TESTING ENDOGENOUS GROWTH MODEL: HEALTH AND MILITARY EXPENDITURES IN DEVELOPING COUNTRIES

Hale Akbulut
Hacettepe University
Department of Public Finance,
Beytepe, Ankara, 06800, Turkey
Email: halepehlivan@hacettepe.edu.tr

Abstract
This study aims to examine the effects of health and military expenditures on economic growth for 30 developing countries during the period 1995-2011. This study eliminates some deficiencies that took place in previous literature. I achieve this using the dynamic panel data method which allows use of instrumental variables instead of endogenous variables. I also consider revenue side of the budget and eliminate possible biases that may arise from model misspecification. The results indicate that health and military expenditures have a statistically insignificant effect on economic growth, in accordance with the neoclassical growth theory.

Key Words: Health Expenditures, Military Expenditures, Growth, Developing Countries.

Jel Codes: E62, H51, H56, I18, O49.

1. INTRODUCTION

Increasing per capita income and hence welfare of individuals is the primary aim of most of economic policies, consequently there is huge literature about economic growth. The increasing importance of economic growth results to increase efforts in order to determine its triggers. Of those, the effect of public expenditures is heavily been interested in and there are two main theories that examine this issue. According to Solow's (1956) and Swan's (1956) neo-classical growth models, the composition of public expenditures have no effect on economic growth. However in endogenous growth models (Barro, 1990; King and Rebello, 1990) they act as a determinant in the process of growth.

Although there are some studies that examine the relationship between health/military expenditures they suffer from the lack of model specification, data and methodology. In this paper those deficiencies are tried to be eliminated by employing endogenous variables, dynamic panel method and by including revenue side of the budget to the model.

We investigate the effects of health/military expenditures using data from panel of 30 developing countries the period 1995-2011. By this way we employ the most comprehensive data available for developing countries. Our results provide support for the neoclassical growth models in which public expenditures are assumed to be unproductive.

The remainder of paper is organized as follows. In section 2, we begin our analysis by a brief review of economic growth theories and public expenditures. In section 3, we examine existing literature and previous empirical studies. In section 4 we describe data sources and construction. In Section 5 we provide estimation results. We conclude with general reviews and interpretations.

2. REVIEW

The main objective of economic policy is often seen as achieving social welfare and the principle way to increase social welfare is economic growth. Therefore, researchers are interested in economic growth and trying to find out determinants of it. Although, there are different types of growth models, they are usually classified in the literature into two broad categories: neoclassical and endogenous growth models.

In neoclassical growth models of Solow (1956) and Swan (1956), the economic growth rate is driven by population growth and technological rate of technical progress. In this context, public policy has no effect on economic growth. Besides, in endogenous growth models (Barro, 1990; King and Rebello, 1990), the engine of economic growth is human capital, knowledge or technology. This allows fiscal policy to have an impact on economic growth rate through either some taxes or some types of public expenditures being able to affect decisions by private firms about investing in human capital, knowledge or research and development (Narvaez, 2004: 3). Distortionary taxation and productive expenditure are thought to have such kinds of effects.

The main contribution of Barro (1990) to endogenous growth model is to include public sector to the analysis. (k) indicates per capita capital stock and g indicates the value of public services per capita and it is assumed that these services are provided without user fees. In addition, demand congestion which may be occurred as a result of this situation has been ignored. Under the assumption that the factors of production have constant returns to scale, production function can be expressed as follows:

$$y = \Phi(k,g) = k.\ \phi(g/k) \qquad (1)$$

Assuming that the production function is in Cobb-Douglas form, it can be re-written as:

$$y/k = \phi(g/k) = A.\ (g/k)^{\alpha} \qquad (2)$$

It is assumed that public expenditures are financed by a flat-rate income tax and a balanced budget policy is followed:

$$g = T = \tau.\ k.\ \Phi(g/k) \qquad (3)$$

(T) indicates public revenues and (τ) the tax rate. In such a production function marginal efficiency of capital is expressed as follows:

$$\partial y / \partial k = \Phi(g/k)\ .\ (1- \Phi'\ .\ g/y) = \Phi(g/k)\ .\ (1- \eta) \qquad (4)$$

In equation (4), (η) indicates the flexibility of (y) according to (g) with exogenous (k) and gets the value between 0 and 1. According to the equivalence marginal product is calculated by varying (k) and holding (g) fixed. In this case, it is assumed that changes in a representative producer capital or output will not result in any change in the amount of public services. In the presence of such a flat tax rate (τ), marginal return on capital will be referred as (1-τ).(∂y/∂k). Therefore, steady-state growth rate can now be expressed as follows:

$$\boldsymbol{\gamma = \frac{\dot{c}}{c} = \frac{\left[\frac{1-g}{y}.(1-\eta)\varphi\left(\frac{g}{k}\right) - \rho\right]}{\sigma}} \qquad (5)$$

Thus, process of endogenous growth model is created in which public interventions are included. Romero and Strauch (2003), in a similar way, based on the Barro Model, declared that productive public expenditures and taxes would affect the long-term growth rate. Production function is as follows:

$$y= Ak^{1-\gamma} g^{\gamma} \tag{6}$$

(k) refers to the physical capital of the private sector and (g) is the productive public expenditures and plays a direct role in the production process. It is assumed that the government budget constraint is in equilibrium in each period:

$$g + G = \tau .y + T \tag{7}$$

(G) represents other public expenditures which are not included in the production process, (T) represents lump-sum taxes and (τ) is the proportional tax which has a destructive effect on investment decisions. Consumers maximize their utility under the budget constraint. (ρ) represents time preferences and (σ) represents the intertemporal elasticity of substitution. Then, consumption and production growth rate is expressed as follows:

$$\frac{\mathbf{c}^{\cdot}}{\mathbf{c}} = \frac{\mathbf{y}^{\cdot}}{\mathbf{y}} = \frac{\left[(\mathbf{1}-\tau).(\mathbf{1}-\boldsymbol{\alpha})\mathbf{A}^{(\mathbf{1}/(\mathbf{1}-\boldsymbol{\alpha}))}.(\frac{\mathbf{g}}{\mathbf{y}})^{\boldsymbol{\alpha}/(\mathbf{1}-\boldsymbol{\alpha})}-\boldsymbol{\rho}\right]}{\boldsymbol{\sigma}} \tag{8}$$

Equation (8) expresses that productive public expenditures have positive, distortionary taxes have negative effects on economic growth. On the other hand non-productive government expenditures (G) and non-distorting lump-sum taxes (T) have no effect on growth. Another important result pointed put by this equation is that it will cause a specification error if productive public expenditures and distortionary taxes are not both used in the model.

3. RELATED LITERATURE

The question of how public military and health expenditures affect economic growth is a controversial issue. The unproductivity of public expenditures can be traced back to classical economists. However, there is also a new and huge literature that points out the productive effects of some public expenditures. Of those, military expenditures are thought to promote growth by preventing depression and serving military research and technical development (Cappelen et al., 1984: 361). The theoretical work has allowed the identification of a number of channels through which military spending can impact the economy, through labor, capital, technology, external relations, socio political effects, debt, conflicts etc,. In addition, health can affect productivity and hence economic growth by improving productivity and creativity of employees. It increases investment attraction in education and educational opportunities from one side and will prepare the individuals to continue education and obtain more skills by enhancement of learning capability from the other side and encourage individuals towards more saving through reduction of mortality and increasing of life expectancy (Peykarjou, 2011: 1041). Therefore, net effects on economic growth is ambiguous and can only be ascertained by empirical analysis (Dunne, 2012: 2).

Previous surveys of the military spending growth literature usually employ causality tests or OLS estimation methods. Of those, Cappelen et al. (1984) find that military expenditures have a negative effect on economic growth. They employ 17 OECD countries data for the period of 1960-1981. Faini et al. (1984) and Başar (2012) support this finding for different data sets. Faini et al. (1984) conclude that defense burden (share of defense in GDP) and economic growth have a negative relationship, for 69 countries during the period of 1952-1970. Similarly, Başar (2012) in his study of panel data estimation of 36 countries, observes that military expenditures have significant and negative effect on economic growth for the period of 1997-2004.

There are also some studies that find insignificant relationship. Mintz and Stevenson (1995), for example, in their study of 103 countries for the period of 1950-1985, conclude that military expenditures have no significant effect on economic growth. Narvaez (2004), observes negative and insignificant effects on economic growth in 28 low and middle income countries (1975-2000). Dunne (2012), employ a large country panel data set for 1988-2006 and concluded that military burden has a significant and negative short run effect and insignificant long-run effect on per capita GDP growth.

Studies that employ causality tests are of Chowdhury (1991), Kollias and Makrydakis (1996) and Dunne et al. (2001). Chowdhury (1991) and Kollias and Makrydakis (1996) conclude that there is no causality relationship between military expenditures and growth, on the other hand Dunne et al. (2001) suggest that military expenditures have a negative effect on economic growth. In summary, empirical findings usually point out insignificant or negative effect of defense expenditures but there is no consensus. The same is true for the empirical studies which test the growth effects of health. Gyimah and Wilson (2004), Koying and Young-Hsiang (2006), Bakare and Sanmi (2011) and Majdi (2012) are those that find significant and positive relationship between health expenditures and income or growth. Gyimah and Wilson (2004) test the relation for African and OECD countries and conclude that health expenditures are increasing per capita income. Koying and Young-Hsiang (2006) support this finding for 15 OECD countries and defend that health expenditures have a positive effect on economic growth. In addition Bakare and Sanmi (2011) confirm positive relation for Nigeria and Majdi (2012) for 15 countries of the North and South Bank Mediterranean.

Some other studies point to the insignificant effect of health expenditures on economic growth. Narvaez (2004), for example, observed insignificant effects of health expenditures. Çetin and Ecevit (2010) again defend that health expenditures have an insignificant effect on economic growth in 15 OECD countries (1990-2006). In summary, there is no consensus for the net growth effects of health expenditures as in the case of defense. This paper tries to troubleshoot by testing the relationship with dynamic panel data method and eliminating some previous deficiencies which are determined in the next section.

4. DATA AND METHODOLOGY

In this section, the relationship between military/health expenditures and economic growth is tested empirically with dynamic panel data analysis. Econometric model is constructed in accordance with the endogenous growth models (Barro, 1990; Romero and Strauch, 2003) and empirical literature.

Studies examining the effects of public expenditures on economic growth usually focus on the expenditure side of the budget only. However, Helms (1985); Modifi and Stone (1990), Miller and Russek (1993) and Kneller et al. (1999) proved that using only one side of the budget would cause a systematic deviation in the parameter estimates. Therefore, I employ taxes on income, profits and capital gains in the regression and remove only taxes on goods and services (which are assumed to be neutral in endogenous growth models) in order to eliminate multicollinearity.

Following Barro (1990), non-tax government revenues and interest payments that are considered to have no impact on economic growth are not included in the model. Thus, financial variables to be included in the equation are determined as health expenditures, military expenditures, other public expenditures, taxes on income, profits and capital gains (distortionary taxes) and budget cash balance. In addition, non-fiscal variables that expected to affect growth are determined as capital formation and labor force.
In accordance with the previous studies, our econometric model is determined as follows:

$$GRPC_{it} = \beta_0 + \beta_1 GRPC_{it-1} + \beta_2 LABG_{it} + \beta_3 DGCAP\_GDP_{it} + \beta_4 HEALTH + \beta_5 MILITARY + \beta_6 OTH\_GDP_{it} + \beta_7 TAXI_{it} + \beta_8 CASH_{it} \quad (9)$$

where GRPC is the GDP per capita growth (%), LABG is the labor force participation growth rate (%), DGCAP_GDP is the change in the ratio of gross capital formation to GDP (%), HEALTH is the ratio of government health expenditures to GDP (%), MILITARY is the ratio of military expenditures to GDP (%), OTH_GDP is the ratio of other public expenditures to GDP (%), TAXI is the ratio of taxes on income, profits and capital gains to GDP (%) and CASH is the ratio of budget cash deficit/surplus to GDP (%).

Data on 30 developing countries (IMF, 2012) are used for the years 1995-2011. The countries included into the sample are: Belarus, Brazil, Bulgaria, Croatia, Ethiopia, Georgia, Guatemala, Hungary, India, Indonesia, Iran, Jordan, Kazakhstan, Kenya, Kuwait, Latvia, Lithuania, Malaysia, Maldives, Moldova, Mongolia, Nicaragua, Pakistan, Paraguay, Peru, Sri Lanka, Tunisia, Uganda, Ukraine and Uruguay.
The data are obtained from the World Bank's "World Development Indicators (WB, 2014)" database and Stata 10 econometric package program is used. I tested the problem of multicollinearity with a correlation matrix (for details, see Appendix 1) and found no multicollinearity between the variables that may cause econometrical problems.

5. EMPIRICAL RESULTS

In the estimation of dynamic models, both Arellano Bond (1991) estimator which is based on the first diffence transformation and Arellano Bover (1995) estimator which minimizes data loss by using orthogonal deviations are widely used. Blundell and Bond (1998) emphasized the importance of utilizing the extra moment conditions especially when N>T by showing that the lagged variables are poor estimates when there are continuous instrumental variables. Therefore dynamic model is estimated with the two-staged system-GMM method (Arellano and Bover, 1995). The reason of two-staged estimation choice is that it takes the heteroscedastic structure of the error terms into consideration (Doornik and Hendry, 2001) and by this way it is thought to be more efficient, assymptoticaly (Khadraoui, 2012: 4). The estimation results are given in Table 1 (for details, see Appendix 2).
Both of the models are statistically significant based on the Wald probability values. The coefficients of GRPC(-1), LABG and DGCAP_GDP variables are statistically significant in all models. Accordingly, investments have a positive effect on economic growth and it is consistent with theoretical expectations. The lagged dependent variable has a positive and statistically significant coefficient. This result is not consistent with convergence hypothesis. However, as I employ countries that have relatively similar per capita incomes, the result may point out conditional convergence of Solow (1956). LABG variable is found to have a negative sign and this result is consistent with a number of studies (Beaudry and Collard, 2002; McGuckin and Van Ark, 2005; Pickelmann and Roegeri, 2008; Dew-Becker and Gordon, 2008). These studies explain the negative relationship with the lack of practical skills of new employees and the need for time in order to learn job and become completely productive.

As can be seen from Table 1, all of the fiscal variables including health and military expenditures are found to have statistically insignificant coefficients. TAXI variable that is supposed to be distortionary according to Barro (1990) classification, has an insignificant coefficient in both of the models and this result is consistent with neoclassical expectations. Similarly expenditures on both health and military have no effect on economic growth. In addition, the results of Model 2 again indicate that there is no significant relationship even if we employ the expenditures in total. In this context, our study is contrary to the endogenous growth models which defend the productivity of some public expenditures. But our results are confirming neoclassical growth models.

Sargan test (Arellano and Bond, 1991) is widely used in order to test the validity of instrumental variables. The results of Sargan Test and autocorrelation test which tests the null hypothesis of "There is no second-order autocorrelation" for the residuals of first difference model are given in Table 1. Accordingly, the null hypothesis of Sargan test cannot be rejected (Mileva, 2007: 7), thus we concluded that the instrumental variables are valid. Furthermore, there is first order autocorrelation according to the AR (1) Test. This result is not a surprise, as we used lagged dependent variable as an explanatory variable. Finally, we observed also no second order correlation problem.

6. CONCLUSION

The effect of health and military expenditures on economic growth is a controversial issue. Neoclassical theory and endogenous theory contradicts about the role of fiscal policies. Empirical studies, in addition suffer from some deficiencies. In this paper, data of 30 developing countries for the period 1995-2011 is employed in order to test the relationship between health/military expenditures and economic growth by eliminating problems of endogenous variables and model misspecification. The results of as Wald Test, Arellano Bond Autocorrelation Test and Sargan Test have shown that estimating the model with dynamic panel method is suitable. Our results suggest that both of the public expenditures have no statistically effect on economic growth. This result is consistent with the studies of Chowdhury (1991), Mintz and Stevenson (1995), Kollias and Makrydakis (1996), Narvaez (2004), Çetin and Ecevit (2010) and Dunne (2012) also neoclassical theoretical expectations.

REFERENCES

Arellano, M. & Bond S. (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. Review of Economic Studies, 58(2), 277-297.

Arellano, M. & Bover, O. (1995). Another Look at the Instrumental Variable Estimation of Error-Componenets Models. Journal of Econometrics, 68(1), 29-51.

Bakare, A. S. & Sanmi, O. (2011). Health Care Expenditure and Economic Growth in Nigeria: An Empirical Study. Journal of Emerging Trends in Economics and Management Sciences, 2(2), 83-87.

Barro, R. J. (1990). Government Spending in a Simple Model Of Endogenous Growth. Journal of Political Economy, 98(5), 103-125.

Başar, S. & Künü S. (2012). Savunma Harcamalarının İktisadi Büyümeye Etkisi. Journal of the Institute of Social Sciences, 10, Autumn, 1-30.

Beaudry, P. & Collard, F. (2002). Why Has the Employment Productivity Trade-off Among Industrialized Countries Been So Strong?. NBER Working Paper, No.8754.

Blundell, R. & Bond S. (1998). Initial Conditions and Moment Restrictions in Dynamic Panel Data Models. Journal of Econometrics, 87(1), 115-143.

Cappelen, A., Gleditsch, N. & Isferkholt O. (1984)."Military Spending and Economic Growth in the OECD Countries.Journal of Peace Research, 21(4), 361-373.

Chowdhury, A. R. (1991). A Casual Analysis of Defense Spending and Economic Growth. The Journal of Conflict Resolution, 35(1).

Çetin, M. & EcevitE. (2010). Sağlık Harcamalarının Ekonomik Büyüme Üzerindeki Etkisi: OECD Ülkeleri Üzerine bir Panel Regresyon Analizi. Doğuş Üniversitesi Dergisi, 11(2), 166-182.

Dew-Becker, I. & Gordon, R. J. (2008). The Role of Labour Market Changes in the Slowdown of European Productivity Growth. CERP Discussion Paper, No. 6722.

Doornik, J. A. & Hendry, D. F. (2001). GiveWin: An Interface to Emprical Modelling, London: Timberlake Consultants Press.

Dunne, P. J. (2012). Military Spending, Growth, Development and Conflict. Defence and Peace Economics, (forthcoming).

Dunne, J. P., Nıkolaıdou, E. & Vougas, V. (2001). Defence Spending and Economic Growth: A Causal Analysis for Greece and Turkey. Defence and Peace Economics, 12 (1).

Faini, R. Annez, P. & Taylor L. (1984). Defense Spending, Economic Structure, and Growth:Evidence Among Countries and Over Time. Economic Development and Cultural Change, 32: 487-498.

Gyimah, K. B. & Wilson, M. (2004). Health Human Capital and Economic Growth in Sub-Saharan African and OECD Countries. The Quarterly Review of Economics and Finance, 44(2), 296-320.

Helms, L. (1985). The Effect of State Local Taxes on Economic Growth: A-Time Series Cross Section Approach. The Review of Economics and Statistics, 67(3), 574-582.

IMF (2012), World Economic Outlook Report. [Online] Available: http://www.imf.org/external/pubs/ft/weo/2012/01/pdf/text.pdf (03.03.2014)

Khadroui, N. (2012). Financial Development and Economic Growth: Static and Dynamic Panel Data Analysis. International Journal of Economics and Finance, 4(5), 94-104.

King, R. & Rebello, S. (1990). Public Policy and Economic Growth: Developing Neoclassical Implications. Journal of Political Economy, 98(1), 126–151.
Kneller, R., Bleaney, M. F. & Gemmel N. (1999). Fiscal Policy and Growth. Journal of Public Economics, 74(2), 171-90.

Kollias, C. & Makrydakis, S. (1996). Defence Spending and Growth in Turkey 1954–1993: A Causal Analysis. Defence and Peace Economics, 8, 189–204.

Koying, C. & Young-Hsiang Y. (2006). Economic Growth, Human Capital Investment, and Health Expenditure : A Study of OECD Countries. Hitotsubashi Journal of Economics, 47(1),
1-16.

Majdi, M. (2012). Study of the Relation Between Health and Economic Growth: Validation Empirical From a Panel of 15 Countries of the North and South Bank Mediterranean. Interdisciplinary Journal of Contemporary Research in Business, 4(1), 175-186.

Mcguckin, R. & Ark, V. B. (2005). Productivity and Participation: An International Comparison. Research Memorandum, GD-78, Groningen: Growth and Development Centre.

Mileva, E. (2007). Using Arellano-Bond Dynamic Panel GMM Estimators in Stata, Tutorial with Examples Using Stata 9.0. [Online] Available: http://www.fordham.edu/economics/ mcleod/Elitz-UsingArellano%E2%80%93BondGMM Estimators.pdf.

Miller, S. M. & Russek F. S. (1993). Fiscal Structures and Economic Growth: International Structures. Macroeconomics Working Paper, No. 9309001.

Mintz, A. & Stevenson R. T. (1995). Defense Expenditures, Economic Growth, and the "Peace Dividend": A Longitudinal Analysis of 103 Countries. The Journal of Conflict Resolution, 39(2).

Modifi, A. & Stone J. (1990). Do State and Local Taxes Affect Economic Growth?. Review of Economics and Statistics,72(4), 686-691.

Narvaez, R. C. (2004). The Composition of Public Expenditure and Economic Growth Inflow
and Middle-Income Countries. OIDA International Journal of Sustainable Development, 5(6), 39-50.

Peykarjou, K., Gollu, R. B., Gasti, H. P. & Shahrivar R. B. (2011). Studying the Relationship Between Health and Economic Growth in OIC Member States. Interdisciplinary Journal of Contemporary Research in Business, 3(8), 1041-1054.

Pickelmann, K. & Roeger, W. (2008). Employment and Labor Productivity in the EU: Reconsidering a Potential Trade-off in the Lisbon Strategy. In B. Eichengreen, M. Landesmann & D. Stiefel (Eds.), The European Economy in an American Mirror (pp. 128-142).

Romero, A. D. & Strauch S. R. (2003). Public Finances and Long-Term Growth in Europe- Evidence from a Panel Data Analysis. ECB Working Paper, No. 246.

Solow, R. (1956). A Contribution to the Theory of Economic Growth. Quarterly Journal of Economics, 70(1), 65-94.

STATA 10, Statistics/Data Analysis, Copyright 1984-2007, Texas: StataCorp.

Swan, T. W. (1956). Economic Growth and Capital Accumulation. Economic Record, 32(63), 334-61.

World Bank, (2014), World Development Indicators. [Online] Available: http://data.worldbank.org/data-catalog/world-development-indicators.

APPENDIX 1

Correlation Matrix

	CASH	TAXI	GCAP_GDP	HEALTH	LABG	MILITARY	GRPC	OTH_GDP
CASH	1.0000							
TAXI	-0.1639	1.0000						
GCAP_GDP	0.1936	0.0659	1.0000					
HEALTH	0.1097	-0.0235	0.0122	1.0000				
LABG	-0.0800	0.1276	0.0045	-0.3595	1.0000			
MILITARY	-0.0948	-0.1589	-0.0977	-0.0540	0.1823	1.0000		
GRPC	0.2148	-0.0508	0.4052	-0.0327	-0.1670	-0.0455	1.0000	
OTH_GDP	0.0447	-0.0159	-0.0152	0.5966	-0.4462	0.0568	-0.0333	1.0000

APPENDIX 2

Tablo 1. System-GMM Estimation Results

Dependent Variable: GRPC		
Two Staged Arellano Bover Estimator		
Explanatory Variables	**1.Model**	**2.Model**
GRPC (-1)	0.2070 (3.67)*	0.2276 (5.19)*
LABG	-0.2394 (-2.25)**	-0.3601 (-3.76)*
DGCAP_GDP[a]	0.6313 (8.31)*	0.5994 (7.40)*
HEALTH[a]	0.7038 (-0.63)	
MILITARY[a]	0.0761 (0.20)	
OTH_GDP[a]	0.0190 (0.12)	-0.0194 (-0.10)
HEALTH+MILITARY[a]		0.4711 (0.98)
TAXI[a]	0.0099 (0.02)	-0.3572 (-0.72)
CASH	0.1527 (1.43)	0.1900 (1.26)
Wald Statistic	579.69	648.06
Wald Probability	0.0000	0.0000
Sargan Test	1.0000	1.0000
AR(1) Test	0.0002	0.0004
AR(2) Test	0.3061	0.2861

Note: Figures in parenthesis are t and z statistics.

* p<%1, ** p<%5, ***p<%10.

a variable is included in the regression as endogenous.