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Assessing the Causal Link Between Human Capital and GDP in Southern European Countries

Georgios Garafas[1]

[1] Department of Accounting and Finance, University of Ioannina, Greece

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ABSTRACT

Purpose:
The purpose of this study is to empirically evaluate if there is a causal relationship between human capital and GDP in four southern European countries—Portugal, Italy, Greece, and Spain—that have been severely affected by the 2008 financial crisis.

Design/methodology/approach:
The analysis begins by analyzing the order of integration of the time series under examination to determine the optimal method for determining the presence of causal links. Given that the order of integration varies by country, the Toda-Yamamoto (1995) approach was used. Annual data were employed for the human capital index and real GDP.

Findings:
The empirical analysis results indicate that the relationship between economic growth and human capital varies substantially among countries. Specifically, no causal relationship was identified in Portugal and Spain, whereas a causal relationship is observed only from GDP to human capital in Italy. In Greece, human capital appears to Granger cause economic growth.

Research limitations/implications:
The observed differences in causal linkages may reflect the economic structures, education systems, and policies in each country.

Originality/value:
The study contributes to the existing literature by demonstrating that each country's economic and political factors have a unique impact on human capital effectiveness.

1. Introduction

This study aims to empirically test the theory of human capital. Human capital is widely recognized as a key driver of sustainable and long-term economic development. We typically use the term "human capital" to describe the health, skills, and experience of individuals, as well as their educational background. It is evident that these factors have the potential to impact on both employee productivity and the overall economy. Several empirical studies have been conducted to explore the correlation between human capital and economic growth. The authors of these studies used various indicators, such as years of schooling, enrollment rates, and government spending on education, to measure the stock of human capital.

Studies in the literature yield conflicting results, showing the intricate nature of human capital. For instance, Musila and Belassi (2004) discovered a positive correlation between education spending and economic growth, although they note that simply increasing spending is not enough; effective management of resources by the government is also needed. Hage et al. (1988) argue that the positive effect of education on economic growth necessitates the existence of a minimum level of educational program standardization. Sylwester (2000) asserts that while public education expenditure positively correlates with future economic growth, its immediate impact may be adverse.

†Corresponding Author: Georgios Garafas

e-mail: ggarafas@uoi.gr

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Men's secondary and higher education has a positive correlation with economic growth, while women's education has no effect, according to Barro's (2001) analysis of the factors influencing economic growth in a panel of 100 countries. This suggests that many countries underutilize women's human capital. Cohen and Soto (2007) highlight the importance of data in reducing measurement error and offer further confirmation of the macroeconomic impacts of human capital. Lim et al. (2018) estimate expected human capital as a measure of health and education, and they found that quicker economic development is linked to larger improvements in predicted human capital.

Asteriou and Agiomirgianakis (2001) identify a cointegrating relationship between education, as indicated by enrollment rates in primary, secondary, and tertiary education, and GDP per capita. They conclude that education Granger causes economic growth, except for tertiary education, where reverse causality is found. Garafas et al. (2022) also find a positive correlation between GDP and Greek enrollment rates over the long term, but they do not find evidence that education Granger causes economic growth. However, they uncover that GDP Granger causes general secondary education.

The current analysis empirically explores the relationship between human capital and economic growth in four southern European countries—Portugal, Italy, Greece, and Spain—known pejoratively as the P.I.G.S. countries due to their poor economic performance during the 2008 crisis. The primary goal of this study is to determine whether increases in human capital Granger cause economic growth in these economies. As these countries have long struggled with core concerns such as public debt, labor markets, and productivity, they have come to reflect for many the much-discussed "two-speed Europe" aspect. Many of these issues have been addressed; however, the split between the North and South of Europe remains a relevant framework for comparative analysis.

In this light, these countries have displayed notable variations in their economic performance in recent years, making them intriguing candidates for studying the influence of human capital on economic growth. According to Puig and Sanchez (2018), Portugal and Spain, although part of the same P.I.G.S. group, encountered distinct challenges and adopted different approaches. In Italy, De Meulemeester and Rochat (1995) found no causal relationship between higher education and economic development. However, Bronzini and Piselli (2009) discovered that human capital has a significant impact on productivity across Italian regions.

In Portugal, Teixeira and Fortuna (2003) identified a positive link between human capital and total factor productivity. Obradovic and Lojanica (2016) used the Toda-Yamamoto approach and discovered that, in the short run, tertiary education causes GDP per capita. Also, Garafas et al. (2020) used the Toda-Yamamoto approach and argued that human capital has a beneficial impact on economic growth in Greece.

This study aims to contribute to the literature by investigating the discrepancies in the relationship between human capital and economic growth in the four countries under consideration. The empirical analysis is presented in the following section, while the concluding remarks of the study can be found in the final section.

2. Empirical Analysis

The current analysis begins by examining the order of integration of the series to determine the most suitable approach for investigating the existence of causal linkages. Afterward, it is demonstrated that the human capital index and the real GDP series are integrated to varying degrees for each of the countries examined. Despite surplus lag concerns, the Toda-Yamamoto (1995) approach is extensively used to handle mixed integration orders and minimize biases. Considering integration orders, the Toda-Yamamoto approach is more favorable for the current investigation. Garafas et al. (2020) conducted research identifying varying degrees of integration between the human capital index and the GDP growth rate in Greece and ultimately selecting the Toda-Yamamoto (1995) approach as the most suitable method to test causality. The present study expanded their research to encompass the other southern European countries.

To summarize, the following procedures were carried out: The series' order of integration is initially verified using the augmented Dickey-Fuller (ADF) test and subsequently cross-checked using the Phillips-Perron (PP) test. When in doubt, the correlograms were visually examined. For each country, a two-variable VAR model was employed, with the real GDP and human capital index expressed in logarithms. The optimal lag length was determined using the information criteria, and the model's dynamic stability was assessed. Furthermore, the residuals were examined, and the LM test was implemented to assure serial independence. Following the Toda-Yamamoto (1995) approach and setting m as the maximum order of integration, an augmented VAR model was applied, with m additional lags for each variable added to each equation of the VAR model. The Wald test was then conducted to

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determine Granger non-causality, without incorporating the coefficients for the m lags. As a result, a rejection provides evidence for the existence of Granger causality.

The empirical analysis utilized annual time series data from 1950 to 2019, with the exception of Greece, where the available data was from 1951 to 2019. Data were retrieved from the Penn World Table (PWT) version 10.01 (Feenstra et al., 2015). The human capital index is based on years of schooling and returns to education, while real GDP is expressed at constant 2017 national prices.

Starting with Portugal, the unit root tests make it clear that the human capital index is I(2) and that real GDP is most likely I(1). In the case where an intercept is included, the GDP series appears to be stationary according to the PP test (see Table 1). Nonetheless, both cases confirm that the series exhibits varying degrees of integration, with the maximum order of integration being m = 2.

Table 1. Unit Root Test Results for Portugal

	p-values					
	H$_0$: Series has a unit root					
	ADF			PP		
	None	Intercept	Intercept and trend	None	Intercept	Intercept and trend
LGDP_PRT	0.9995	0.0535	0.9859	1.0000	0.0024	0.9848
D(LGDP_PRT)	0.0713	0.0001	0.0000	0.0018	0.0001	0.0000
LHC_PRT	0.8979	0.8149	0.5001	1.0000	0.9506	0.7487
D(LHC_PRT)	0.2893	0.2144	0.5203	0.2851	0.1813	0.4713
D(LHC_PRT,2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

LGDP = Log of Real GDP, LHC = Log of Human Capital Index

As determined by the FPE, AIC, SC, and HQ information criteria, two lags were chosen as the appropriate number of lag lengths. The inverse roots of the characteristic AR polynomial were analyzed to assess the model's stability. The VAR model is regarded as stationary due to the fact that all of its roots lie within the unit circle. Additionally, the residual serial correlation LM test confirmed the absence of residual autocorrelation.

To test for Granger non-causality, the Wald test is used without accounting for the coefficients for m lags. The data in Table 2 show that there are no causal relationships.

Table 2. VAR Granger Causality/Block Exogeneity Wald Tests, Portugal

Dependent variable: LGDP_PRT			
	Chi-square	df	Prob
LHC_PRT	2.894040	2	0.2353
Dependent variable: LHC_PRT			
LGDP_PRT	0.777810	2	0.6778

Based on the unit root test results (see Table 3), it appears that the log of real GDP in Italy is non-stationary I(1), except in the case where we assume the presence of a constant. Nevertheless, a careful examination of the

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correlograms reveals that the autocorrelations do not rapidly decay to zero as the lag length increases, suggesting that the series cannot be considered stationary. Based on the results, it is clear that the human capital index log is I(2). The optimal number of lag lengths was determined to be two due to the information criteria FPE, AIC, SC, and HQ. Furthermore, all roots fall within the unit circle, and the residuals show no signs of serial correlation, as confirmed by the LM test.

Table 3. Unit Root Test Results for Italy

	p-values					
	H_0: Series has a unit root					
	ADF			PP		
	None	Intercept	Intercept and trend	None	Intercept	Intercept and trend
LGDP_ITA	0.9337	0.0000	0.9808	1.0000	0.0000	0.9803
D(LGDP_ITA)	0.0748	0.2475	0.0000	0.0017	0.0001	0.0000
LHC_ITA	0.4880	0.3330	0.5251	1.0000	0.8880	0.9337
D(LHC_ITA)	0.5451	0.7351	0.9003	0.5429	0.6951	0.8920
D(LHC_ITA,2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

LGDP = Log of Real GDP, LHC = Log of Human Capital Index

The Wald test, at a significance level of 5%, suggests a marginal acceptance of the hypothesis that human capital does not cause GDP. However, the inverse direction of causality—from GDP to human capital—is evident (see Table 4).

Table 4. VAR Granger Causality/Block Exogeneity Wald Tests, Italy

Dependent variable: LGDP_ITA			
	Chi-square	df	Prob
LHC_ITA	5.799027	2	0.0550
Dependent variable: LHC_ITA			
LGDP_ITA	7.147903	2	**0.0280**

For Greece, the unit root test results (see Table 5) indicate that the log of real GDP should be defined as a non-stationary I(1) series, unless we assume the existence of an intercept, in which case it could be claimed to be a stationary I(0) series. Nevertheless, the latter case is not supported by visual inspection of the correlograms. The results reveal that the human capital index should be a non-stationary I(2) series. Correlograms provide more support for this argument. As a result, the series appear to be integrated in varying degrees.

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Table 5. Unit Root Test Results for Greece

	p-values					
	H_0: Series has a unit root					
	ADF			PP		
	None	Intercept	Intercept and trend	None	Intercept	Intercept and trend
LGDP_GRC	0.9604	0.0057	0.9010	0.9976	0.0189	0.9742
D(LGDP_GRC)	0.0198	0.0005	0.0000	0.0006	0.0002	0.0000
LHC_GRC	0.9481	0.6358	0.0028	1.0000	0.0081	0.0004
D(LHC_GRC)	0.0407	0.1210	0.3814	0.0405	0.1210	0.3724
D(LHC_GRC,2)	0.0000	0.0000	0.0353	0.0000	0.0000	0.0000

LGDP = Log of Real GDP, HC = Log of Human Capital Index

Based on the LR, FPE, AIC, and HQ information criteria, three lags were determined to be optimal. The VAR model is considered stationary since all of its roots lie within the unit circle. Furthermore, the residual serial correlation LM test demonstrated the absence of residual autocorrelation. The Wald test is then conducted, excluding the coefficients for the m lags to test Granger non-causality. The findings indicate that human capital Granger causes GDP in Greece.

Table 6. VAR Granger Causality/Block Exogeneity Wald Tests, Greece

Dependent variable: LGDP_GRC			
	Chi-square	df	Prob
LHC_GRC	12.00510	3	**0.0074**
Dependent variable: LHC_GRC			
LGDP_GRC	1.232936	3	0.7451

When it comes to Spain, the time series of the logarithm of GDP appears to be integrated of order 1, I(1), unless the constant is included, in which case it becomes stationary, I(0). Visual analysis of the correlograms clearly disproves the claim of the series being stationary. For the human capital index, the cases "none" and "intercept & trend" suggest that it primarily follows an I(2) pattern; but "intercept" appears to follow an I(1) pattern. However, the correlograms clearly indicate that it should be classified as I(2).

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Table 7. Unit Root Test Results for Spain

	p-values					
	H_0: Series has a unit root					
	ADF			PP		
	None	Intercept	Intercept and trend	None	Intercept	Intercept and trend
LGDP_ESP	0.9999	0.0286	0.7208	1.0000	0.0003	0.7208
D(LGDP_ESP)	0.0001	0.0000	0.0000	0.0001	0.0000	0.0000
LHC_ESP	0.9975	0.9096	0.3287	1.0000	0.9985	0.0388
D(LHC_ESP)	0.5897	0.0236	0.1788	0.5897	0.0234	0.1834
D(LHC_ESP,2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

LGDP = Log of Real GDP, HC = Log of Human Capital Index

After considering the LR, FPE, AIC, and HQ information criteria, it was determined that five lags were optimal. Nonetheless, there is autocorrelation in the model's residuals. To address this issue, the lag length of the VAR model is extended to seven. The residuals exhibit no autocorrelation, and all roots are contained within the unit circle. According to the Wald test results, there is no significant evidence of Granger causality when excluding the coefficients for the m lags (see Table 8).

Table 8. VAR Granger Causality/Block Exogeneity Wald Tests, Spain

Dependent variable: LGDP_ ESP			
	Chi-square	df	Prob
LHC_ ESP	11.88171	7	0.1045
Dependent variable: LHC_ ESP			
LGDP_ ESP	3.614525	7	0.8230

3. Conclusions

The current study first identifies the varying orders of integration between the GDP and the human capital index for each of the so-called P.I.G.S. countries. This fact necessitates Toda-Yamamoto's (1995) methodology to investigate the causal relationships between the preceding series.

The analysis did not reveal any causal relationship that was significant for Portugal. GDP appears to be unaffected by human capital in Italy; however, an inverse causal relationship between GDP and human capital was established. Human capital was found to Granger cause GDP in Greece, as was the case in the research conducted by Garafas et al. (2020), who discovered that human capital Granger causes economic growth over a slightly different time span. Lastly, no statistically significant causal relationship between the two variables was identified for Spain. In general, the findings indicate that the causality of the relationship between economic growth and human capital is not consistent across the countries examined and is contingent upon the national context and characteristics of each economy, such as the educational system and policies applied in each country.

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