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Human Capital and Economic Growth in Greece: Evidence from the Toda–Yamamoto Approach

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Abstract

The current article attempts to investigate the causal relationship between human capital and economic growth in postwar Greece. For this purpose, we use annual time series data from 1952 to 2017 retrieved from the Penn World Table (PWT) version 9.1 and we apply the Toda – Yamamoto (1995) approach. Our findings indicate a one-way causality that runs from human capital to economic growth. This is consistent with proposals that the Greek government, despite budget cuts due to the recent fiscal financial crisis, should focus its efforts on the development of human capital in order to achieve sustainable economic growth.

JEL Classification: I25, O40, C22
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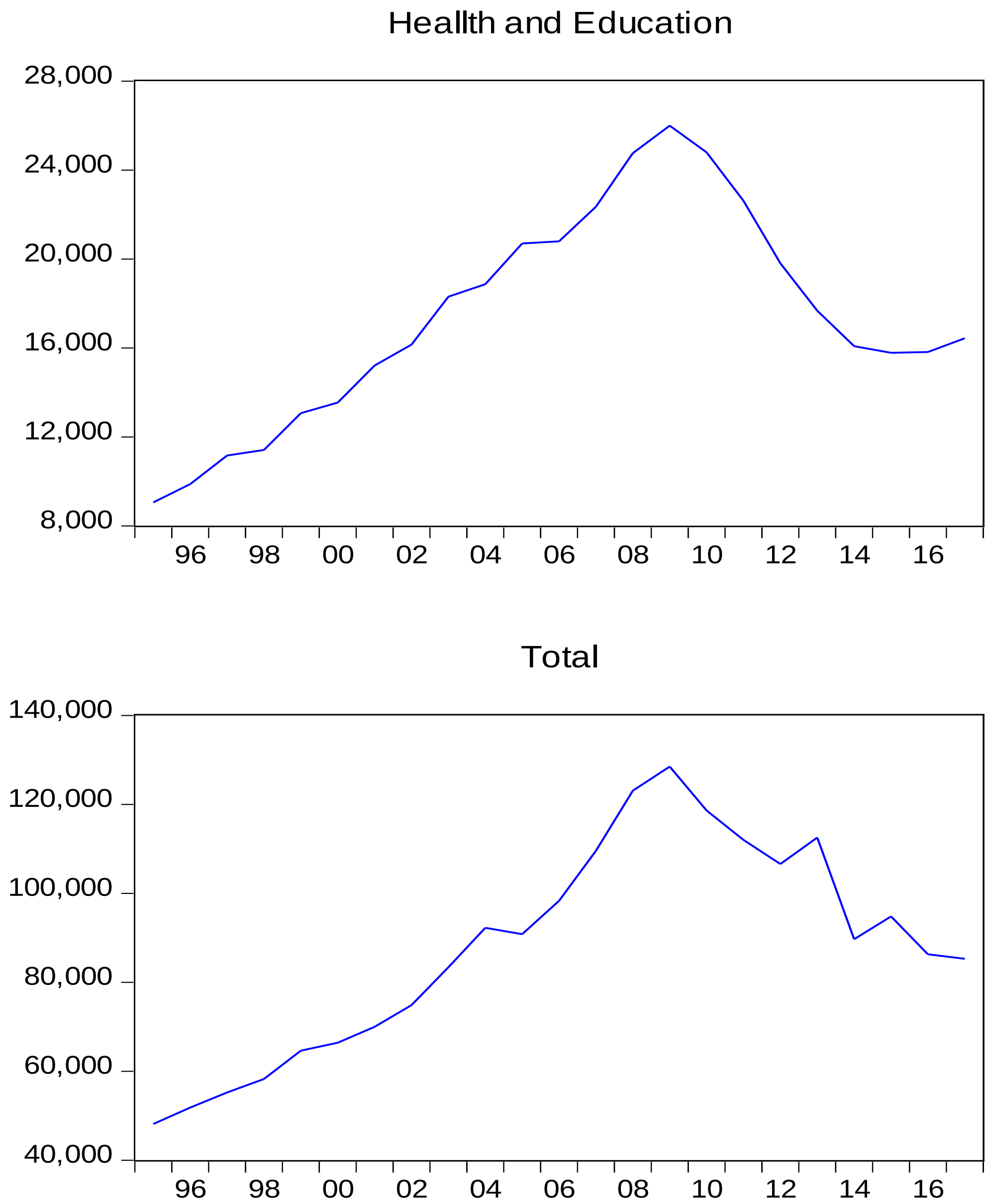
1. Introduction

The World Bank (2002a) indicates that education is one of the most powerful means of alleviating poverty and inequality. While the International Monetary Fund advised developing countries in Africa to take measures to reduce their budget deficits without reducing public investment in health and education (IMF, 1996). This proposal was a broader IMF call to developing countries implementing its programs in 1999. However, in Greece public spending on education and health follows the downward trend in total public spending that took place after the economic crisis of 2009, with unique exception the increase of the public expenditure on education and health in 2017 (see Figure 1).

Figure 1: General government expenditure (million euro).



Source: Eurostat

The main question arising thus is whether the development of human capital can promote economic growth. The theory of human capital highlights the positive and important contribution of education to economy and the endogenous growth theories argue that human capital can drive economic growth (see Lucas, 1988; Romer, 1986). However, the empirical evidence is not always conclusive. A review of empirical studies indicates that the manner by which human capital affects economic growth does not always align with theory predictions and the results of empirical research are usually mixed. For example, Cheng & Hsu (1997), Awel (2013), Akaakohol & Ijirshar (2018) and Akinwale & Grobler (2019) conclude that there is a two-way causal relationship between human capital and economic growth. But on the other hand, Boldin et al. (2000) do not find strong evidence that education causes GDP or vice versa in the cases of Argentina and Chile. Similarly, De Meulemeester & Rochat (1995) do not find a causal relationship in the cases of Italy and Australia.

Also, many empirical studies confirm the existence of a one-way causality. Indicatively, Sharmistha & Grabowski (2003) approach human capital by the mean years of schooling and conclude in the case of the Japan economy that pre-war and post-war primary education causes economic growth, while secondary and higher education affect only post-war development. They also find vocational education not affecting development. They do not observe any impact of economic growth on any of the previous human capital measures (hence no two-way relationship is observed). Ali et al. (2017), Mallick & Dash (2015) and Sunde (2017) find a one-way Granger causality from educational spending to economic growth. Meanwhile, Obradovic & Lojanica (2016) examine the relationship between higher education and economic development in Sweden by following the Toda - Yamamoto approach and conclude that higher education Granger causes per capita GDP, without indications of the existence of reverse causality. Concerning the Greek economy Asteriou & Agiomirgianakis (2001) proceed with a series of Granger bi-variable causality tests for the period 1960 - 1994, which indicate human capital affecting economic growth except in the case of higher education. The latter was found to have a reverse causality, namely that economic growth causes an increase in interest for higher education. In contrast, Pegkas (2012) for the period 1981 - 2009 finds that human capital, proxied by the average years of schooling of the population in employment, has no significant effect on economic growth in Greece.

The existence of conflicting findings seems to be largely due to: the fact that human capital is not directly measurable and there are a number of different ways of to approach it; and to the often poor quality of data. In our study data quality and the manner by which human capital is approached are of prime importance. It is of particular value that our sample size investigates the period from 1952 to 2017 and is one of the largest internationally for empirical studies concerning a single country. Moreover, we apply the Toda – Yamamoto (1995) approach and we use time series data retrieved from the well-known dataset of the Penn Word Table version 9.1 (Feenstra et al., 2015). The human capital index that is being used is available since PWT version 8.0 and its calculation is based on average years of schooling from Cohen and Soto (2007) / Cohen and Leker (2014) with an estimated rate of return to education from the Mincer equation (Psacharopoulos, 1994). Therefore, the index contains information from multiple indicators, and it is interesting to compare the results of the current research with the rest empirical studies. In the case of economic growth, the growth rate of real GDP is being used.

2. Methodology

Unlike most empirical studies utilizing the conventional Granger causality test, in our paper we adopt the Toda – Yamamoto (1995) approach. The superiority of the latter lies first in avoiding problems of incorrect identification of the integration order of time series. Secondly, Toda & Yamamoto formulated a VAR process that is able to test "*restrictions on the parameter matrices even if the processes may be integrated or cointegrated of an arbitrary order*" (Toda & Yamamoto, 1995: 225). This procedure is based on an augmented VAR model ($k+d_{max}$) in the levels of the data, irrespective of the order of integration, where k is the optimal lag length and d_{max} is the maximum order of integration for the system's variables.

In order to decide on the maximum order of integration the first step is to perform a unit root testing of all the variables involved. For this purpose, we use the augmented Dickey-Fuller test (ADF, hereafter) followed by the Phillips-Perron test (PP, hereafter) for cross-checking.

The next step involves the identification of a VAR model in order to determine the optimal lag length (k) by using appropriate information criteria, such as *Akaike information criterion* (AIC) followed by serial correlation testing to avoid the misspecification of the model; d_{max}

additional lags of each of the variables are then added into each of the equations and the VAR model is set up for the case of two time-series, X and Y, as follows:

$$Y_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} Y_{t-i} + \sum_{j=k+1}^{d_{max}} \alpha_{2j} Y_{t-j} + \sum_{i=1}^{k} \delta_{1i} X_{t-i} + \sum_{j=k+1}^{d_{max}} \delta_{2j} X_{t-j} + u_t \quad (1)$$

$$X_t = \beta_0 + \sum_{i=1}^{k} \beta_{1i} X_{t-i} + \sum_{j=k+1}^{d_{max}} \beta_{2j} X_{t-j} + \sum_{i=1}^{k} \varphi_{1i} Y_{t-i} + \sum_{j=k+1}^{d_{max}} \varphi_{2j} Y_{t-j} + v_t \quad (2)$$

Finally, we decide on causality by testing the hypothesis that the coefficients of the first k lagged values of X are zero in equation (1) with a Wald test. Similarly, we test the coefficients of the first k lagged values of Y in equation (2).

3. Results

The first step of the empirical part is to determine the order of the integration of the time series data included in the analysis by applying ADF and PP tests. Both tests indicate that growth rate of real GDP (RGDP) is stationary at levels and human capital index (HC) is stationary at second differences. This also comes from the observation of the correlograms over time. The results of ADF and PP tests are reported in Table 2. Namely, the growth rate of real GDP was found to be I(0) and the human capital index I(2) and so the maximum order of integration for the system's variables **(**d_{max}) is 2. Therefore, only the Toda Yamamoto approach may be applied as the time series are integrated in different order.

Table 1: Descriptive statistics

`	HC	RGDP
Mean	2.398964	3.150903
Median	2.392072	3.277907
Max.	3.091254	13.20385
Min.	1.571550	-9.132501
Std. Dev.	0.413605	4.652971
Skewness	-0.086353	-0.248750
Kurtosis	1.972007	3.035547

Regardless of the orders of integration, a 2 equation VAR model is then set up in the levels of the data and via AIC information criteria the lag length of 3 periods is determined as optimal. Autocorrelation LM test is undertaken in order to avoid model misspecification. As it can be seen in Table 3 the null hypothesis that there is no correlation amongst residuals, i.e. they are independent, cannot be rejected.

Then we re-estimate the VAR model in the levels and because d_{max} is 2 we add 2 additional lags to the optimal lag length of each variable into each of the equations. Finally, we perform a Wald test in order to test the Granger non – causality but without including the d_{max} additional lags of each variable. The results indicate that human capital Granger causes economic growth, without any evidence of vice versa causality (Table 4).

Table 2: Unit Root & Stationarity Tests on Growth Rate of GDP and Human Capital Index

	p-values					
	H_0: Series has a unit root					
	ADF Tests			PP Tests		
	None	Intercept	Intercept and trend	None	Intercept	Intercept and trend
RGDP	0.0244	0.0005	0.0000	0.0008	0.0002	0.0000
D(RGDP)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
D(HC)	0.1384	0.0986	0.3230	0.1403	0.0986	0.3230
D(HC,2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

RGDP = Growth rate of real GDP, HC = Human Capital Index

Table 3: Breusch-Godfrey Serial Correlation LM Test

H_0: No serial correlation at up to 3 lags			
LM-Stat	6.480386	Prob.	0.1660

Table 4: VAR Granger Causality/Block Exogeneity Wald Tests

Dependent variable: RGDP		
	Chi-square	Prob
HC	10.24840	**0.0166**
Dependent variable: HC		
RGDP	0.375128	0.9453

4. Conclusions

The current study applies the Toda – Yamamoto approach in a particularly large sample by using data from the Penn World Table 9.1 database. The results show strong indications that human capital can drive economic growth in Greece. This conclusion is particularly important for the policymakers as it implies that any cuts in the public spending should not be horizontal and that the development of human capital must be a priority.

Additionally, our results indicate the absence of a two-way causality between economic growth and human capital in Greece. This shows that while education seems to promote economic growth, when the latter is achieved, the policy maker does not provide more resources on human capital to promote a feedback mechanism that will further enhance economic growth.

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