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A PANEL REGRESSION ANALYSIS OF HUMAN CAPITAL RELEVANCE IN SELECTED SCANDINAVIAN AND SE EUROPEAN COUNTRIES

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Abstract
The study of human capital relevance to economic growth is becoming increasingly important taking into account its relevance in many of the Sustainable Development Goals proposed by the UN. This paper conducted a panel regression analysis of selected SE European countries and Scandinavian countries using the Granger causality test and pooled panel regression. In order to test the relevance of human capital on economic growth, several human capital proxy variables were identified. Aside from the human capital proxy variables, other explanatory variables were selected using stepwise regression while the dependant variable was GDP. This paper concludes that there are significant structural differences in the economies of the two observed panels. Of the human capital proxy variables observed, for the panel of SE European countries only life expectancy was statistically significant and it had a negative impact on economic growth, while in the panel of Scandinavian countries total public expenditure on education had a statistically significant positive effect on economic growth. Based upon these results and existing studies, this paper concludes that human capital has a far more significant impact on economic growth in more developed economies.

Keywords: area studies, human capital proxies, economic growth, education expenditure, Sustainable Development Goals.

Jel Classification: C23; C32; I25

INTRODUCTION

Since Adam Smith's time in the 18th century, the influence of human capital on economic growth was considered. There is an increased number of studies that are measuring not only the impact of human capital on economic growth, but several authors have begun to question its relevance as one of the main generators of attracting physical capital and achieving long-term growth (Mujahid, Amin, and Khattak 2014). With the introduction

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of the Millennium Development Goals (MDG), the focus of one of the world's largest international organization was placed on existential issues related to the survival of the environment and addressing the basic needs of every human being (United Nations General Assembly 2000). The Sustainable Development Goals (SDG) take us a significant step further by not only ensuring what humanity needs to survive, but securing goals that are necessary in order for humanity to prosper. By analysing the SDGs it is clearly possible to state that one of their key guidelines is improving and increasing human capital (United Nations 2015). Many of the goals, such as achieving full employment, are standard topics of academic debates, yet whether such a concept can be achieved has often been contested (Seccareccia 2015). Several authors have addressed the mind-set change concerning the SDGs as primarily human centred and answering key issues humanity is facing today (Kumar, Kuman, and Vivekadhish 2016). There are several methodological approaches to measuring human capital[2] and while there are several models that have wide approval, there is still room for improvement.

While a vast number of studies consider the relation between human capital and economic growth and since the 1990s several studies have addressed that there is a significant difference between the relevance of human capital to economic growth in developed and developing countries. This paper shall implement a panel approach to compare two vastly significant areas within Europe. It shall attempt to address whether there is any statistically significant difference between human capital relevance to economic growth in the chosen SE European countries and the Scandinavian countries. Based upon previously conducted studies and basic macro-economic traits, the initial hypothesis of this paper is that the impact of human capital on economic growth is far more significant in the Scandinavian countries than in the countries of SE Europe (Neagu 2012; Giménez, López-Pueyo and Sanaú 2015, and Akpolat 2014).

1. LITERATURE REVIEW

Lucas (1988) modified the original Sollow-Swan model, which can be summarized as:

$$Y = AK^{\alpha} (lhL)^{1-\alpha} \quad (1)$$

Y	GDP growth
A	Total factor productivity
K	Capital
h	Stock of human capital
L	Labour force
α	Output elasticity of capital

Inclusion of human capital by augmenting the Sollow model implies further consideration of the relevance of human capital to economic growth. Mankiw (1995, 294) suggest several variables that might be used to proxy human capital in relation to economic growth, where he primarily suggests viewing minimal wage as a return with minimal human capital and return to schooling. This is also one of the two approaches that is generally used to measure human capital. A significant number of studies use proxy variables for human capital, while others use models to calculate the human capital. Judson (2002) conducted a study where she attempted to measure human capital

[2] These methodological approaches are discussed more thoroughly within the literature review.

as physical capital and concluded that human capital's growth discomposition is significantly lower to that of physical capital.

Giménez, López-Pueyo and Sanaú (2015, 97) conducted a Granger causality test, measuring the relationship between GDP growth and several human capital proxies in a panel of selected OECD countries, and concluded that while there is a statistically significant link between GDP growth and their proposed human capital indicator there is no relationship between the observed education related human capital variables[3] and GDP growth. Neagu (2012) calculated the market value of human capital, also in selected OECD countries, and his conclusion was that the market value of human capital is higher in more developed OECD countries such as Australia, Austria and the USA. Akpolat (2014) conducted a panel cointegrated regression analysis by using proxy variables[4] in selected developed and developing countries where he concluded that the developed countries had more efficient physical capital and educational expenditure investments. Edrees (2016) conducted an advanced Granger causality test for selected countries of the Arab world and found few structural differences in regards to human capital relevance to economic growth in more developed and less developed countries of the Arab world.

Škare (2001) questioned the relevance of human capital to Croatian GDP growth and implemented the following model for human capital calculation:

$$H = f(K, R, N) \quad (2)$$

H Human capital
K Private expenditure on education
R Total public expenditure
N Forgone earnings

Based upon his calculations, Skare (2001, 199) concludes that the Croatian economic growth is directly caused by an increase in human capital. Tica and Djukec (2008) conducted a study in which they concluded that physical capital is by far the most important factor in determining the economic growth of Croatia, while other factors such as human capital are far less significant, yet they still are significant at a statistical level. Based upon the conducted literature review, it can be seen that most authors focus on either their respected countries or on versions of panels of OECD countries for which there is the most data available. It can further be concluded that using human capital proxy variables is not only widely accepted, but practised by a significant percentage of the field.

2. METHODOLOGY AND DATA

Data was extracted from Eurostat for the period 1995–2015 for the considered SE European and Scandinavian countries. Within the panel of SE European countries Slovenia, Croatia and Macedonia are considered. The panel of Scandinavian countries consists of Norway, Sweden, Denmark and Finland. Based upon the previously conducted literature review, the author suggests using three significant human capital proxy variables as the independent variables — life expectancy at birth, total public

[3] The variables observed by the authors were gross enrolment rate in secondary schooling and average schooling years in the total population.

[4] The proxy variables were life expectancy at birth and education expenditure.

expenditure on education and tertiary school enrolment. The dependent variable is the natural logarithm of GDP, measured in constant 2010 millions of euros.

2.1. Unit root test and Granger causality

The first step is to conduct a Granger causality test between GDP and the chosen human capital proxy variables. Before proceeding with the causality test, unit root test will be performed to ensure that the variables are stationary. Several unit root tests will be conducted, namely the tests proposed by Levin, Lin and Chu (2002), Im, Pesaran and Schin (2003) and augmented versions of the test proposed by Philips and Pheron (1988) and Dickey and Fuller (1979). All of these tests are conducted against the null hypothesis of non-stationarity, meaning that the rejection of the null hypothesis leads to the conclusion that we can reject the non-stationarity hypothesis. If the variables were not stationary in their natural logarithms, the first difference of the variables was calculated. Regarding the Granger causality test initially introduced by Granger (1969), it is computed by running bivariate regression with the appropriate number of lags of the tested variable. The number of lags is automatically calculated in E-Views based upon the Schwartz criterion. The general models are as follows:

$$GDP_{i,t} = \alpha_{0,i} + \alpha_{1} GDP_{i,t-1} + \ldots + \alpha_{l,i} GDP_{l,\,t-1} + \beta_{1,l} HC_{l,\,t-1} + \ldots + \beta_{1,l} HC_{l,t-1} + \ldots + \epsilon_{i,t} \quad (3)$$

$$HC_{i,t} = \alpha_{0,i} + \alpha_{1} HC_{i,t-1} + \ldots + \alpha_{l,i} HC_{l,\,t-1} + \beta_{1,l} GDP_{l,\,t-1} + \ldots + \beta_{1,l} GDP_{l,t-1} + \ldots + \epsilon_{i,t} \quad (4)$$

GDP	Gross domestic product
HC	Human capital proxy variable
$\alpha_{0,l}$	Constant
$\alpha_{1,l}$, $\beta_{1,t}$	Coefficients
$\epsilon_{i,t}$	Error term

Based upon these models it will be possible to calculate whether there is any statistically significant Granger causal relation between GDP and the chosen human proxy variables.

2.2. Panel regression

Due to the limitations of the Granger causality test, the second step was considering a panel regression model. As the explanatory value of the model might be very low which might compromise the interpretation of the results, several other explanatory variables were considered. The selection of other independent variables was made using stepwise regression in order to achieve that the model have the highest possible explanatory value. The selected panels also provide us with an interesting opportunity to test whether there is any statistically significant difference between the EU and non-EU member states within the respective panels by adding a dummy variable EU.[5] Correlation matrixes between the independent variables are considered in order to avoid multicollinearity. A summary table of all of the variables theoretically considered in the regression is provided in Table 1.

[5] Within the panel of SE European countries, Croatia and Slovenia are EU member-states and in the panel of Scandinavian countries Finland, Denmark and Sweden are EU member-states.

Table 1. Variables considered by the regression model: 1995–2015

Name of the variable	Abbreviated	Relevance to the model	Measurement
Gross domestic product*	GDP	Dependant variable	In inflation corrected 2010 million euros
Life expectancy at birth	Life	Independent variable	In years
Total public expenditure on education*	Publicexp		In inflation corrected 2010 million euros
Tertiary school enrolment	Educ		Percentage of total population
Total government expenditure*	Gov		In inflation corrected 2010 million euros
Export of goods and services*	Exp		In inflation corrected 2010 million euros
Gross fixed capital formation*	GFCF		In inflation corrected 2010 million euros
Number of employed*	Labour		In thousand persons
Taxes less subsidies on products*	Tax		In inflation corrected 2010 million euros
EU	/	Dummy variable	1 if country is an EU member-state, 0 if it is not

Note: * these variables are in the form of their natural logarithms

Based upon the results of the stepwise regression, two additional explanatory variables will be selected alongside the chosen human capital proxy variables. Therefore the final general model of the panel regression will be:

$$GDP_{i,t}=\alpha_{0,i}+\alpha_1 life_{i,t}+\alpha_2 educ_{i,t}+\alpha_3 publicexp_{i,t}+\alpha_4 x_{i,t}+\alpha_5 z_{i,t}+\epsilon_{i,t} \quad (5)$$

GDP	Gross domestic product
educ	Tertiary school enrolment
publicexp	Total public expenditure on education
$\alpha_{0,i}$	Constant
$\alpha_{1...5}$	Coefficients
x, z	Variables determined by stepwise regression
$\varepsilon_{i,t}$	Error term

2.3. Methodological and data constrains

Several authors have argued against using human capital proxies due to the fact that the results often appear statistically insignificant (Giménez, López-Pueyo, and Sanaú 2015). Using human capital proxies is an imperfect approach, yet as there is no final consensus on a valid approach to human capital measurement, it may be considered suitable. A more significant issue is that the data for the SE European panel is considerably limited in comparison to the panel of the Scandinavian countries. Especially in regards to total public expenditure on education the data for Macedonia was only available for the years 2002 and 2003.[6] Despite several attempts to salvage the data from other databases, ultimately Macedonia was excluded when considering the regression model with total public expenditure on education.

[6] For several other considered variables there was no data in 2010 real million euros so the variables in nominal values were manually adjusted for inflation by the author using the GDP deflator.

3. DISCUSSION AND RESULTS

The stationarity of all of the variables considered in the model is confirmed, with a summary of the conducted tests presented in Table 2.

Table 2. Unit root tests with constant and without trend: 1995–2015

Variable	Levin, Lin and Chu t	Im, Peseran and Schin W-stat	ADF – Fischer Chi Square	PP – Fischer Chi Square
Panel of Scandinavian countries				
GDP*	-4.84671	-3.46204	25.6913	25.0662
	(0.0000)	(0.0003)	(0.0012)	(0.0015)
Educ*	-6.31394	-4.77842	35.8581	37.5184
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Publicexp*	-8.42856	-7.13898	51.3673	59.7408
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Labour*	-5.01594	-4.08522	31.2334	17.547
	(0.0000)	(0.0000)	(0.001)	(0.0249)
Exp*	-5.96530	-4.62661	34.3092	35.1923
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
GFCF*	-4.04387	-4.01776	30.5724	21.8069
	(0.0000)	(0.0000)	(0.0002)	(0.0053)
Gov**	-11.8639	-11.5738	100.045	141.544
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Life*	-9.23061	-7.91039	59.1126	79.9778
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Tax*	-4.63324	-3.58270	26.9445	21.4185
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Panel of SE European Countries				
GDP*	-3.4099	-2.59506	16.6603	16.3444
	(0.0003)	(0.0047)	(0.0106)	(0.012)
Educ*	-4.20888	-2.08135	15.2983	14.9414
	(0.0000)	(0.0187)	(0.0181)	(0.0207)
Publicexp**	-6.40144	-2.64582	15.8135	19.1998
	(0.0000)	(0.0041)	(0.0033)	(0.0007)
Labour*	-2.14468	-1.97093	13.4113	12.5071
	(0.016)	(0.0244)	(0.0369)	(0.0516)
Exp*	-5.39882	-4.07863	26.6647	34.6447
	(0.0000)	(0.0000)	(0.0002)	(0.0000)
GFCF*	-2.68699	-2.64469	16.8978	16.8286
	(0.0036)	(0.0041)	(0.0097)	(0.0099)
Gov*	-3.22531	-3.84125	24.9865	22.9936
	(0.0006)	(0.0001)	(0.0003)	(0.0008)
Life*	-9.32494	-8.66466	54.2515	65.6579
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Tax*	-4.44993	-3.31283	21.5189	21.3477
	(0.0000)	(0.0005)	(0.0015)	(0.0016)

Note: * signifies that the variable is stationary in its first difference, while ** signifies that the variable is stationary in its second difference. Aside from the test statistic, values in the parenthesis represent the p value.

Based upon the results of several unit root tests we can reject the null hypothesis of non-stationarity for all of the variables considered in the model. The first attempt considered whether the variables were trend stationarity at level, but that lead to a failure of rejecting the null hypothesis by the majority of the considered unit root tests. At that point the first difference was calculated and at first difference all of the variables rejected the null hypothesis of a unit root present, with the exception of total government expenditure in the panel of Scandinavian countries and total public expenditure on education in the panel of SE European countries. The number of lags was automatically selected by E-Views based upon the Schwartz criterion. In all further calculations the

variables will be considered in the form in which they have rejected the null hypothesis of unit root presence.

3.1. Granger causality test

The relationship between GDP and the chosen human capital proxy variables was considered, with the results summarized in Table 3.

Table 3. Granger causality test: number of observations specified in table

	Panel of Scandinavian countries		Panel of SE European countries	
Null hypothesis	F statistic	Number of observations	F statistic	Number of observations
Educ does not Granger cause GDP	0.80609 (0.451)	70	0.29724 (0.745)	35
Publicexp does not Granger cause GDP	0.5955 (0.5236)	56	1.53204 (0.2733)	13
Life does not Granger cause GDP	1.3182 (0.2749)	68	0.63145 (0.5376)	41
GDP does not Granger cause educ	0.10502 (0.9005)	70	0.28094 (0.757)	35
GDP does not Granger cause life	3.18752* (0.048)	68	0.73129 (0.4883)	41
GDP does not Granger cause publicexp	0.08208 (0.9213)	56	0.44475 (0.6559)	13

Note: * indicates rejection of the null hypothesis at p=0.05; p values may be found in the parenthesis.

Based upon the results of the Granger causality test, we fail to reject the null hypothesis for both panels regarding either of the chosen human capital proxy variables Granger causing GDP. The only statistically significant relationship that was detected using the Granger causality test is between GDP Granger causing life for the panel of Scandinavian countries. As the results of this basic analytic tool have not provided significant results nor suggested that the human capital proxy variables are significant to economic growth to either panel of countries, the regression results should either conclude that the chosen human capital proxy variables are not statistically significant to both panels or provide an alternative conclusion.

3.2. Model specification and stepwise regression

Aside from the chosen human capital proxy variables, the remaining two explanatory variables are chosen through stepwise regression. Table 4 summarizes the stepwise regression analysis.

Table 4. Stepwise regression: 1996–2015

	Panel of Scandinavian countries		Panel of SE European countries	
Variable	t-statistic	p value	t-statistic	p value
Exp	12.77834***	0.0000	6.0676061***	0.0000
Tax	6.338861***	0.0000	3.360633***	0.0021
GFCF	3.155432***	0.0024	3.656456***	0.001
Gov	-1.362953	0.1777	2.362463***	0.0015
Labour	1.1101145	0.275	3.485775**	0.0248

Note: *,**,*** implies statistical significance at the respected 0.1, 0.05 and 0.01 values.

Based upon the results of the stepwise regression, the variables that will maximize the explanatory value of the model are export of goods and services and taxes less subsidies on products for the panel of Scandinavian countries. For the panel of SE European countries the variables that maximize the explanatory value of the model are export of goods and services and gross fixed capital formation. In order to avoid multicollinearity issues, a correlation matrix is considered between all of the possible explanatory variables.[7] For both panels there is no significant correlation[8] between the human capital proxy variables and the other explanatory variables.[9] For the panel of Scandinavian countries, the variables that are proposed by the stepwise regression are adequate due to the fact that there is no significant correlation between exports of goods and services and taxes less subsidies on products. For the panel of SE European countries, there is significant correlation between exports of goods and services with the explanatory variables gross fixed capital formation and taxes less subsidies on products. Therefore to avoid multicollinearity issues, the best option was to consider exports of goods and services and the third variable proposed by the stepwise regression, which is total government expenditure.

3.3. Panel regression

Due to the fact that the number of regressors is larger than the number of cross-section units, using a random error regression would yield statistically inaccurate results. Therefore, a standard pooled regression is considered, as well as a regression with cross-section dummy variables. Summarized results are presented in Table 5. Specification tests for the chosen model for both panels are briefly considered and further discussed in the appendix.

Table 5. Summary of panel regression results: 1996–2015

	Pooled regression			Cross-section fixed regression		
	Panel of Scandinavian countries[10]					
Variable	Coefficient	Standard error	p value	Coefficient	Standard error	p value
Exp***	0.297601	0.017678	0.0000	0.30861	0.017608	0.0000
Tax***	0.319358	0.036821	0.0000	0.289376	0.035925	0.0000
Life	-0.000153	0.006802	0.9821	0.005768	0.00651	0.3795
Educ	0.000389	0.000742	0.602	0.000397	0.000693	0.5695
Publicexp**	0.065774	0.029464	0.0295	0.062896	0.027883	0.0282
Constant	-0.001099	0.002301	0.6346	-0.001943	0.002169	0.3744
R-squared	0.909739			0.927812		
Adjusted R-squared	0.901822			0.917118		
Durbin-Watson statistic	1.828564			2.26019		

[7] The correlation matrix generated by E-Views may be found in the appendix.

[8] Significant correlation would be considered if the value was higher than 0.5.

[9] The only exception being statistically significant correlation between total public expenditure on education and taxes less subsidies on products in the panel of SE European countries.

[10] The value of the Jarque-Berra test statistic of 3.059, with a p value of 0.216608 indicates that we fail to reject the null hypothesis that the residuals are normally distributed. The value of the cross-section F test suggests that there are no redundant fixed effects. Aside from the value of the Durbin-Watson statistic, the LM test that may be found in the appendix clearly confirms that the model is not affected by autocorrelation.

Table 5. (*continued*)

	Pooled regression			Cross-section fixed regression		
	Panel of SE European countries[11]					
Variable	Coefficient	Standard error	p value	Coefficient	Standard error	p value
Exp***	0.463775	0.042649	0.0000	0.46702	0.04772	0.0000
Gov***	0.643325	0.139753	0.0008	0.650256	0.149016	0.0014
Life**	-0.022805	0.009312	0.0323	-0.022457	0.009847	0.0457
Educ	-0.009828	0.005129	0.0817	-0.00876	0.006986	0.2384
Publicexp	-0.021675	0.061551	0.7314	-0.019109	0.065264	0.7757
Constant	0.000419	0.00663	0.9507	-0.000591	0.009124	0.9434
R-squared	0.943554			0.943874		
Adjusted R-squared	0.917897			0.910199		
Durbin-Watson statistic	2.381593			2.392973		

Note: *,**,*** implies statistical significance at the respected 0.1, 0.05 and 0.01 values.

Based upon the results of the panel regression, the cross-section fixed model was deemed most representative for the panel of Scandinavian countries and upon conducting the specification tests it exhibited no signs of statistical errors. For the panel of SE European countries, the standard pooled regression results are considered due to the fact that we fail to reject the hypothesis that the fixed effects are redundant. The panels for both countries have a satisfactory R-squared value which indicates that the independent variables can respectably account for 92.8% and 94.4% of the change of the dependant variable. The adjusted R-square, which takes into account the number of independent values in the model, is satisfactory. The final conclusion of the regression is that of the three selected human capital proxy variables, only one was statistically significant at p=0.05 in each of the respective models. In the model considering the Scandinavian countries, the variable total public expenditure on education was statistically significant. It indicates that there is a positive relationship between public expenditure on education and GDP growth. Of the human capital proxy variables considered for the panel of SE European model, only life expectancy was statistically significant at p=0.05 and it had a slightly negative effect on GDP growth. Including the dummy variable EU did not positively affect the explanatory value of the models nor was it deemed statistically significant at p=0.05 for either model.

3.4. Relevance and implications

The results of the panel regression seem to incline that there is no statistically significant positive relationship between the chosen human capital proxy variables and GDP growth in the SE European countries. Perhaps partially the cause is the methodological framework of considering human capital through proxy variables, yet in the case of the Scandinavian countries there was a positive relationship between total public expenditure on education and GDP growth. Akpolat (2014) attempts to explain the relationship

[11] The value of the redundant fixed error test confirmed that the cross-section dummy variables included were redundant. Therefore for the panel of SE European countries the standard pooled regression was considered. The pooled regression model did not exhibit signs of autocorrelation based upon the LM test and the value of the Durbin-Watson statistic. The value of the Jarque-Berra test statistic is 1.980556, with a p value of 0.371 which signifies that we fail to reject the null hypothesis of normal distribution of the residuals.

between life expectancy and economic growth through the viewpoint of the financial burden of retirement. This is a significant problem in several SE European countries where the ratio between the working population and retirees is dangerously close to 1:1. A ratio close to one employee for each retiree in countries with relatively low natural growth and concerning demographic statistics is not sustainable in the long term. Even during Mankiw's (1995) consideration of secondary school enrolment rate as a human capital proxy variable, there was criticism that it was an inadequate variable. Perhaps due to the presence of the ″brain drain″ phenomenon any kind of measuring of enrolment in education may prove unfavourable results for the panel of SE European countries. Although there is still much debate regarding the measurement of human capital the vast majority of existing calculations of human capital depend upon proxy variables at some point of the calculation. It is possible to conclude that expenditure on education displays the perceived relevance of education in certain societies as one of the pillars of obtaining and increasing human capital. As such it served as an adequate proxy variable to display significant differences between the panel of SE European countries and the Scandinavian countries.

CONCLUSION

Several statistical analysis tools were used to analyse the relevance of chosen human proxy variables on economic growth for selected panels of SE European and Scandinavian countries. While the Granger causality test failed to reject the null hypothesis regarding statistically significant impact of the chosen human capital proxy variables on economic growth, a panel pooled regression confirmed that there was statistically significant relevance of life expectancy on economic growth in the panel of SE European countries and total public expenditure on education in the panel of Scandinavian countries. The results provided by this study suggest that there are statistically significant differences between the relevance of human capital on economic growth in the selected panel of SE European countries and in the Scandinavian countries. The empiric results confirm that, taking into account the current consideration of human capital, it has a far more significant impact on economic growth in more developed economies in comparison to developing economies.

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APPENDIX

The correlation matrix for the independent variables used in the panel of Scandinavian countries and the SE European countries is presented in Table A1.

Table A1. Correlation matrix for independent variables

Panel of Scandinavian countries								
	Publicexp	Tax	GFCF	Exp	Labour	Educ	Gov	Life
Publicexp	1.00000	0.1665007	0.173871	0.217419	0.076198	0.101873	0.035470	-0.22752
Tax	0.165007	1.00000	0.623977*	0.351401	0.456512	0.066239	0.023487	-0.008226
GFCF	0.173871	0.623977*	1.00000	0.625446*	0.720043*	0.057712	0.038710	-0.00263
Exp	0.217419	0.351401	0.625446*	1.00000	0.480251	0.110081	-0.064231	-0.22494
Labour	0.076198	0.456512	0.720043*	0.480251	1.00000	0.012112	0.153437	-0.226916
Educ	0.101873	0.066239	0.057712	0.110081	0.012112	1.00000	0.011822	-0.141837
Gov	0.03547	0.023487	0.038710	-0.064231	0.153437	0.011822	1.00000	-0.0665065
Life	-0.022752	-0.008226	-0.00263	-0.022494	-0.226916	-0.141837	-0.065065	1.00000
Panel of SE European countries								
	Publicexp	Educ	Labour	Exp	GFCF	Gov	Life	Tax
Publicexp	1.00000	-0.131924	0.007268	0.492937	0.248083	-0.057938	0.075272	0.613638*
Educ	-0.131924	1.00000	-0.379254	0.133557	-0.131771	-0.227021	-0.037781	-0.015944
Labour	0.007268	-0.379254	1.00000	0.137155	0.639247*	0.707492*	-0.198226	0.375177
Exp	0.492937	0.133557	0.137155	1.00000	0.631478*	-0.010755	0.224339	0.889753*
GFCF	0.248083	-0.131771	0.639247*	0.631478*	1.00000	0.474942	-0.007377	0.727614*
Gov	-0.057938	-0.227021	0.707492*	-0,010755	0.474942	1.00000	-0.002187	0.236166
Life	0.075272	-0.037781	-0.198226	0.224339	-0.007377	-0.002187	1.00000	0.053702
Tax	0.613638*	-0.015944	0.375177	0.889753*	0.727614*	0.236116	0.053702	1.00000

Note: * signifies statistically significant correlation between the variables

As can be seen in Table A2, the value of the cross-section F statistic suggests that the fixed effects are statistically significant for the panel of Scandinavian countries.

Table A2. Redundant Fixed Effects Test for panel of Scandinavian countries

Effects test	Value of test statistic	d.f.	p value
Cross-section F	4.506512	(3,54)	0.0068
Cross-section Chi square	14.076276	3	0.0028

For the panel of SE European countries, as can be seen in the value of the cross-section F statistic in Table A3, we fail to reject the null hypothesis that there are statistically significant cross fixed effects. Taking into account these results, only the standard pooled regression was considered.

Table A3. Redundant Fixed Effects Test for panel of SE European countries

Effects test	Value of test statistic	d.f.	p value
Cross-section F	0.056967	(1,10)	0.8162
Cross-section Chi square	0.09657	1	0.756

As can be seen from the value of the LM test for autocorrelation, all of the test statistic values suggest that we fail to reject the null hypothesis of no cross-section correlation in residuals, meaning that the model is adequate. These calculations are conducted for the chosen models – the pooled panel regression model for the SE European countries and the cross-sections fixed regression model for the panel of Scandinavian countries.

Table A4. LM Test for Autocorrelation for selected models

Panel of SE European countries			
Test	Test statistic	d.f.	p value
Breusch-Pagan LM	1.99931	1	0.1574
Peseran scaled LM	0.706619		0.4798
Peseran CD	1.41397		0.1574
Panel of Scandinavian countries			
Test	Test statistic	d.f.	p value
Breusch-Pagan LM	8.930761	6	0.1775
Peseran scaled LM	0.846038		0.3975
Bias-corrected scaled LM	0.712704		0.476
Peseran CD	-1.29863		0.1954