (2009) show that there is a bidirectional causality between higher education enrollment and the growth of GDP per capita in China between 1971 and 2007. Pradham (2009) demonstrates that there is a unidirectional causality running from economic growth to education in India from 1951 to 2002. Danacica (2011) finds evidence of unidirectional causality between education and economic growth in Romania for the period of 1985 to 2009. Zivengwa (2012) reports a unidirectional causality running from education to economic growth in Zimbabwe from 1980 to 2008. Qazi *et al.* (2014) find bidirectional causal relationship between higher education and economic growth in Pakistan from 1980 to 2011.

Many empirical studies suggest that education has a positive impact on the growth rate of income. However, the magnitude of this effect depends on the level of education and varies by country to country and time to time.

3. DATA AND METHODOLOGY

The causal relationship between human capital and output is estimated for seven EEC including, Bulgaria, Czech Republic, Hungary, Lithuania, Poland, Romania, and Slovenia. In empirical analyses for these countries an annual real Gross Domestic Product (GDP) and higher education enrolment ratio (HE) are used. HE is the proxy variable for the human capital. Higher education enrolment ratio is the ratio of total enrolment to the population of the age group that officially corresponds to the higher education. GDPs are in logarithmic form. The time span for each country

is determined by the availability of the data and ranges within the period of 1980-2012. The annual data for Real GDP and HE variables are obtained from World Bank database.

Several tests are commonly used to demonstrate the causality between variables *i.e.* Granger (1969), Engle & Granger (1987) and Johansen & Jesulious (1990). However, these tests are sensitive to model selection and they have pre requirements for stationarity and cointegration. He and Maekawa (1999) argue that usual Granger-causality test may lead to spurious causality relationship when one or both time series are non-stationary. In this paper, to overcome these shortcomings, the causal relationship between GDP and HE is estimated by applying the technique developed by T-Y. T-Y (1995) introduced an alternative causal testing methodology based on the Granger non-causality test but added extra lags determined by probable order of integration. The main distinction of TY technique is that Block Exogeneity Wald test can be applied whether variables are at the same order of integration or cointegrated (Toda and Yamamoto, 1995; Dolado and Lutkepohl, 1996).

In this study, as a first stage Augmented Dickey Fuller (ADF) test is applied to each of the time-series to determine their order of integration. Second, the following p-lag VAR (p) model is estimated in levels:

$$Y_t = a_1 + \sum_{t=1}^{p} \emptyset_i Y_{t-1} + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where Y_t *is n x 1 vector of two endogenous variables (GDP, HE),* a is the nx1 intercept vector of VAR, $\emptyset_i$ is the ith n x n matrix of autoregressive coefficient vector for i = 1, 2, 3…, p, and $\varepsilon_{t=}\, \varepsilon_{1t}, \ldots, \varepsilon_{nt}$ is the n x 1 vector of white noise process. The appropriate maximum lag length for the variables in the VAR, (k*), is selected based on the usual information criteria, such as Akaike and Schwarz Information Criteria (thereafter AIC and SIC, respectively). Third, the usual misspecification tests are performed to ensure that the VAR is well-specified. As a next step, the augmented (k+m) VAR is estimated, where m is the maximal order of integration. Finally, Granger non-causality hypothesis is tested using a Wald test.

4. EMPIRICAL FINDINGS

As preliminary analysis stationary of variables are tested using Augmented Dickey Fuller (ADF) test by Dickey and Fuller (1979, 1981). ADF test is applied with and without a time trend variable. Table 1 presents the ADF test results. The test results indicate that the variables are I(1) or I(2). Then optimal lag lengths of the VARs are selected based on AIC and SIC. The selected optimal lag lengths are presented in Table 2. Afterwards, autocorrelation, normality, and heteroskedasticity tests are applied to determine whether VARs (k*) are well-specified. Misspecification tests are reported in Table 3. The tests indicate that the model specifications used in the VARs estimation are appropriate.

Table 1: The ADF unit root test results

Country	Time	Variable		Level	First Difference	Second Difference
Bulgaria	1980-2012	GDP	wc	-1.126	-3.009**	
			wct	-1.866	-2.999	-5.907*
		HE	wc	0.476	-2.423	-11.22*
			wct	-2.989	-2.434	-11.05*
Czech Republic	1990-2012	GDP	wc	-1.372	-5.038*	
			wct	-1.433	-4.579*	
		HE	wc	-1.150	-2.935**	
			wct	-2.526	-2.901	-5.523*
Hungary	1989-2012	GDP	wc	-0.970	-2.669***	
			wct	-2.572	-2.641	-6.054*
		HE	wc	-0.979	-2.224	-3.099**
			wct	-3.792**	-2.146	

Lithuania	1990-2012	GDP	wc	-1.756	-3.390*	
			wct	-3.140	-2.094	-6.896*
		HE	wc	-1.798	-1.055	-3.657**
			wct	-2.499	-0.966	-5.005*
Poland	1990-2012	GDP	wc	-1.933	-6.300*	
			wct	-3.896**	-5.986*	
		HE	wc	-0.867	-3.126***	
			wct	-1.144	-3.119	7.689*
Romania	1980-2011	GDP	wc	-1.603	-2.693***	
			wct	-1.829	-3.363***	
		HE	wc	-1.799	-1.545	-5.365*
			wct	-2.489	-1.130	-5.514*
Slovenia	1990-2011	GDP	wc	-0.030	-3.723**	
			wct	-1.168	-3.456***	
		HE	wc	-0.952	-2.928***	
			wct	-1.152	-2.974	-7.278*

Notes: *, **, and *** indicate significant at 1%, 5%, and 10%, respectively. wc and wct are the test statistics for a unit root with a constant and with constant and trend. The lag lengths are selected based on SIC

Table 2: Selection of the order of the VARs (k^*)

Country	AIC		SIC		Optimal (k*)
	1	2	1	2	
Bulgaria	0.754	0.555	1.031	1.017	2
Czech Republic	-0.082	-0.385	0.215	0.111	2
Hungary	0.767	-0.264	1.062	0.226	2
Lithuania	2.668	1.432	2.966	1.929	2
Poland	-0.888	-1.183	-0.590	-0.686	2
Romania	1.794	0.894	2.079	1.370	2
Slovenia	0.527	0.329	0.825	0.824	2

Note: (k*) indicates the selected order of the VARs

Table 3: Misspecification tests for the VARs(k^*)

Country	Autocorrelation test	Normality test	Heteroskedasticity test
Bulgaria	2.838 (0.58)	3.129 (0.53)	40.246 (0.02)
Czech Republic	3.975 (0.40)	5.256 (0.26)	26.604 (0.32)
Hungary	1.971 (0.74)	8.772 (0.06)	24.423 (0.43)
Lithuania	6.907 (0.14)	3.345 (0.50)	19.699 (0.71)
Poland	4.100 (0.39)	7.873 (0.09)	18.671 (0.76)
Romania	4.661 (0.32)	0.687 (0.95)	66.948 (0.25)
Slovenia	4.549 (0.33)	1.403 (0.84)	51.845 (0.29)

Notes: Autocorrelation test is the residual serial correlation LM test. Normailty test is the residual normality test of orthogonalization: Cholesky (Lutkepohl). Heteroskedasticity test is the test for residual Heteroskedasticity tests: No cross terms. The values in the parentheses are the p-values

Following the T-Y procedure, having determined maximal order of integration is I(2) for all countries, two lags augmented bi-variate VARs are estimated. The causal relationship between GDP and HE is estimated by carrying out Block Exogeneity Wald test. The Wald test results are presented in Table 4. The results reported in Table 4 provide evidence of a uni-directional causality running from HE to GDP for Hungary and Slovenia. For these countries changes in higher education enrolment ratio have significant impact on income. This means that an increasing in higher education enrolment ratio generates a continuous rise in income. The Wald test results also indicate that uni-directional causality running from GDP to HE exists in Romania. This result suggests that sustained economic growth leads continuous increase in higher education enrolment.

Table 4: Granger Causality test results based on the T-Y methodology

Country	GDP Granger causes HE	HE Granger causes GDP	Direction of causality
Bulgaria	1.814 (0.40)	0.786 (0.67)	none
Czech Republic	6.013 (0.04)	10.327 (0.00)	HE ↔ GDP
Hungary	0.041 (0.97)	4.703 (0.09)	HE → GDP
Lithuania	1.936 (0.37)	0.534 (0.76)	none
Poland	2.437 (0.29)	3.265 (0.19)	none
Romania	10.809 (0.09)	3.577 (0.77)	GDP → HE
Slovenia	2.799 (0.59)	11.386 (0.02)	HE → GDP

Notes: The reported estimates are asymptotic Wald statistics. The values in the parentheses are the p-values. The [k+m]th-order level VAR is estimated with maximal order of integration (m) being 2

There exist bi-directional causality between GDP and HE in Czech Republic, indicating that GDP and HE mutually affect each other. In other words, an increase in income leads an increase in higher education enrolment ratio and vice versa. The results indicate non causality between GDP and HE in Bulgaria, Lithuania, and Poland.

5. CONCLUSION

The relationship between education and economic growth has been well discussed in the growth literature on different times and on different countries, especially in the last three decades. This study has presented some further evidence to the results obtained so far in the literature using a different set of countries. The bi-variate (VAR) model and T-Y (1995) causality testing methodology are used to estimate the direction of the causal relationship between higher education enrolment ratio and income in the seven EEC for the period 1980-2012. The empirical results demonstrate that higher education enrolment ratio is dependent on income and vice versa indicating that the causality is bidirectional in Czech Republic. In the case of Hungary and Slovenia it is found that an increase in higher education ratio cause an increase in income, meaning that causality runs from higher education ratio to income. For the Romania, it appears that causality runs from income to higher education ratio. However, the results show none causality between higher education enrolment ratio and income in Bulgaria, Lithuania, and Poland.

The policy implication of this study is that governments in Czech Republic, Hungary, and Slovenia should take measures to enlarge higher education participation to achieve higher economic growth in these countries.

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