Bilal Mehmood – Syed Hassan Raza

English or German or Both: Recipes for Developing Countries

Econometric Evidence from Aggregated and Disaggregated Data

SUMMARY: Since its inception, Wagner's law has gained the attention of researchers and is well-documented in literature. It deals with the relationship between the increase of government expenditure and improved macroeconomic performance over time. On the contrary, Keynesian theory purports an opposite causality between the two. This paper contributes to literature by investigating this long-term relationship between government expenditure (aggregated and disaggregated) and income per capita in developing countries. The Pooled Mean Group (PMG) approach to cointegration is employed on data of 76 developing countries for the years 1990-2012. As a heterogeneous panel estimation technique, PMG allows the slope and short run parameters to vary across countries. Results show the presence of a long-term relationship between government expenditures and its components and income per capita. Causality analysis is also conducted in this paper that provides insights into the relationship between income per capita and government expenditure (aggregated and disaggregated). Possibilities of Wagnerian and/or Keynesian causality(s) are explored. Recommendations are made on the basis of empirical analysis.

KEYWORDS: Wagner's Law, Keynesian Theory, Mean Group, Pooled Mean Group, Dynamic Fixed Effects, Granger Causality.
JEL CODES: H50, E12, C23, C10

INTRODUCTION

Governments around the world have introduced fiscal packages over the past couple of decades in response to economic crisis which includes the fiscal expansion of various compositions. There is great debate in literature about the merits and demerits of such fiscal injections along with causation and procedural impacts. The first attempt in this regard was made by *Adolf Wagner* (1883) who proposed through empirical findings that government expenditure grows faster than national output during the process of economic development. He further argued about the impacts of public spending, which is further divided into three categories,

1. firstly it enhances administrative capacity,
2. secondly, it enhances the educational and health care services,
3. and thirdly, it will increase infrastructure due to a lower inclination of private sector to engage in major investment.

E-mail address dr.philos.bilal@gmail.com
hassanraza.economist@gmail.com

Whether government can foster economic growth by changing the composition of public expenditure is a key question for many economies around the world. For instance, fiscal austerity can be desirable in times of extreme indebtedness. Likewise, this paper carefully investigates the composition of public sector expenditure and measures their contribution to economic growth. In modern times, many developed economies attained a high level of economic growth by specialising and focusing on special expenditures in terms of health, education and defense. Policy makers really need to decide what type of expenditures should be reduced in order to achieve economic growth. We can trace the example of spending reallocation in history at the end of the Cold War in western economies. They curtailed the defense budget and spent this peace dividend on education and infrastructure.

In spite of the reasonable importance of the mentioned topic, there are very few attempts to collectively investigate government expenditures and their contribution to economic growth.

LITERATURE REVIEW

There is a broad scope of literature available examining the effect of health and military expenditures on economic growth, but the peculiar role of education expenditure by the public sector has come into focus since *Lucas's* (1988) study in which he established that human capital plays a vibrant role in economic development. *Easterly* and *Rebelo* (1993) empirically studied the role of the human capital and economic growth. They revealed a contradiction in terms of common intuition as they concluded that growth is not always enhanced by education spending.

Devarajan, Swaroop and *Zou* (1996) conducted a study on the composition of public expenditures and its impact on steady state rate of growth in economy. They took 20 years of data for 43 developing countries and concluded over-utilisation of productive expenditures can also have an impact. They further concluded that current expenditure plays a positive and significant role in determining economic growth.

Kneller, Bleaney and *Gemmell* (1999) studied how steady state growth rate is affected by the structure of taxation and public expenditures. They took the panel of 22 OECD countries by using the data from 1970 to 1995 with the support of the Barro model. The results revealed that distortionary taxes reduce economic growth, whereas no distortionary taxes enhance economic growth.

Blankenau and *Simpson* (2004) estimated the relationship between growth and education in context of the endogenous growth model. They concluded that a relationship exists between the mentioned variables as non-monotonic, as a positive relation concerning public education expenditures and growth can be negated when other factors of growth are affected by adjustments in general equilibrium.

Gupta, Clements, Baldacci, & *Granados* (2005) evaluated the effects of fiscal federalism and public sector expenditures on economic growth. Using the data of 39 low income countries, they concluded that economies with a better budgetary position enjoy faster economic growth. They went on to add that countries which spend more on wages enjoy lower economic growth as compared to those who spend more on services or non-wage goods.

Gemmell, Kneller and *Sanz* (2012) estimated the relationship between different components of public expenditures and economic growth. They took the data of 17 OECD countries from 1972 to 2012 and applied the pooled mean group technique. Results reveal that economic growth can be fostered by reallocating public expenditure towards education and infrastructure. Additionally, research suggests increasing the share of welfare expenditure can halt or slow the pace of economic growth.

Grullón (2014) assessed the Wagner's Law for Latin American countries by using the data from 1980 to 2012. They also applied the bound test approach and Granger causality to gain deeper insight. The research concluded the validity of Wagner's Law in the long run, which states government expenditure increases faster than economic growth. Furthermore, the study provides a positive relationship between economic growth and GDP.

This paper contributes to literature in the case of developing countries and exploits the recently developed Pooled Mean Group (PMG) cointegration technique to determine the existence of a long-term relationship. We based our analysis on different models with government final consumption expenditures, health expenditures, education expenditures and military expenditures. Panel Ganger causality is used to infer whether Wagnerian causality or Keynesian causality applies, or both.

Objectives

This paper aims to check whether government expenditure (aggregated and disaggregated) and income per capita have a long-term relationship in the case of developing countries. The hypothesis is narrated as follows:

$H_{A:}$ *There exists a long-term causal relationship between Government Expenditure (and its components) and Income per capita to point out the validity of Wagner or Keynesian views for developing countries.*

To test the cogency of this hypothesis, the following data and methodology are employed.

DATA AND METHODOLOGY

Data of income per capita and government expenditure [Public spending on education, total (% of government expenditure), Health expenditure, public (% of GDP) and Military expenditure (% of central government expenditure)] from 1990 to 2012 is used. The data are obtained from world development indicators WDI (2014). The countries include Afghanistan, Albania, Algeria, American Samoa, Argentina, Armenia, Azerbaijan, Bangladesh, Belize, Benin, Bolivia, Botswana, Bulgaria, Burkina Faso, Burundi, Cameroon, Central African Republic, China, Colombia, Congo Republic, Cote d'Ivoire, Dominican Republic, Ecuador, Egypt, El Salvador, Ethiopia, Fiji, Gambia, Georgia, Ghana, Guatemala, Guinea, Honduras, India, Indonesia, Islamic Republic Iran, Jordan, Kazakhstan, Kenya, Kyrgyz Republic, Lao PDR, Lebanon, Lesotho, Macedonia, Madagascar, Malaysia, Mali, Mauritius, Mexico, Moldova, Mongolia, Mozambique, Namibia, Nepal, Niger, Pakistan, Palau, Philippines, Russian Federation, Rwanda, Senegal, Serbia, Sierra Leone, South Africa, Sri Lanka, Syrian Arab Republic, Tajikistan, Tanzania, Thailand, Togo, Tunisia, Turkey, Uganda, Ukraine, Venezuela and Vietnam. All the variables are in logarithmic form for linearisation. The countries and time period are taken as per availability of data for selected developing countries.

The model to be estimated is as follows:

$$ln(YPC_{i,t})=\alpha_i+\beta_i \cdot ln(G_{i,t})+\varepsilon_{i,t} \quad (1)$$

YPC=*GDP* per capita (constant 2005 US$)

G=General government final consumption expenditure (constant 2005 US$)

$$\varepsilon_{i,t}=\rho_i \ \varepsilon_{i,t-1}+\omega_{it} \quad (1.1)$$

$\varepsilon_{i,t}$ is the disturbance from the panel regression and ρ_i shows the autoregressive vector of residuals in the i^{th} cross countries. The model parameter α_i allows for the possibility of the country specific fixed-effects and the coefficient of β_i allows for the variation across individual countries.

To judge the role of components of government expenditure, we use three of them alternatively. Such is modelled in the following equations:

$$ln(YPC_{i,t})=\alpha_i+\beta_i\cdot(E_{i,t})+\varepsilon_{i,t} \quad (2)$$

$$ln(YPC_{i,t})=\alpha_i+\beta_i\cdot(H_{i,t})+\varepsilon_{i,t} \quad (3)$$

$$ln(YPC_{i,t})=\alpha_i+\beta_i\cdot(M_{i,t})+\varepsilon_{i,t} \quad (4)$$

E = Public spending on education, total (% of government expenditure)

H = Health expenditure, public (% of GDP)

M = Military expenditure (% of central government expenditure)

$$ln(YPC_{i,t})=\alpha_i+\beta_i\cdot(E_{i,t})+\gamma_i\cdot(H_{i,t})+\delta_i\cdot(M_{i,t})+\varepsilon_{i,t} \quad (5)$$

Empirical Analysis

Panel Unit Root Tests

Our panel dataset has a time dimension of 23 years which constitutes a substantial length of time series and, therefore, the existence of unit roots in variables cannot be ruled out. *Eberhardt* (2011) supports the use of macro panel estimation techniques if the time dimension is greater than 20. To confirm the presence of variables containing unit roots, we employ three different, yet popular tests: *Levin et al.* (2002) (LLC), Im et al. (2003) (IPS) and Maddala and Wu (1999) (MW) tests. The LL tests are based on the homogeneity of the autoregressive parameter, while the IPS tests are based on the heterogeneity of autoregressive parameters. Thus, no pooling regressions are associated with IPS tests. MW tests, on the other hand, are based on Fisher type unit root tests that are not restricted to the sample sizes for different samples (Maddala and Wu, 1999).

We use three different tests to confirm our results. Maddala and Wu (1999) argue that "other conservative tests (applicable in the case of correlated tests) based on Bonferroni bounds have also been found to be inferior to the Fisher test." Results from all these tests are given in Table 1. The selection of the appropriate lag length was made using the Schwarz Bayesian Information Criterion.

Table 1 shows the statistics and *p* values of the panel unit root test. The results suggest that *YPC, G, E* and *M* have a unit root rendering them non-stationary. After first differencing the variables and repeating, the test variables series become stationary as a common intercept panel unit root test rejects the null

Table 1

UNIT ROOT TESTS

Test		Y	ΔY	G	ΔG	E	ΔE	H	M	ΔM
LLC		3.981	–13.755***	7.623	4.016	1.875	–1.916**	–11.495***	–4.261	–84.717***
IPS		9.582	–13.293***	10.188	–5.250***	1.714	–7.265***	–8.649***	0.063	–25.797***
MW	ADF	85.194	483.309***	97.950	374.756***	134.377	325.386***	351.463***	152.747	895.076***
	PP	88.345	722.931***	263.484	807.502***	115.445	600.248***	533.147***	208.855	837.557***
Remarks		I(1)		I(1)		I(1)		I(0)	I(1)	

Δ denotes first difference. Both variables are taken in natural logarithms. All tests take non-stationarity as null.

Note: Table shows the individual statistics and *p*-values with a lag length selection of one. Intercept is included in all terms with or without first differences. Probabilities of a fisher type test use asymptotic χ^2 distributions while other types of tests assume asymptotic normality. **: 5%, ***: 1%

Source: authors' estimates

of non-stationary at a 1% level of significance and individual intercept panel unit root tests are significant at a 5% level of significance. Most of the tests infer that *H* is level stationary, I(0), while *YPC, G, E* and *M* are first difference stationary, I(1).

Cointegration Analysis

After investigating the stationarity of the *Y* and *FD*, we employ Panel ARDL approach panel cointegration to find a long-term relationship between them.

Panel ARDL Cointegration Approach

Panel ARDL approach to cointegration allows the finding of cointegration despite a different order of integration of variables. Here we have a mixed order of integration, i.e. I(0) and I(1). *Pesaran* and *Smith* (1997) suggested a pooled mean group (PMG) estimator of dynamic panels for a large number of time observations and large number of groups. PMG estimator allows variation in the intercepts, short-run dynamics and error variances across the groups, but it does not allow long-term dynamics to differ across the groups. The PMG estimation model has an adjustment coefficient φ_i that is known as the error-correction term. In fact, this error-correction term φ_i shows how much adjustment has occurred in each period.

The results in *Table 2* are segmented into five models using three techniques of panel cointegration, namely; Mean Group (MG), Dynamic Fixed Effects (DFE) and Pooled Mean Group (PMG). In all of the models, PMG is found to be the most suitable technique by using the Hausman test. It is deduced from the *p*-values of Hausman statistics. Therefore, we focus on the results of PMG in lieu of MG and DFE. These models are explained as follows:

Model – I: reveals the contribution of government expenditure (*G*) to income per capita. The relationship is positive and statistically significant. The error correction term (φ_i) is negative and less than 1 in an absolute sense. φ_i is statistically significant for 1%. In the following models, we use the contribution of different components of government expenditure, namely, public spending on education (*E*), public health expenditure (*H*) and military expenditure (*M*).

Model – II: depicts the contribution of public spending to education (*E*) in terms of income per capita. The relationship is positive and statistically significant. The error correction term (φ_i) is negative and less than 1 in an absolute sense. φ_i is statistically significant for 1%. It shows a presence of cointegration between *E* and *YPC*.

Model – III: shows the contribution public health expenditure (*H*) in income per capita. The long run relationship is positive and statistically significant. The error correction term (φ_i) is negative and less than 1 in absolute sense. φ_i is statistically significant for 1%.

Model – IV: discloses the contribution of military expenditure (*M*) to income per capita. The relationship is positive and statistically significant. The error correction term (φ_i) is negative and less than 1 in absolute sense. φ_i is statistically significant for 1%. Cointegration is proven for this model as well.

Model – V: portrays the contribution of all three components of government expenditure collectively (*E, H* and *M*). The long-term relationship as shown by slope coefficients is positive and statistically significant for all three components. The error correction term (φ_i) is negative and less than 1 in an absolute sense. φ_i is statistically significant for 1%.

The five models show that government expenditure, as a whole and in its components, has a positive long-term relationship. Now can turn to our main objective of the paper which is to judge the type of causality, i.e. either Wagnerian or Keynesian. To check the causality between income per capita and

Table 2

COINTEGRATION RESULTS

	Model – I			Model – II			Model – III			Model – IV			Model – V		
	YPC = f(G)			YPC = f(E)			YPC = f(H)			YPC = f(M)			YPC = f(E, H, G)		
	MG	DFE	PMG	MG	DFE	PMG	MG	DFE	PMG	MG	DFE	PMG	MG	DFE	PMG
	Long–term Parameters														
G	0.575 (0.071)	0.687 (0.000)	**0.202 (0.000)**	–	–	–	–	–	–	–	–	–	–	–	–
E	–	–	–	–0.190 (0.441)	0.098 (0.037)	**0.234 (0.000)**	–	–	–	–	–	–	–0.014 (0.748)	0.023 (0.092)	**0.019 (0.000)**
H	–	–	–	–	–	–	0.010 (0.954)	0.380 (0.000)	**0.533 (0.000)**	–	–	–	0.493 (0.223)	0.342 (0. 000)	**0.591 (0.000)**
M	–	–	–	–	–	–	–	–	–	0.024 (0.235)	0.120 (0.068)	**0.2359 (0.000)**	–0.120 (0.102)	0.042 (0.004)	**0.069 (0.000)**
	Average Convergence Parameters														
φ_i	–0.166 (0.000)	–0.055 (0.000)	**–0.061 (0.000)**	–0.085 (0.000)	–0.017 (0.018)	**–0.022 (0.001)**	–0.066 (0.001)	–0.034 (0.000)	**–0.023 (0.007)**	–0.103 (0.000)	–0.014 (0.048)	**–0.018 (0.001)**	–0.162 (0.000)	–0.032 (0.000)	**–0.021 (0.001)**
	Short–term Parameters														
ΔG	0.113 (0.000)	0.015 (0.078)	**0.136 (0.000)**	–	–	–	–	–	–	–	–	–	–	–	**–**
ΔE	–	–	–	–0.006 (0.004)	–0.002 (0.005)	**–0.006 (0.004)**	–	–	–	–	–	–	–0.002 (0.435)	–0.001 (0.259)	**0.0001 (0.951)**
ΔH	–	–	–	–	–	–	–0.030 (0.000)	–0.025 (0.000)	**–0.031 (0.000)**	–	–	–	–0.019 (0.000)	–0.023 (0.000)	**–0.028 (0.000)**
ΔM	–	–	–	–	–	–	–	–	–	–0.006 (0. 015)	–0. 002 (0.004)	**–0.005 (0.067)**	–0.003 (0.238)	–0.001 (0.034)	**–0.003 (0.177)**
C	–0.227 (0.654)	–0.398 (0.000)	**0.192 (0.000)**	0.543 (0.000)	0.115 (0.026)	**0.121 (0.000)**	0.413 (0.002)	0.227 (0.000)	**–0.031 (0.000)**	0.689 (0.000)	0.103 (0.043)	**0.118 (0.000)**	1.092 (0.000)	0.201 (0.000)	**0.115 (0.001)**
***p*–value**	(Hausman)MG/DFE = 0.995			(Hausman)MG/DFE = 0.969			(Hausman)MG/DFE = 0.948			(Hausman)MG/DFE = 0.987			(Hausman)MG/DFE = 0.986		
	(Hausman)MG/PMG = 0.392			(Hausman)MG/PMG = 0.123			(Hausman)MG/PMG = 0.589			(Hausman)MG/PMG = 0.056			(Hausman)MG/PMG = 0.527		
Remarks	PMG is Efficient & Consistent			PMG is Efficient & Consistent			PMG is Efficient & Consistent			PMG is Efficient & Consistent			PMG is Efficient & Consistent		

Note: In parenthesis, *p*–values of parameters are given.

Source: authors' estimates

government expenditure (in total and in components), we resort to the panel version of Granger causality.

Panel Causality Test

The key question raised in this paper is the suitability of the two main schools of thought regarding government expenditure and national income, namely; English (Keynesian) and German (Wagnerian). We attempt to explore this matter by using a causality test. Keynesian theory and Wagner's law distinguishes the prominence of government intervention in the economy but present two contrasting opinions about causality. Keynesian theory considers causality from public expenditure to economic growth plausible while Wagnerian school maintains the opposite. Research evidence has revealed an inconclusive choice between the two opposite causality arguments. For instance; *Vedder* and *Gallaway* (1998), Aly and *Strazicich* (2000), *Bader* and *Qarn* (2000), *Bağdigen* and *Çetintaş* (2003), *Cooray* (2006), *Pieroni* (2006), *Andrésa*, et al (2007), *Fatas* and *Mihov* (2007), *Mavrov* (2007), *Arpaia* and *Turrini* (2008), *Alexiou* (2009), *Hakro* (2009) and *Yanyan* (2009), *Olopade* and *Olopade* (2010), *Nurudeen* and Usman (2010), Ighodaro and *Oriakhi* (2010), *Oktayer* and *Oktayer*, (2013), *Srinivasan* (2013) and *Grullón* (2014) among others. This paper overcomes the short-sightedness of existing research evidence to consider the possibility of both views holding true concurrently. It can also be assumed that for disaggregated data of government expenditure, some components might follow Wagnerian causality and others Keynesian. Our empirical results show both of these possibilities.

Table 3 shows the panel granger causality between income per capita and government expenditure. A uni-causal relationship running from government expenditure to income per capita is revealed. This infers the validity of Keynesian theory for the selected developing countries. A uni-causal relationship found between income per capita to public health expenditure and military expenditure is reflective of the existence of Wagner's law, while a bi-causal relationship is found between income per capita and public health expenditure. It shows a possibility of Keynesian-Wagner's Duality, where both causal possibilities

Table 3

GRANGER CAUSALITY TEST RESULTS

Causality	*F*-Stat	*p*-value	Support for:
General government final consumption expenditure → Income per capita	14.942	0.000	Keynesian Theory
Income per capita → General government final consumption expenditure	0.103	0.902	
Public spending on education → Income per capita	0.924	0.397	Wagner's Law
Income per capita → Public spending on education	4.278	0.014	
Public health expenditure → Income per capita	4.923	0.007	Keynesian and Wagner's Duality
Income per capita → Public health expenditure	7.254	0.001	
Military expenditure → Income per capita	0.692	0.716	Wagner's Law
Income per capita → Military expenditure	2.130	0.025	

Source: Authors' estimates

concur. Hence the two possibilities that we anticipated above seem to hold true from the data of developing countries. No overwhelming support is found for either of the two schools of thought.

CONCLUSION

The results of this study suggest that reallocation or readjustments on government expenditures significantly affect economic growth. Government final consumption expenditures and public expenditures on education also cause economic growth. Bi-directional causality is found between public health expenditures and economic growth. So it implies that developing countries should concentrate more on health, education and consumption in order to foster economic growth.

We based our analysis on the impact of public sector expenditures through different composition on economic growth for 76 developing countries. We used heterogeneous panel data to further apply pool mean group (PMG), which enabled us to measure long and short-term responses as well. After Granger causality, our PMG results reveal the positive relationship between economic growth and public expenditure, not only as a whole, but also as individual category. Nonetheless, a part of our findings contradict *Easterly* and *Rebelo* (1993) and support Kneller, Bleaney and Gemmell's (1999) findings which state that communication, health, transportation and education positively affect economic growth. Increased income per capita causes increased awareness and demand for education and national security. This leads to an increase in public health expenditure and military expenditure. In turn, improved health contributes to per capita income via improved labor productivity and increased income per capita boosts the demand for health services leading to an increase in public health services.

In an overall sense, the developing countries have a tendency to depend on government expenditure to increase their national income. This result is plausible since developing countries, generally, have low national incomes. Extracting resources from their meagre national incomes to spend on public services is not easy. Deficit financing usually comes to aid in such situations.

From a disaggregated point of view, Wagner's law is better supported, especially for education and military expenditure, while health expenditure has both Wagnerian and Keynesian causality. These results of disaggregated data suggest that the causality of components of government expenditure is more of a contextual issue. As the most important of the necessities or public services, health has shown a feedback effect as well. In turn, education and military expenditure in selected developing countries are dependent on macroeconomic performance.

Literature

Blankenau, W. F. – Simpson, N. B. (2004). Public Education Expenditures, Taxation, and Growth. *Journal of Development Economics. 73*(2), pp. 583–605

Eberhardt, M. (2011). *Panel Time-Series Modeling: New Tools for Analyzing xt Data.* Paper presented at the UK Stata Users Group meeting, Cass Business School

Devarajan, S. – Swaroop, V. – Zou, H. F. (1996). The Composition of Public Expenditure and Economic Growth. *Journal of Monetary Economics. 37*(2), pp. 313–344

Easterly, W. – Rebelo, S. (1993). Fiscal Policy and Economic Growth. *Journal of Monetary Economics. 32*(3), pp. 417–458

Im, K. S. – Pesaran, M. H. – Shin, Y. (2003). Testing for Unit Roots in Heterogeneous Panels. *Journal of Econometrics. 115*(1), pp. 53–74

Kneller, R. – Bleaney, M. F. – Gemmell, N. (1999). Fiscal Policy and Growth: Evidence from OECD Countries. *Journal of Public Economics. 74*(2), pp. 171–190

Gemmell, N. – Kneller, R. – Sanz, I. (2012). Does the Composition of Government Expenditure Matter for Economic Growth? *Manuscript. University of Nottingham*

Grullón, S. (2014). National Income and Government Spending: Co-Integration and Causality Results for Selected Latin American Countries. *International Journal of Economics, Commerce and Management. 2*(4), pp. 1–9

Gupta, S. – Clements, B. – Baldacci, E. – Mulas-Granados, C. (2005). Fiscal Policy, Expenditure Composition, and Growth in Low-Income Countries. *Journal of International Money and Finance. 24*(3), pp. 441–463

Levin, A. – Lin, C.-F. – James Chu, C.-S. (2002). Unit Root Tests in Panel Data: Asymptotic and Finite-Sample Properties. *Journal of Econometrics. 108*(1), pp. 1–24

Maddala, G. S. – Wu, S. (1999). A Comparative Study of Unit Root Tests with Panel Data and a New Simple Test. *Oxford Bulletin of Economics and Statistics. 61*(S1), pp. 631–652

Mehmood, B. – Siddiqui, W. (2013). What Causes what? Panel Cointegration Approach on Investment in Telecommunication and Economic Growth: Case of Asian countries. *Romanian Economic Journal. 47*(1): pp. 3–16

Oktayer A. – Oktayer, N. (2013). Testing Wagner's Law for Turkey: Evidence from a Trivariate Causality Analysis. *Prague Economic Papers. 2*, pp. 284–301

Pesaran, M. H. – Smith, R. (1995). Estimating Long-Run Relationships from Dynamic Heterogeneous Panels. *Journal of Econometrics. 68*(1), pp. 79–113

Pesaran, M. H. – Shin, Y. – Smith, R. P. (1997). *Pooled Estimation of Long-Run Relationships in Dynamic Heterogeneous Panels*: University of Cambridge, Department of Applied Economics

Pesaran, M. H. – Shin, Y. – Smith, R. P. (1999). Pooled Mean Group Estimation of Dynamic Heterogeneous Panels. *Journal of the American Statistical Association. 94*(446), pp. 621–634

Srinivasan, P. (2013). Causality between Public Expenditure and Economic Growth: The Indian Case. *International Journal of Economics and Management. 7*(2), pp. 335–347