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Empirical Modeling of Education Expenditures for Balkans: Evidence from Panel FMOLS and DOLS Estimations

Vedat YORUCU[1], Dervis KIRIKKALELI[2]

Abstract

The focal point of this study is to investigate the possible determinants of public education expenditures for Balkan countries. Panel cointegration, FMOLS, DOLS, panel causality tests have been conducted throughout this study. The empirical findings reveal that GDP per capita income, economic stability, school enrolments and technological development are found to be the main determinants which have dynamic significant relationships on public education expenditures in the long-run. Dumitrescu-Hurlin panel causality test with individual coefficients mirror (i) bi-directional causalities between education expenditures and school enrolments and between education expenditures and GDP per capita income; (ii) unidirectional causalities running from technological development to education expenditures and from education expenditures to financial risk.

Keywords: Balkans, Education Expenditure, FMOLS and DOLS, Panel Causality, Panel Cointegration.

Introduction

Following the Lehman‘ Brothers solvency in 2008, systemic financial crisis has spread all over Europe and caused very serious budgetary problems in many economies, in particular to the Balkans. Economic reforms were centered on the public expenditures of the annual budgets, followed by austerity packages in reforming the public sector‘s spending, such as education expenditures, health and public spending. The Balkans have suffered from chronic budgetary deficits

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over the last decade and it was inevitable for them to restructure their economic activities. After the sovereign debt crisis of the EU, education expenditures have played an important role in reforming the education system during uneasy circumstances, which were followed by labor union rallies. The policy makers ought to decide how much they should spend for their nations' public expenditures, while there are limitations on budget spending. Therefore, many countries have to deal with trade-offs between education expenditures and other parts of public spending. Baqir (2002) has argued that expanding economy in a country may vary the public education expenditures. This encourages many researchers and academic scholars to investigate factors that cause changes in public education expenditures and factors that determine public education expenditures. This is important because it is well known that public education expenditures have direct impacts on human capital investments as well as economic development, which also has spillover effects in other sectors of the economy (Baqir, 2002).

Over the last few decades, only minor changes have taken place with public education expenditures in the Balkan countries. Expanding public education expenditure has contributed to a fundamental transformation of communities in the Balkan countries. In 2011, the ratio of public spending in education to GDP is 3% in Albania, 3.6% in Bulgaria, 4% in Croatia, 4.1% in Greece, 4.1% in Romania, 6.7% in Slovenia and 2.6% in Turkey, respectively. This is 5.3% on average for the twenty-seven EU countries. Globally, the highest ratio is in Denmark, Iceland, Israel, Korea, Chile and the United State with over a 7% ratio.

In the 1970s it was a privilege for young adults to complete a tertiary education in most of the Balkan countries. Less than 19% of the population could hold a tertiary degree in the Balkans in 1981. However, human capital investment and education have noticeably increased during the last three decades. In the Balkans, access to the primary, secondary and tertiary education has widened over the majority of the population. In 2011, one in every two adults has a tertiary degree in Albania, Bulgaria, Croatia, Romania and Turkey. Although substantial growth has been achieved in accessing to the primary, secondary and tertiary education in the Balkan countries, no comprehensive study has been implemented in this region. Thus, the lack of empirical evidence in this field and the lack in rising awareness about public education has encouraged us to investigate and determine the main determinants and their impact on education expenditures, particularly in the Balkans by implementing recently developed panel techniques, such as a "fully modified ordinary least squares (FMOLS) and dynamic ordinary least squares (DOLS) estimations".

Lucas (1988), Barro and Lee (1993), and Barro and Sala-I-Martin (1995) have underlined the importance of human capital on economic growth. In these studies, there is empirical evidence that human capital investment plays a significant role in influencing economic growth both in developed and developing economies.

Engelbrecht (2002) argued that there is a positive role for human capital and international knowledge spillovers in total factor productivity growth of some of the selected developing counties. Another study carried out by Cheng and Hsu (1997), underlined that there is feedback causality between human capital and economic growth in Japan for the period of 1952-93 by implementing Johansen Cointegration test and Hsiao's version of the Granger causality method.

Although vast numbers of studies in the literature have been conducted on the impact of education in various sectors of the economy, only the few of them have tried to investigate the determinants of education expenditures, which have not been explored comprehensively. The aim of this research is therefore to fill this gap and to explore a new debate.

Method

Data collection tools

The long-run determinants of public education expenditures for the selected economies have been analysed with panel cointegration tests. Moreover, to examine the possible relation between public education expenditures and its possible determinants, panel causality analysis has been performed. As also stated by Harris and Sollis (2003), testing for unit roots in panel data is becoming more common, given both the development of testing procedures and their incorporation into econometric software packages. In this study the tests suggested by Levin, Lin and Chu's (2002) - LLC hereafter, Breitung (2000), Im, Pesaran and Shin's (2003) - IPS hereafter, Dickey and Fuller (1979; 1981), Fisher (1932) and Philips and Perron (1988), Maddala and Wu (1999) and Choi (2001) have been considered to check for the existence of panel stationarity. Harris and Sollis (2003) have emphasized that all these tests take non-stationarity (i.e., the presence of unit root) as the null hypothesis and test against alternatives involving stationarity.

Collection of Data

Data related with the selected Balkan countries, namely Albania, Bulgaria, Croatia, Greece, Romania, Slovenia, and Turkey have been used throughout this study. In this study we use annual data covering the period from 1998 to 2011. Data on public education expenditures, GDP per capita income, foreign direct investment inflows, consumer price index, schooling enrolment and internet user were extracted from the World Bank while data on economic risk, financial risk and political risk indexes were obtained from the Political Risk Services. The remaining data listed in *Table 1* have been used in our estimations and they are in natural log forms.

Table 1. Sources of Data

Data	Source	Code
Public education expenditure	World Bank	PEE
GDP per capita income	World Bank	PCI
Foreign direct investment inflow	World Bank	FDI
Consumer price index	World Bank	CPI
Schooling enrolment	World Bank	SCE
Internet user	World Bank	INU
Economic risk index	Political Risk Services	ERI
Financial risk index	Political Risk Services	FRI
Political risk index	Political Risk Services	PRI
Source: World Bank and Political Risk Services		

Analysis of the data

The unit root tests for a panel employed by Hadri (2000) for heteroscedasticity corrected statistics have also been implemented in this study to check stationarity. Unlike the others, the test proposed by Hadri (2000), checks for the null of stationarity against alternative of unit roots in the panel data.

The most popular panel unit root test is the one by Levin et al. (2002) which is based on the ADF (Augmented Dickey Fuller) test. The model is represented as follows:

$$\Delta y_{it} = \alpha_i + \beta_i y_{it-1} + \sum_{j=1}^{pi} p_i \Delta y_{it-j} + e_{it} \quad \text{(eq.1)}$$

where$\Delta y_{it}$is the first difference of the series of observations for country i, in time period t=1……T. Since the LLC approach carry on according to the assumption of a homogenous panel therefore β_ι is identical for all country. We test the null hypothesis $\beta_\iota = \beta = 0$ for all countries against the alternative

H1 : $\beta_\iota = \beta > 0$ which assumes that all series are stationary.

An extension of the LLC test is the IPS test, which relaxes the homogeneity constraint by estimating the equation (eq.1) with β_ι free to vary across the *i* individual series in the panel. They also allow for different lags for the *i* cross sections in the model. With this test, alternative hypothesis reveals that some or all of the individual series are stationary.

The last test considered in this study based on the null of non-stationarity has been proposed by Maddala and Wu (1999), which encourage the use of a Fisher (1932) type test that combines the significance levels for rejecting the null (the *p*-

values) obtained when estimating a unit root test (i.e., the ADF and Fisher-PP test, which are also defined by Choi (2001) as the type of non-parametric tests) for each cross section *i* separately. One of the significant advantage of this test is that the value of test does not depend on different lag lengths in the individual ADF regressions.

The test statistic is demonstrated with an equation given below:

$$P=-2 \sum_{i=1}^{N} \ln_{\beta i} \qquad \text{(eq.2)}$$

The Fisher type ADF and PP tests are all allowed for individual unit root processes, in another words the null hypothesis is that each series in the panel has a unit root. The tests are all specified by the combining of individual unit root test to derive panel-specific results. In Fisher-type tests the null hypothesis is that all the panels contain a unit root. The advantage of using eq.2 is that it is simple to calculate, does not require a balanced panel for any unit root test statistic (not just DF-type test). Maddala and Wu (1999) also came across that this Fisher-type *P*-test is superior to the IPS test, which in turn is more powerful than the LLC test. Beside that Choi (2001) has constructed another model displayed with eq.3 below:

$$Z=\frac{1}{\sqrt{1}}\sum_{i=1}^{n}\phi^{-1}(\pi_i) \sim N(0,1) \qquad \text{(eq.3)}$$

where the ϕ^{-1} is inverse of the normal cumulative distribution function. As also highlighted by Harris and Sorris (2003), all the previous test are based on a null hypothesis that the individual series in the panel are jointly non-statinary, against alternatives where some or all of these series are stationary. Hadri (1999) has propoesed a test of the null that the time series for each *i* are stationary around a deterministic trend, against the alternative hypothesis of a unit root in the panel data. The Hadri-test that is a residual-based LM (lagrange multiplier) test, where the null hypothesis is that the time series for each cross section member are stationary around a deterministic trend.

As underlined by Granger and Newbold (1974), the initial step prior to implementing a model is to check the level of stationarity for each variable. This is because using non-stationary data in models may lead to spurious models. Following the panel unit root tests, Pedroni's cointegration test have been performed to determine whether there is any cointegration relationships exist among variables.

Panel DOLS and Panel FMOLS tests have been carried out next to estimate various estimators available include “within- and between-group FMOLS and DOLS” estimators. Among several panel estimators, the FMOLS and DOLS are the mostly commonly chosen ones. In line with Harris and Sorris (2003), the “FMOLS is a non-parametric approach to cope with corrections for serial correlation, while DOLS is a parametric approach where lagged first-differenced terms are clearly estimated. By using DOLS, the residuals are augmented with lags, lead and contemporaneous values of the regressors”. Pedroni (2001) argues that the between group estimators are preferable to the within group estimators for a number of reason. Regarding the superiority of each model, more detail information is available in Pedroni (1999) and, Harris and Sollis (2003). In this study, we implemented Pedroni’s (2001) approach and three different models have been constructed:

Model 1: $PEE_{it=}\ \rho_{it}+\beta_{it}+\nu_{1i}PCI+\ \nu_{2i}FDI+\ \nu_{3i}CPI+e_{it}$ (eq.4)

Model 2: $PEE_{it=}\ \rho^{0}{}_{it}+\beta^{0}{}_{it}+\nu^{0}{}_{1i}ERI+\ \nu^{0}{}_{2i}FRI+\ \nu^{0}{}_{3i}PRI+e^{0}{}_{it}$ (eq.5)

Model 3: $PEE_{it=}\ \rho\bullet_{it}+\beta\bullet_{it}+\nu\bullet_{1i}INU+\ \nu\bullet_{2i}SCE+\ e\bullet_{it}$ (eq.6)

where “ρ_i denotes country specific effects, ν_i is the deterministic time trends and e_{it} is the residual, capturing the disturbances running from the long-run linkage towards short-run equilibrium; i=1,2…,N are panel members, and t=1,2..,T stands for the time period”.

It is also assumed that $\varsigma_{it} = \lim T \to \infty E\left[T^{-1}\left(\sum_{t=1}^{T}\nu_{1iT}\right)\left(\sum_{t=1}^{T}\nu_{1iT}\right)\right]$ be the covariance vector which can be decomposed into $\varsigma_{it} = \varsigma_{it}^{0} + \Gamma_i + \Gamma_i^{'}$ where is the contemporaneous covariance and Γ_i is a weighted sum of auto-covariances.

Then the FMOLS estimators can be estimated follows:

$$\beta^{*}_{fmols} = N^{-1}\sum_{1}^{N}((\sum_{t=1}^{T}(PCI-\overline{PCI})^{2})^{-1}(\sum_{t=1}^{T}(PCI-\overline{PCI})PEE_{it}^{*}-TY_{1i} \quad \text{(eq.7)}$$

whereas the DOLS estimators are estimated as shown below:

$$\beta^{*}_{fmols} = N^{-1}\sum_{i=1}^{N}(\sum_{t=1}^{T}Z_{it}Z_{it}^{i})^{-1}(\sum_{t=1}^{T}Z_{it}PEE_{it}^{*}) \quad \text{(eq.8)}$$

Following the above equation, Z_{it} is 2(k+1)1 vector of regressors. Although comparing the accuracy of two tests are subjective, Maeso-Fernandez et al. (2006)

pointed out that the FMOLS test requires fewer assumption than the DOLS test and therefore it is likely to deliver more robust results. According to Harris and Sollis (2003), as to whether FMOLS or DOLS is preferred, the empirical evidences are conflicting. Regarding the superiority of the tests, the type of empirical modelling, number of variables used, amount of data included in the model, the possibility of adding deterministic dummies in a model and etc. matters a lot and may play significant role in producing robust outcomes. Yet, in this study our scope is not to test which models give better result, instead, our the aim is to investigate the main determinants in public education expenditures. In the first model, the possible economic factors influencing public education expenditures have been investigated. With the second model, three independent country risk variables, namely, "economic risk, financial risk and political risk", indices have been employed, aiming to explore the possible uncertainty impacts on public education expenditures in the Balkans. Finally, the last model contains two possible determinants of public education expenditures, such as schooling enrolment and internet users, attending to measure the impact of social and technological developments in the community in regards to public education expenditures.

Pedroni (2001) emphasizes that "the between group estimators are superior to the within group estimators".

$$PEE_{it} = \alpha_i + \beta_{1i} PCI_{it} + \beta_{2i} FDI_{it} + \beta_{3i} CPI_{it} + e_{it} \quad \text{i=1,2,...N, t=1,2,... T} \qquad \text{(eq.9)}$$

$$PEE_{it} = \alpha_i + \beta_{4i} ERI_{it} + \beta_{5i} PRI_{it} + \beta_{6i} FRI_{it} + e_{it} \quad \text{i=1,2,...N, t=1,2,... T} \qquad \text{(eq.10)}$$

$$PEE_{it} = \alpha_i + \beta_{7i} INU_{it} + \beta_{8i} SCE_{it} + + e_{it} \quad \text{i=1,2,...N, t=1,2,... T} \qquad \text{(eq.11)}$$

Dumitrescu-Hurlin panel causality test has also been applied to identify two-way causal relationship between public education expenditures and its possible determinants. Finding cointegration relationships between the variables, also implies a possibility of causal relationship among the variables, however this fact does not reveal the direction of causality. Such a similar methodology on education and economic growth causality relationship was undertaken by In and Doucouliagos (1997) for the US and there is a strong robust evidence of causality from human capital formation to private sector GDP and vice versa. Due to the varieties of different education policies in different countries, it is more favorable to investigate a panel form of causality among the group of countries to explore relationship between public education and its possible determinants (Yorucu & Bahramian, 2015, Kirikkaleli, 2016).

Dumitrescu and Hurlin (2011) have develop a "traditional Granger causality test to permit the element of heterogeneity by adding cross-sectional units based on homogenous non-causality, indicating that under the null hypothesis there is no causality among the variables of the panel while the heterogeneous non-causality indicates a causal linkage for any of the variables of the panel".

Results and Discussion

Together with Harris and Sorris (2003), "panel unit root tests were undertaken to detect the order of integration for each variable". Table 2 and Table 3 report the findings of unit root tests. For the first variable - PEE, the stationarity has not been detected. In line with Hadri (2000), 8 out of 9 unit root test results, "the model with an intercept and the model with a trend and intercept" cannot reject the null hypothesis of no unit root, while 2 out of 2, "Hadri's z-stat statistics and Heteroscedasticity corrected z-stat (the model with an intercept and the model with a trend and intercept) reject the null hypothesis" of stationarity at 5% significance level, implying that the variable has stationarity problem. The majority of the stationarity tests, at the first difference, indicate the order of integration - I(1). Regarding other variables, this situation is not any different, meaning that the order of integration is similar for the other variables, which is I(1).

Table 2. Panel Unit Root Tests for Panel Data (1998-2011) (Including Only Constant)

Variables	LLC	IPS	ADF – Fisher	PP-Fisher	Hadri	Heteroscedasticity
	t-stat	W-stat	Chi-square	Chi-square	z-stat	corrected z-stat
Series in Levels						
PEE	-1.8(0.03)*	1.2(0.89)	5.3(0.98)	4.5(0.99)	6.5(0.00)**	6.4(0.00)**
ERI	-2.1(0.01)*	-1.0(0.14)	20.7(0.10)	32.5(0.00)**	3.4(0.00)**	2.6(0.00)**
FDI	-1.4(0.07)[b]	-0.9(0.17)	17.3(0.23)	23.6(0.05)*	0.7(0.23)	0.7(0.23)
FRI	-2.1(0.01)*	0.2(0.60)	15.2(0.35)	17.4(0.23)	3.6(0.00)**	4.1(0.00)**
CPI	-1.3(0.08)[b]	-2.6(0.00)**	32.6(0.00)**	81.7(0.00)**	6.0(0.00)**	3.7(0.00)**
INU	1.7(0.95)	4.1(1.00)	1.1(1.00)	1.0(1.00)	6.8(0.00)**	6.8(0.00)**
PCI	-2.0(0.02)*	0.9(0.84)	5.9(0.96)	3.9(0.99)	6.4(0.00)**	6.3(0.00)**
PRI	-1.0(0.155)	0.1(0.45)	25.3(0.03)*	18.8(0.17)	3.5(0.00)**	4.5(0.00)**
SCE	-0.5(0.09)*	2.4(0.84)	11.3(0.96)	7.9(0.99)	6.5(0.00)**	6.0(0.00)**
Series in First Differences						
PEE	-5.21(0.00)**	-2.8(0.00)**	31.3(0.00)**	37.9(0.00)**	0.0(0.47)	0.17(0.43)
ERI	-3.66(0.00)**	-2.5(0.00)**	29.1(0.01)**	73.6(0.00)**	2.4(0.00)**	2.41(0.00)**
FDI	-3.42(0.00)**	-3.0(0.00)**	34.2(0.00)**	72.7(0.00)**	1.0(0.15)	1.47(0.07)
FRI	-2.70(0.00)**	-2.9(0.00)**	33.7(0.00)**	74.7(0.00)**	0.5(0.28)	2.04(0.02)*
CPI	-1.72(0.03)*	-3.9(0.00)**	42.8(0.00)**	97.4(0.00)**	4.3(0.00)**	3.39(0.00)**
INU	-3.54(0.00)**	-2.3(0.00)**	27.7(0.01)*	46.0(0.00)**	3.0(0.00)**	2.39(0.00)**
PCI	-5.85(0.00)**	-3.1(0.00)**	34.0(0.00)**	23.2(0.05)[b]	-0.0(0.52)	0.05(0.47)
PRI	-4.84(0.00)**	-3.6(0.00)**	39.5(0.00)**	51.2(0.00)**	2.7(0.00)**	2.42(0.00)**
SCE	-0.75(0.22)	-4.4(0.00)**	13.7(0.46)	22.5(0.06)[b]	3.0(0.00)**	2.87(0.00)**

Source: Authors

Note**, * and [b] denote statistical significance at the 1%, 5%, and 10% levels, respectively. () denotes the p-values.

Table 3. Panel Unit Root Tests for Panel Data (1998-2011) (Including Trend and Constant)

Variables	LLC	Breitung	IPS	ADF - Fisher	PP-Fisher	Hadri	Heteroscedasticity
	t-stat	t-stat	W-stat	Chi-square	Chi-square	z-stat	corrected z-stat
Series in Levels							
PEE	-0.2(0.38)	-0.8(0.20)	-0.2(0.40)	14.3(0.42)	9.3(0.80)	2.5(0.00)**	2.897(0.00)**
ERI	0.3(0.61)	0.1(0.56)	0.4(0.65)	12.0(0.59)	27.8(0.01)*	5.2(0.00)**	5.216(0.00)**
FDI	-0.6(0.24)	-1.1(0.12)	0.5(0.69)	10.0(0.75)	13.7(0.46)	3.7(0.00)**	3.047(0.00)**
FRI	-2.2(0.01)*	0.7(0.77)	0.1(0.57)	13.6(0.47)	18.6(0.17)	4.6(0.00)**	4.483(0.00)**
CPI	-0.0(0.42)	0.9(0.82)	-0.7(0.23)	21.6(0.08)[b]	53.3(0.00)**	5.5(0.00)**	6.632(0.00)**
INU	-2.1(0.01)*	0.3(0.63)	0.1(0.55)	11.0(0.68)	12.5(0.56)	5.2(0.00)**	4.303(0.00)**
PCI	-0.6(0.27)	-1.1(0.12)	-0.7(0.20)	17.5(0.22)	5.5(0.97)	2.7(0.00)**	2.837(0.00)**
PRI	-0.4(0.31)	1.4(0.92)	1.2(0.89)	11.5(0.64)	7.9(0.89)	5.3(0.00)**	4.420(0.00)**
SCE	-0.3(0.37)	2.1(0.98)	1.2(0.90)	7.3(0.92)	4.1(0.99)	5.0(0.00)**	4.324(0.00)**
Series in First Differences							
PEE	-5.8(0.00)**	-1.7(0.04)*	-1.28(0.09)[b]	20.6(0.11)	25.9(0.03)*	4.990(0.00)**	5.5(0.00)**
ERI	-1.5(0.06)[b]	-0.7(0.23)	-1.10(0.13)	19.8(0.13)	50.9(0.00)**	4.288(0.00)**	9.7(0.00)**
FDI	-3.5(0.00)**	-3.4(0.00)**	-1.90(0.02)*	25.8(0.02)*	57.6(0.00)**	1.965(0.02)**	9.4(0.00)**
FRI	-2.1(0.01)*	-0.2(0.41)	-1.23(0.10)	23.2(0.05)[b]	58.98(0.00)**	4.863(0.00)**	10.7(0.00)**
CPI	-2.4(0.00)**	-2.9(0.00)**	-3.11(0.00)*	34.7(0.001)**	85.6(0.00)**	8.696(0.00)**	15.1(0.00)**
INU	-3.6(0.00)**	-1.0(0.14)	-1.26(0.10)	21.5(0.08)[b]	38.7(0.00)**	8.031(0.00)**	9.7(0.00)**
PCI	-6.8(0.00)**	-2.1(0.01)*	-1.56(0.05)[b]	22.9(0.06)[b]	15.9(0.31)	4.904(0.00)**	5.0(0.00)**
PRI	-9.1(0.00)**	-1.7(0.03)*	-4.53(0.00)*	46.1(0.00)**	74.2(0.00)**	7.344(0.00)**	16.0(0.00)**
SCE	-2.1(0.01)**	3.3(0.00)**	-0.36(0.36)	16.1(0.30)	31.1(0.00)**	5.951(0.00)**	9.5(0.00)**

Source: Authors

Note**, * and [b] denote statistical significance at the 1%, 5%, and 10% levels, respectively. () denotes the p-values

After detecting non stationarity, in line with Pedroni's (1999 and 2001) "panel cointegration procedure, tests have been proceeded to investigate whether there is any long-run equilibrium relationship exist" between (i) PEE, PCI, FDI and CPI in (eq.8), (ii) PEE, ERI, FRI and PRI in (eq.9), and (iii) PEE, SCE and INU in (eq.10) by applying by allowing heterogeneity as stated earlier in Section 4.

Table 4 reports, "the results of Pedroni Panel Cointegration tests" for model 1,2 and 3, respectively. In the first model, 4 out of 7 statistics, "Panel PP-Statistic, Panel ADF-Statistic, Group PP-Statistic and Group ADF-Statistic" are found to be significant at 5 % confidence interval, and the results reveal that most of the procedures reject the "null hypothesis of no cointegration" in the first model. The alternative hypothesis that the variables are cointegrated was then accepted, indicating that "there is a long-run equilibrium relationship among the variables" defined in the first model. The results for the second and third model is alike the first one. All these findings are then allow us to perform "Panel FMOLS and Panel DOLS estimations to investigate the long-run coefficients" of PEE for the Balkan countries.

Table 4. Pedroni Residual Cointegration Tests for Panel Data for the Balkan countries

	Within dimension (Homogeneous)			Between dimension (Heterogeneous)		
	Test	Statistics	Prob	Test	Statistics	Prob
	Panel v-Statistic	-1.5	0.94	Group rho-Statistic	3.1	0.99
Model 1.	Panel rho-Statistic	1.0	0.85	Group PP-Statistic	-4.0	0.00**
	Panel PP-Statistic	-9.4	0.00**	Group ADF-Statistic	-5.0	0.00**
	Panel ADF-Statistic	-2.7	0.00**			
	Panel v-Statistic	-1.4	0.92	Group rho-Statistic	3.3	0.99
Model 2.	Panel rho-Statistic	1.1	0.87	Group PP-Statistic	-3.7	0.00**
	Panel PP-Statistic	-9.5	0.00**	Group ADF-Statistic	-5.1	0.00**
	Panel ADF-Statistic	-2.7	0.00**			
	Panel v-Statistic	1.3	0.08[b]	Group rho-Statistic	1.2	0.88
Model 3.	Panel rho-Statistic	0.0	0.51	Group PP-Statistic	-2.5	0.00**
	Panel PP-Statistic	-2.0	0.02*	Group ADF-Statistic	-3.8	0.00**
	Panel ADF-Statistic	-2.2	0.00*			

Source: Authors

Note**, * and [b] denote statistical significance at the 1%, 5%, and 10% levels, respectively. () denotes the p-values

Table 5 displays the results for Panel FMOLS and Panel DOLS estimations of PEE with between and within dimensions. The first model indicates that the GDP per capita in the FMOLS model (between and within dimensions) has statistically significant and positive impact on public education expenditures in the long-run. The coefficients range between 1.013 and 1.001, implying that a 1% increase in GDP per capita leads to a 1% increase in public education expenditures. The result is consistent with the output of DOLS estimator but the elasticity coefficient has declined to 0.863 in both cases (between and within dimensions). In the same model, rising CPI is associated with declining public education expenditures in the long-run (except the model of FMOLS estimator within dimensions). The coefficient values are slightly different in the FMOLS and DOLS models with (-0.001) and (-0.008), respectively. Surprisingly, this model also reveals that foreign direct investment has no impact on public education expenditures of Balkan economies at least for the long-run.

Finally, in model 3, where we intend to explore the impact of school enrolment and technological development of community on public education expenditures, the findings both from the FMOLS and DOLS estimation have been found quite interesting. In all cases, rising school enrolment and internet users are associated with rising public education expenditures in the long-run.

Table 5. Panel (FMOLS and DOLS) Estimations of PEE

	FMOLS (Between Dimensions)				DOLS (Between Dimensions)			
	Variables				Variables			
Model 1.	PCI	FDI	CPI	DM08	Model 1.	PCI	FDI	CPI
	1.01**	-0.01	-0.01**	-0.03**		0.86**	-0.02	-0.01**
	(90.0)	(-1.3)	(-2.9)	(-3.7)		(137.6)	(-1.0)	(-31.1)
Model 2.	ERI	FRI	PRI	DM08	Model 2.	ERI	FRI	PRI
	0.90*	0.679	1.929**	-0.9**		4.6**	-0.27	-8.50
	(2.1)	(-1.9)	(-5.6)	(-22.4)		(2.5)	(-0.10)	(-0.3)
Model 3.	SCE	INU		DM08	Model 3.	SCE	INU	
	0.01**	0.02		-0.10*		0.02**	0.02**	
	(9.6)	(14.2)		(-2.1)		(7.1)	(9.9)	
	FMOLS (Within Dimensions)					DOLS (Within Dimensions)		
	Variables					Variables		
Model 1	PCI	FDI	CPI	DM08	Model 1	PCI	FDI	CPI
	1.00**	-0.01	-0.01	-0.03		0.86**	-0.02	-0.01**
	(38.6)	(-0.4)	(-1.3)	(-1.5)		(170.9)	(-0.3)	(-27.6)
Model 2	ERI	FRI	PRI	DM08	Model 2	ERI	FRI	PRI
	1.31*	0.47	-1.23	-0.95**		4.67*	-0.27	-8.53
	(2.0)	(-0.5)	(-1.2)	(-9.7)		(1.9)	(-0.1)	(-1.6)
Model 3	SCE	INU		DM08	Model 3	SCE	INU	
	0.01**	0.02		-0.11		0.02**	0.019**	
	(3.2)	(5.0)		(-0.9)		(5.2)	(5.6)	

Source: Authors

Note: ( ) denotes t-statistics from FMOLS and DOLS models. **, * and ^{b} denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 6 reports the findings from Dumitrescu-Hurlin (2012) panel causality tests with individual coefficients. The findings reveal that that there are bi-directional causalities between schooling enrolment and public education expenditure, as well as GDP per capita and public education expenditures. The test also reveals two uni-directional causalities running from internet users to public education expenditure and from public education expenditure to financial risk index, which designates that the variations in technological development significantly lead to changes in public education expenditures, and the variations in public education expenditures significantly lead to changes in financial risk index, correspondingly.

Freire-Serén (2002) also emphasized that there is a relationship between human capital accumulation and economic growth with the level of income spend on human capital investment in Spain. Hirsch and Sulis (2009) also investigated the impact of human capital investment and wealth on the economic growth in Italy and their study reveals that in the sectors, where human capital accumulation is extensively used, human capital contributes to the economic growth, positively. Vandenbussche, Aghion, and Meghir, (2006) pointed out that investing on higher education is likely to enhance innovation, production capacity and economic development.

Table 6 Dumitrescu Hurlin Panel Causality Test (lags=2)

(individual coefficient)		
Null Hypothesis:	Zbar-Stat.	Prob.
INU -> PEE	3.0	0.00**
PEE ->INU	0.81	0.41
SCE ->PEE	3.8	0.00**
PEE ->SCE	4.7	0.00**
ERI ->PEE	0.4	0.68
PEE ->ERI	0.4	0.65
FRI ->PEE	0.6	0.54
PEE ->FRI	2.8	0.00**
PRI ->PEE	0.8	0.39
PEE ->PRI	-0.1	0.88
PCI ->PEE	2.8	0.00**
PEE ->PCI	2.8	0.00**
FDI ->PEE	-0.5	0.56
PEE ->FDI	-0.0	0.97
CPI ->PEE	0.3	0.72
PEE ->CPI	-0.2	0.80
Source: Authors Note**, * and [b] denote statistical significance at the 1%, 5%, and 10% levels, respectively.		

Conclusions

In this study, Pedroni Panel Cointegration, Panel FMOLS, Panel DOLS, Dumitrescu-Hurlin Panel Causality tests have been performed. The empirical findings reveal that the GDP per capita, economic stability, school enrolments and technological development have been found to be the main determinants which have dynamic significant and positive impacts on public education expenditures in the long-run. Panel Causality tests with common coefficients reveal that “there are bi-directional causalities between education expenditures and financial risk”, and also between public education expenditures and foreign direct investments. Dumitrescu-Hurlin Panel Causality tests with individual coefficients also show bi-directional causalities between public education expenditures and school enrolments as well as public education expenditures and GDP per capita. Uni-directional causalities also run from technological development to education expenditures and from education expenditures to financial risk in the Balkan countries.

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