

The Central Government Debts, Welfare and Warfare Expenditure Nexus: The High Income Members of OECD and PVAR Analysis

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Abstract

This study uses the fixed effect model to analyze possible effects of the military, educational and health expenditures, subsidies and other transfer charges on the central government debts, and the PVAR dynamic panel data model with separate OLS and GMM estimations to analyze causality relationships among the variables for 31 High Income OECD countries in 1999-2012 period. The fixed effect model showed that military and health expenditures have positive and negative effects on the debts respectively. According to dynamic causality and impulse response analyses, the other types of expenditures, except health expenditures, have causality relationships towards the debts. However, a bidirectional causality relation is found only between the debt and military expenditures.

Keywords: Government Debt, Military Expenditure, Government Health Expenditure, Government Education Expenditure, Government Subsidies, Dynamic Panel Data

Merkezi Devlet Borcu, Refah ve Askeri Harcamalar İlişkisi: Yüksek Gelirli OECD Ülkeleri ve PVAR Analizi

Özet

Bu çalışma 1999-2012 dönemini kapsayan 31 Yüksek Gelirli OECD ülkesine ait askeri harcamaların, eğitim harcamalarının, sağlık harcamalarının, sosyal harcamalar ve diğer transfer harcamalarının merkezi devlet borçları üzerindeki etkilerini sabit etkiler modelini kullanarak ve değişkenler arasındaki nedensellik ilişkilerini ise PVAR dinamik panel veri modelini Panel OLS ve GMM ile ayrı ayrı tahmin ederek analiz etmektedir. Sabit etkiler modeli askeri harcamalar ve sağlık harcamalarının merkezi devlet borcu üzerinde sırasıyla olumlu ve olumsuz etkileri olduğunu ortaya göstermiştir. Dinamik nedensellik ve etki tepki analizlerine göre, sağlık harcamaları hariç, diğer harcama tiplerinden merkezi devlet borcuna doğru nedensellik ilişkisi mevcuttur. Bununla beraber, iki yönlü nedensellik ilişkisi sadece merkezi devlet borcu ve askeri harcamalar arasında bulunmuştur.

Anahtar Kelimeler: Merkezi Devlet Borcu, Askeri Harcamalar, Merkezi Devlet Sağlık Harcamaları, Merkezi Devlet Eğitim Harcamaları, Merkezi Devlet Yardımları, Dinamik Panel Veri

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I. INTRODUCTION

In addition to the educational and health expenses having the nature of semi-public goods (services) and such social expenditure items as the subventions and transfer charges, the defense expenditures are also considered to be integrated into the internal and external resources of the economy, and hence financed with the same resources. Any change in the economic conditions and the shares assigned to the defense and social expenditures in the general budget results in the change of other public expenditures, and it may also affect such economic variables as the public debts, economic growth and development, etc.

Beside the increase in the level of national income per capita within the recent decades, the social expenditures have also grown for development and improvement of the human capital. Furthermore, the increasing use of technologies in such fields as medicine, communications, transportation, etc., a number of improvements have been scored in the levels of economic development. The improvement in economic growth and development level has resulted in elongation of the human life, whereby not only the populations of communities, but also the rate of old age population in the communities have increased. In turn, this makes it necessary for the states to increase the retirement and health expenditures, while there appears a need to raise even the education, health, subvention and transfer expenditures.

In line with the overall increase trend appeared in the shares assigned for defense expenditures as from 9/11 2001, a considerable portion of the resources that might be assigned for the public investments and the social security programs and similar fields has been used for the defense expenditures. On the other hand, since the savings remain short to meet the expenditures for defense industry, and the foreign dependency is high for renewal of the defense industry technologies, the borrowing is more frequently used. In particular, the increase of foreign loans may adversely affect the economic growth and development. As for the increase in, and high borrowing dependence for military expenditures in the distribution of social resources may crowd out the expenditures assigned for health and other social programs, and undermine the overall welfare of the community.

The public expenditures increasing both in the military and social fields will be substituted to each other, or covered by the increased taxes and public revenues or borrowing, depending on the degree or importance. As the states will, at the first instance, fall in the dilemma to increase/decrease the national security expenses, or the social security expenditures, the governments will incline to the populist policies. In consequence, each one of these three options creates some restrictions on the economy.

This study aims at searching through the dynamic panel data methods whether the military, educational and health expenditures as well as subsidies and other transfer charges have any effect on the central government debt, and whether there are any causality relationship among the expenditure variables and the central government debt.

2. LITERATURE REVIEW

The researches on the relationship between the military expenditures and the government debts, and between the government debts and the social expenditures, have been going on for longer than 30 years. However, the researches on the budgetary trade-off relationships between the military and social expenditures date back to some 50 years ago. The different methodologies, econometric modeling and econometric methods used are related to the individual countries or the country comparisons. In spite of the high number of research activities on the two pairs of relationships on the subject matter, the wide variety of applied econometric analyses and estimation techniques, e.g. the sample size, sample characteristics, and the historical, economic, political and social differences of the countries, did not always allow getting a consensus view in the consequent empiric findings even with the same data. However, only a negligible number of studies that concurrently handle the triple data, i.e. military expenditures, government debts and social expenditures was found in the literature.

Following is a brief elaboration of the findings of the studies on bilateral relationships (military expenditures-government debts, military expenditures-social expenditures) determined by the relational literature survey.

Defense (Military) Expenditures and (Government) Debt: Brzoska (1983), who reviewed third world countries for the years between 1970 and 1979, determined that the weapon importation was completely financed through the foreign indebtedness¹. Looney and Fredriksen (1986) observed that the developing countries financed their total import payments through the foreign funds, as the defense expenditures might be directly effective on the national foreign borrowing stock of a country, if it is a weapon importer. They also observed that such expenditures resulted in less accessibility to the resources for the other key public expenditures and productive investments². Looney (1989) studied 61 Less Developed Countries for years between 1970's and early 1980's, and found some insignificant results for the defense-external debt relationship³. Sen (1991) carried out a study for the developing countries in the late 1980's, whereupon he found that the weapon importation of the developing countries contributed to their foreign indebtedness⁴. Günlük-Senesen (2002) studied the years between 1980-2001 for Turkey, and indicated that the defense expenditures applied pressure on the budgetary revenues as to increase the borrowing need of the state, so that it has an indirect increasing effect on the outstanding external debt of the country⁵. Sezgin (2004) studied the years between 1979 and 2000 for Turkey,

1 Michael Brzoska, 'Research communication, The military related external debt of Third World countries'. *Journal of Peace Research* 20(3), 1983, pp. 271-2

2 Robert E. Looney, and Peter C. Frederiksen, 'Defence expenditures, external public debt and growth in developing countries'. *Journal of Peace Research* 23(4), 1986, pp.329-337

3 Robert E. Looney, 'The influence of arms imports on Third World debt'. *The Journal of Developing Areas* 23(2), 1989, pp.221-232.

4 Somnath Sen, 'Debt, financial flows and international security'. In *SIPRI Yearbook 1991, World Armaments and Disarmament*, SIPRI-Oxford University Press, New York, 1991, pp.181-195.

5 Gülay Günlük Şenesen. 'Türkiye 'de savunma harcamaları ve ekonomik etkileri 1980-2001'. *Defence expenditures and its effect in Turkey, 1980-2001*. (İstanbul: TESEV, 2002)

and found no clear evidence for the defense-debt relationship⁶. Dunne et al. (2004a) studied 11 small industrializing economies during the period of 1960-2000, and realized that the military burden had a positive and significant effect on the foreign indebtedness⁷. Dunne et al. (2004b) found in his study covering three major South America countries, including Brazil, Argentina and Chile in the 1980's that the military burden had a positive effect on the outstanding external debt, particularly in Chile. However, no proof could be found on the effect of the military burden on the development of indebtedness of Argentina and Brazil⁸. Smyth and Narayan (2009) studied six Middle Eastern economies for the 1988-2002 period, and reported that the defense expenditures had positive and significant effects on the foreign outstanding debts in both the short and long terms⁹. Ali (2012) studied the 1987-2005 period for the Middle Eastern and North Africa (MENA) countries, and concluded that about a half of the Arab countries had considerable debts to the foreign countries, and the said borrowing was primarily used for the large scale weapon purchases and the supply of other military requirements¹⁰. Alexander (2013) studied the members of the Organization for Economic Cooperation and Development (OECD) and the North Atlantic Treaty (NATO) over the periods of 1988-2009 and 1999-2009, and provided results that the reductions in defense expenditures have a certain potential to reduce the debts in any time, except the years of debt crises in Europe and America¹¹. Paleologou (2013) studied the period between 1996 and 2009 for the enlarged European Union (EU) countries, and suggested that the military expenditures had a considerable positive effect on the overall state debts within EU¹².

Defence (Military) Expenditures and Social Expenditures: In the study carried out by Russett (1969) for the United States and for the United Kingdom for the 1939-1968 and 1947-1965 periods respectively, it was suggested that an increase in the military expenditures would result in a reduction of health and educational expenditures¹³. It is suggested by Benoit (1973, 1978) in his study covering the 44 developing countries for the years between 1950 and 1965 that the defense programs of many countries do not only render professional and technical education and training, but also make

6 Selami Sezgin. 'An empirical note on external debt and defence expenditures in Turkey'. *Defence and Peace Economics* 15(2), 2004, pp.199-203.

7 J. Paul Dunne, Sam Perlo-Freeman, and Aylin Soydan. 'Military expenditure and debt in small-industrialised economies, A panel analysis'. *Defence and Peace Economics* 15(2), 2004a, pp.125-132.

8 J. Paul Dunne, Sam Perlo-Freeman, and Aylin Soydan. 'Military expenditure and debt in South America'. *Defence and Peace Economics* 15(2), 2004b, pp.173-187

9 Russell Smyth and Paresh Kumar Narayan. 'A panel data analysis of the military expenditure-external debt nexus, Evidence from six Middle Eastern countries'. *Journal of Peace Research* 46(2), 2009, pp.235-250.

10 Hamid E. Ali. 'Military Expenditures and Inequality in the Middle East and North Africa, A Panel Analysis'. *Defence and Peace Economics* 23 (6), 2012, pp.575-589.

11 W.Robert.J. Alexander, The defence-debt nexus, 'Evidence from the high-income members of NATO'. *Defence and Peace Economics*, 24 (2), 2013, pp.133-145.

12 Suzanna-Maria. Paleologou, 'A Dynamic Panel Data Model For Analyzing The Relationship Between Military Expenditure And Government Debt In The EU'. *Defence and Peace Economics* 24(5), 2013, pp.419-428.

13 Bruce M. Russett. 'Who pays for defence?'. *American Political Science Review* 63(2), 1969, pp.412-426.

concrete contributions to the civil economies by means of rendering a number of medical care services to the local populations. He suggested that this in turn enhances the human capital in the developing countries¹⁴. Ames and Goff (1975) studied 18 Latin America countries for the 1948 to 1968 period, and concluded that the education and defense expenditures concurrently increase and decrease¹⁵. By the way, it was concluded by Peroff and Podolak-Warren (1979) in their study covering the years between 1929 and 1974 for the United States that there was a tradeoff between the private health sector and the defense in terms of the capital investment solely made for the health. They concluded that the personal health expenditures are dependent of the defense burden in economic aspects¹⁶. Russett (1982) searched the 1947-80 years for the Budget of the U.S. Government, and found that there was no systematic trade-off between the military expenditures and the federal health and education expenditures. Furthermore, they argue that there is no significant depressing effect of the military expenditures on the health and education expenditures¹⁷. Deger and Sen (1983) studied 20 Less Developed Countries for the years between 1965 and 1973, and found that the defense expenditures had a negative net effect on the economy¹⁸. Verner J. (1983) found that the budgetary trade-offs between the education and defense was negative only for El Salvador in his study covering 19 Latin American countries for the 1948-79 period. However, he also noticed a positive relationship in ten countries, and an insignificant trade-off in the remaining seven countries¹⁹. Faini et al. (1984) studied the years between 1952 and 1970 for 69 countries, and concluded that an increase in the military expenditures resulted in a lower within the Gross Domestic Product (GDP), and a decrease in the shares of investments assigned for the other fields, and a higher tax burden²⁰. Harriss and Pranowo (1988) studied 12 Asian countries for the years between 1967 and 1982, and found that there was a negative relationship in two countries, a positive relationship in three countries, and no significant relationship in the remaining seven countries in terms of the trade-offs between the defense and education/health expenditures²¹. Palmer (1990) studied the years between 1950 and 1978 for the Western European

14 Emile Benoit. *Defence and economic growth in developing countries*. Boston, MA, Lexington Books, 1973; Emile Benoit. 'Growth and defence in developing countries'. *Economic Development and Cultural Change* 26, 1978, pp. 271-280

15 Ames, Barry., and Ed Goff. 'Education and Defense Expenditure in Latin America, 1948-68'. *Comparative Public Policy, Issues, Theories and Methods*. Edited by Craig Liske, William Loehr and John McCament, pp.175- 198. (New York: John Wiley, 1975).

16 Kathleen Peroff and Margaret Podolak Warren. 'Does Spending on Defence Cut Spending on Health? A Time-Series Analysis of the U.S.Economy 1929-74'. *British Journal of Political Science* 9(1), 1979, pp.21-39.

17 Bruce Russett, 'Defence Expenditures and Well-being'. *American Political Science Review* 76(4), 1982, pp.767-777.

18 Saadet Deger and Somnath Sen. 'Military expenditure, spin-off and economic development'. *Journal of Development Economics* 13, 1983, pp.67-83.

19 Joel G. Verner. 'Budgetary trade-offs between education and defence in Latin America, a research note'. *Journal of Developing Areas* 18(1), 1983, pp.77-92.

20 Faini Riccardo, Patricia Annez and Lance Taylor Source. 'Defense Spending, Economic Structure, and Growth, Evidence among Countries and over Time'. *Economic Development and Cultural Change* 32(3), 1984, pp.487-498

21 Geoffrey Harris, Mark Kelly Pranowo 'Trade-offs Between Defence and Education/Health Expenditures in Developing Countries'. *Journal of Peace Research* 25(2), 1988, pp.165-177

states, and defended that the heavy defense expenditures might result in delay of the development of new welfare and health programs²². Ward and Davis (1992) defended in their study for the United States, covering the years between 1948 and 1996 that there was a tradeoff among the health and education expenditures and such productive investments as the military expenses. Hence, they concluded that the defense expenditures would likely crowd out the educational expenditures and infrastructural development investments, so that the economic growth might be delayed²³. Özmucur (1996) studied the relationship among the health, education and defense expenditures during 1923 to 1994 for Turkey, and found a negative correlation²⁴. A study carried out by Seigle (1997) for the United States, covering the years between 1939 and 1989, revealed that the budgetary deficits underlying the income transfer between different social groups are correlated with the defense expenditures²⁵. Senesen (2001) studied Turkey for the period between 1980 and 1997 to observe the trend of defense expenditures in comparison with the fundamental welfare expenditures (education and health expenditures). She determined some 100% consistency between 1980 and 1986, and a steep decrease for some 50% between 1987 and 1993, followed by a consistency period. The increasing defense expenditures, combined with the decreasing educational expenditures, resulted in an increase in the funds assigned for the defense expenditures in the following years²⁶. Yıldırım and Sezgin (2002) studied Turkey for the 1924-96 period, and concluded that the trade-off was positive between defense and education, while it was negative between defense and health²⁷. Özsoy (2002) studied the 1925 to 1998 years for Turkey, and reported a negative trade-off relationship among the defense, education and health expenditures. He demonstrated a decrease in education and health expenditures against an increase in the education and health expenditures²⁸. Yıldırım et al. (2005) studied the years between 1989 and 1999 for the Middle Eastern countries and Turkey, and pointed out that the defense industry was more productive than the civil industry, probably attributable to the utilization of high technologies, compared to the other economic sectors. They concluded that the defense expenditures did not crowd out the health and education expenditures and the infrastructural development investments²⁹. Kollias and Paleologou (2011) studied Greece for the 1972-2004 and 1990-

22 Palmer, Glenn Alliance Politics and Issue Areas, 'Determinants of Defense Spending'. *American Journal of Political Science* 34(1), 1990, pp.190-211.

23 Ward, Michael D. and Davis, David R. 'Sizing up the peace dividend, economic growth and military spending in the United States, 1948-1996'. *American Political Science Review* 86(3), 1992, pp. 748-755.

24 Suleyman Özmucur. *The Economics of Defence and Peace Dividend in Turkey*. (Istanbul: Bogazici University Printhouse, 1996).

25 Carlos Seigle. 'Deficits, defence, and income distribution'. *CATO Journal* 17(1), 1997. pp.11-18.

26 Gülay Günlük Şenesen. 'Measuring the extent of defence expenditures, The Turkish case with Turkish data'. *Defence and Peace Economics* 12(1), 2001, pp.27-45.

27 Yıldırım Jülide and Sezgin Selami 'Defence, education and health expenditures in Turkey, 1924-1996'. *Journal of Peace Research* 39, 2002, pp.569-580.

28 Özsoy, Onur. 'Budgetary trade-offs between defence, education and health expenditures, the case of Turkey'. *Defence and Peace Economics* 13, 2002, pp. 129-136

29 Yıldırım Jülide, Sezgin Selami, and Öcal Nadir. 'Military Expenditure And Economic Growth In Middle Eastern Countries, A Dynamic Panel Data Analysis'. *Defence and Peace Economics* 16(4), 2005, pp.283-295.

2004 periods, and reported that the findings pointed out a positive trade-off relationship between the education and defense expenditures, and also a positive trade-off relationship between the social and defense expenditures³⁰. Dunne and Nikolaidou (2012) studied the years between 1961 and 2007, and found no positive effect of the military burden on the EU15 economies. They concluded that it had a negative or no effect³¹. Lin et al. (2013) studied 29 OECD countries from 1988 to 2005. The basic finding of this study is that there is a positive trade-off among the military expenditures and the education and health expenditures. This may be attributed to the higher support extended by the OECD countries to the social welfare programs, as the government may increase the health and education expenditures in response to the increase in the military expenditures (e.g. military personnel and conscripts)³².

3. ECONOMETRIC METHODOLOGY AND DATA

The stationarity of the series used in the study was analyzed by Levin, Lin and Chu (LLC) (2002)³³ and Im, Peseran and Shin (IPS) (2003) unit root tests³⁴. Panel Variance Auto-Regression (PVAR) analysis was used to search the Granger-based causality and dynamic relationships between the variables.

3.1. Data

Covering the 1999-2012 period for 31 high income level OECD countries, the study used DEBT as the share of total central government debt in GDP, and EDUC as the share of Public Education Expenditure in GDP, and HEALTH as the share of Public Health Expenditure in GDP, and MILIT as the share of Military Expenditure in GDP, and SUBTR as the share of Subsidies and Other Transfer in GDP, and GDPGR, i.e. Real GDP Growth Rate as the control variable in equations, and INFCPI as the Inflation rate (Consumer Price Index), and TAXREV as the share of Tax Revenue in GDP. The growth rates of variables were used in the equations. Furthermore, the dummy variable used as the CRISIS variable took the value 1 for 2000 and 2008 and the value 0 for the other years. All data were taken from the World Bank World Development Indicators.

30 Kollias Christos and Paleologou Susana-Maria. 'Budgetary trade-offs between defence, education and social spending in Greece'. *Applied Economics Letters* 18(11), 2011, pp.1071-1075

31 Dunne, John Paul and Nikolaidou Eftychia 'Defence Spending And Economic Growth in The EU15', *Defence and Peace Economic* 23(6), 2012, pp.537-548

32 Eric S. Lin, Hamid E. Ali and Yu-Lung Lu. 'Does Military Spending Crowd Out Social Welfare Expenditures? Evidence from a Panel of OECD Countries'. *Defence and Peace Economics*, 2013, Doi, 10.1080/10242694.2013.848576

33 Andrew Levin, Chien-Fu Lin and Chia-Shang James Chu. 'Unit Root Tests in Panel Data, Asymptotic and Finite-Sample Properties'. *Journal of Econometrics* 108, 2002, pp.1-24

34 Kyung So.Im, M. Hashem Pesaran, and Yongcheol Shin. 'Testing for Unit Roots in Heterogeneous Panels', *Journal of Econometrics* 115, 2003, pp.53-74.

3.2. Panel Unit Root Analysis

Irrespective of being the time series or panel data, any variables used in equations need to be stationary. To determine the stationarity of the variables, LLC and IP tests were used. The most basic difference between LLC and IPS tests is the null hypothesis, LLC test assumes that the series is entirely stationary, namely it has a common unit root, but the null hypothesis of IPS test assumes that the series has an individual unit root. On the other hand, another difference is that IPS test has no non-intercept-trend model. The hypotheses in LLC test may be described as follows:

H_0 : Series have a common unit root process ($H_0: \rho_i = \rho = 1$)

H_1 : Series do not have a common unit root process ($H_1: \rho_i < 1$)

Following are the hypotheses for IPS:

H_0 : Series have a individual unit root process ($H_0: \rho_i = 1$)

H_1 : Series do not have a individual unit root process ($H_1: \rho_i < 1$)

For testing the hypotheses, two different models as Intercept and Intercept-trend were formed for the LLC and IPS compatibility, and they were explained on these two models.

$$\Delta y_{it} = \alpha_{0i} + \rho y_{it-1} + \lambda_{it} + u_{it} \tag{1}$$

$$\Delta y_{it} = \alpha_{0i} + \alpha_{1i} t + \rho y_{it-1} + \lambda_{it} + u_{it} \tag{2}$$

y_{it-1} and Δy_{it} show the lag and difference of the variable, of which stationarity would be tested, and t means the trend variable, and λ_{it} means individual and period (time) effects, and Δ means difference parameter, and α_{0i} shows the intercept term, and α_{1i} and ρ show the variable coefficients, while u_{it} indicated the random error terms. It is possible to use these two models for testing the existence of unit root in a series. Considering the test procedure for LLC as the model no. 1, we can examine it as follows.

$$\Delta y_{it} = \rho y_{it-1} + \sum_{L=1}^{p_i} \theta_{iL} \Delta y_{it-L} + \alpha_{mi} d_{mi} + \varepsilon_{it} \tag{3}$$

In the equation (3), the d_{mi} is cross section (individual) dummy variables, the α_{mi} is coefficients of cross section (individual) dummy variables. $L (L=1, \dots, p_i)$ shows the

optimal lag length, θ_L is the variable coefficients, and ε_{it} is random error terms. And for IPS,

$$\Delta y_{it} = \rho_i y_{it-1} + \sum_{L=1}^{p_i} \theta_{iL} \Delta y_{it-L} + \alpha_{mt} d_{mt} + e_{it} \tag{4}$$

Table 1: Panel Unit Root Tests

Testler	LLC Test		IPS Test	
Variables	Intercept	Intercept Trend	Intercept	Intercept Trend
DEBT	-3.72 (2) ^a	-8.35 (1) ^a	-1.64 (2) ^b	-2.11 (1) ^b
EDUC	-10.5 (1) ^a	-8.38 (1) ^a	-5.20 (1) ^a	-0.41 (1)
MILIT	-14.4 (2) ^a	9.87 (1)	-9.57 (2) ^a	-8.07 (1) ^a
SUBTR	-12.8 (0) ^a	-12.6 (0) ^a	-7.83 (0) ^a	-3.24 (0) ^a
HEALTH	-12.8 (1) ^a	-12.4 (1) ^a	-8.17 (1) ^a	-5.08 (1) ^a
GDPGR	-9.6 (2) ^a	-11.9 (1) ^a	-5.62 (2) ^a	-4.87 (1) ^a
INFCPI	-11.0(2) ^a	-14.0 (2) ^a	-8.31(2) ^a	-6.79 (2) ^a
TAXREV	-4.3 (2) ^a	-4.8 (1) ^a	-1.80 (2) ^b	-0.19 (1)

a and b respectively significant at %1 and %5. The values in parentheses are the optimal lag length by Modified Akaike Information Criteria. Newey-West bandwidth selection using Bartlett Kernel.

The panel stationarity test statistics are calculated, and compared with the LLC and IPS table values. If the calculated test statistics are higher than the critical values in the table, the H_0 hypothesis is rejected, and it is decided that the series does not contain a unit root, but is stationary.

It is understood from the Table 1, all the variables have stationary at levels and I(0) for the Intercept and Intercept-trend model. All the variables are found stationary at level, so the variables could be used at the equation.

3.3. Government Debt Equation

The following model would be estimated to determine the effects of independent variables on the total central government debt.

$$DEBT_{it} = \beta_0 + \mu_1 + \beta_1 EDUC_{it} + \beta_2 MILIT_{it} + \beta_3 HEALTH_{it} + \beta_4 SUBTR_{it} + v_{it} \tag{5}$$

Here, DEBT is the dependent variable, while EDUC, MILIT, HEALTH and SUB-TR represent the independent variables, and v_{it} represents the random error. β_0

shows the constant term, μ_i is the individual effect, and $\beta_1 \beta_2 \beta_3 \beta_4$ are variable coefficients, and the i individual or cross section indices represent the countries. $i = 1, 2, \dots, N$ ve $N=31$ and t represent the period or time index $t = 1, 2, \dots, T$, and $T = 13$. However, the GDPGR, INFCPI and TAXREV were added as the control variables into the equation.

The Redundant Fixed Effect and Hausman Test were used to select which one of the Pooled Ordinary Least Square (POLS), fixed and random effects models would be used to estimate the equation. The Fixed Effect model may usually be estimated by the Within Estimator or Least Square Dummy Variables (LSDV) method, and the Random Effect model by the Generalized Least Square (GLS) method. The Redundant Fixed Effect Test is also known as the F test, and used to determine if the model has an individual effect.

$$F = \frac{(R^2_{within} - R^2_{pooled}) / (N - 1)}{(1 - R^2_{within}) / (N(T - 1) - K)} \tag{6}$$

Table 2: RFE and Hausman Tests for Cross Section Effect

	Pooled OLS vs Fixed Effect	Random Effect vs Fixed Effect
RFE (F Test)	3.27a	-----
Hausman Test	-----	41.9a

a significant in 1%

In the F statistic calculation; R^2_{within} is the determination coefficient of the fixed effect model estimated by the Within Estimator, and R^2_{pooled} is the determination coefficient estimated by POLS, while N is the number of individual (cross-section), T is number of time period and K is the number of coefficients in model. According to the RFE test result, H_0 is rejected, pointing out that the equation (5) involves individual effects, namely contains a different constant term for every country, and dictates that the fixed effect model is to be preferred to POLS.

In Hausman (1978) test, the random effects model, of which H_0 hypothesis has been estimated with GLS, is based on an alternative hypothesis with the Within estimator, representing the fixed effects model³⁵.

$$W = (\hat{\beta}_{within} - \hat{\beta}_{GLS})' [Var(\hat{\beta}_{within}) - Var(\hat{\beta}_{GLS})]^{-1} (\hat{\beta}_{within} - \hat{\beta}_{GLS}) \tag{7}$$

Here, W is the test statistic, $\hat{\beta}_{within}$ is the coefficient matrix obtained by a fixed effects model with within estimator, $\hat{\beta}_{GLS}$ is the coefficient matrix obtained by ran-

35 J.A. Hausman. 'Specification Tests in Econometrics'. *Econometrica* 46 (6),1978, pp.1251–1271

dom effects model with GLS, $Var(\hat{\beta}_{Within})$ the variance-covariance matrix obtained by a fixed effects model and $Var(\hat{\beta}_{GLS})$ the variance-covariance matrix obtained by a random effects model. According to the result of Hausman test, is rejected, so that it is decided to use a fixed effects model estimated with the Within estimator. The equation (5) has been estimated with the fixed effects method, and the following table summarizes the results.

Table 3: High Income OECD Countries Fixed Effects Models

Variables	Coefficient	t Stat.
EDUC	0.45 ^a	2.86
MILIT	0.22 ^c	1.96
HEALTH	-0.4127 ^a	-4.85
SUBTR	-0.02	-0.27
GDPGR	-0.02 ^a	-6.66
INFCPI	-0.02 ^a	-2.82
TAXREV	-0.01 ^b	-2.23
CRISIS	0.05 ^a	2.77
Constant	0.39 ^a	3.32
R²	0.53	Baltagi-Wu LBI 2.10
F_{stat}	7.40 ^a	Bhargava et al. DW 1.92
DW	2.16	Modified Wald 5793^a

a and b significant in respectively 1% and 5%. Arellano (1987) and Rogers (1993) corrected robust standard errors and covariance.

As the equation (5) is estimated by adding a control variable, the simultaneous relationships between the independent and dependent variables are determined. The results obtained from the equation (5) reveal that the GDP Growth, Inflation and Tax Revenue have negative and statistically significant effects on the central government debt, and one may claim that an increase in such variables results in the DEBT's reduction. It has been observed that the crisis periods have a positive effect on DEBT, which may be so expressed that the government debt would increase in the crisis period. While the increases in education and military (defense) expenditures positively affect the debt, the health expenditures are negatively affected. If this effects is negative, it may be interpreted that the debt is reduced with the increase of human productivity, production and revenues as a result of the increase in health expenditures.

No significant effect on DEBT could be determined upon an increase in the subsidies and transfer expenditures. Bhargava et al. (1982), considering the DW table values, it is impossible to reject a null hypothesis expressing that there is no autocorrelation as the lower bound is dPL = 1.8164, and the upper bound is dPU = 1.8945 in case of N=50, T=10 and K=9, hence no auto correlation problem exists in the equation.

However, according to the Modified Wald test proposed by Greene (2000), the null hypothesis has been rejected, and there is a problem of heteroscedasticity in the equation. For this reason, a correction has been made to allow using the robust standard errors and covariance in case of autocorrelation and heretoscedasticity proposed by Arellano (1987) and Rogers (1993).

As the inter-variable simultaneous relationships are obtained by estimating the equity (5), the PVAR method was used to search the dynamic and causality relationships.

3.4. PVAR Analysis

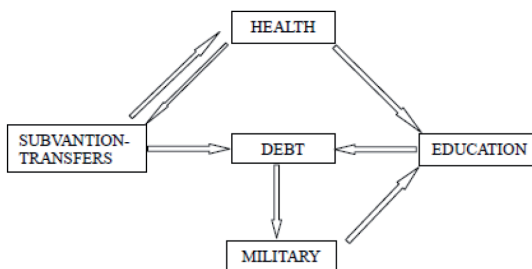
The PVAR model may be used to determine the inter-variable dynamic and causality relationships. Assuming that each variable is endogenous, and each variable sequentially becomes the dependent variable, it is regressed on the lagged values of the other variables. For instance, a PVAR analysis with two variables can be expressed as follows.

$$Y_{it} = \beta_0 + \sum_{j=1}^m \beta_j Y_{it-j} + \sum_{j=1}^m \alpha_j X_{it-j} + \gamma\mu_i + u_{it} \tag{8}$$

$$X_{it} = \delta_0 + \sum_{j=1}^m \delta_j X_{it-j} + \sum_{j=1}^m \theta_j Y_{it-j} + \gamma\mu_i + \varepsilon_{it} \tag{9}$$

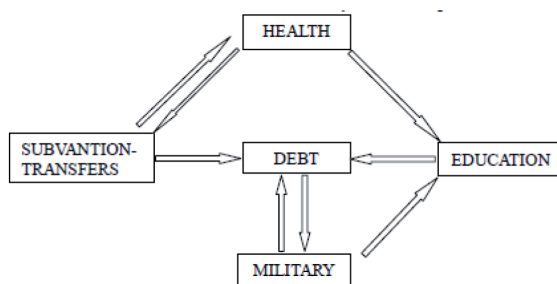
Here, Y and X are variables, and μ_i is the individual effect, β_0 and δ_0 are the constant terms, β_j and δ_j are variable coefficients, m is the length of lag, and u_{it} and ε_{it} are the error terms. RFE and Hausman (1978) tests were used to search if there are individual effects on the equations, and it has been understood that no equation has an individual effect in the PVAR system. Hence, the PVAR system has been estimated with POLS. In PVAR system, the optimal lag length has been found to be 1 with the Akaike and Final Prediction Error (FPE) information criterion. The following table shows the Granger causality relationships obtained at 5% significance level through the PVAR system.

Figure 1: PVAR-POLS Causality Relationships



In this context, a bidirectional causality relationship has been determined between the subsidies and transfer expenditures and health expenditures. An increase in subsidies and transfer expenditures results in the improvement and sustainability of a higher welfare and improved human life standards, so that the health expenditures may be reduced. This negative relationship could be seen even through the impulse response analysis. An increase in the health expenditures creates a decreasing effect, so that the subsidies and transfer charges could change as well. There is a causality relationship from the health expenditures towards the educational expenditures. This relationship has been defined as positive the impulse response analysis, and it may be interpreted as the effect of increased productivity. Furthermore, one may claim that the health and education investments are interrelated, and such investments are concurrently realized in the welfare periods. An increase in the military expenditures may create a decreasing effect on the educational expenditures. However, any increase in such items of expenditure as the subsidies, transfer expenditures and educational expenditures may create such consequences that may increase the external debt. Consequentially, the increased debts may result in saving in the defense expenditures, and a reduction in the defense budgets. As the lagged values of the dependent variables take place as the independent variables in the equation, there is possibility to experience the endogeneity and hence bias problem. For this reason, the PVAR model has been re-estimated through Arellano and Bond (1991) dynamic panel data GMM method, and the causality relationships have been redefined. The below figure shows the results obtained at 5% significance level.

Figure 2: PVAR-GMM Causality Relationships

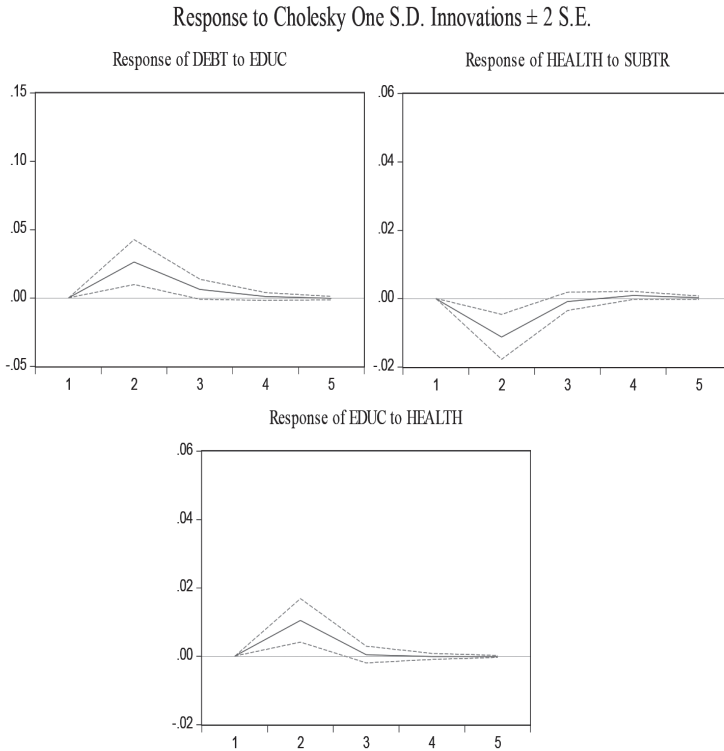


Though almost the same causality relationships are reached for the PVAR results estimated with GMM and those estimated with POLS, the sole difference is the appearance of a causality relationship from the military expenditures towards the debt. One may say that when the military expenditures as an expenditure item increase, the external indebtedness would increase as well.

The Panel Impulse response analysis based on the PVAR analysis has been carried out for five terms, and the statistically significant results are summarized in the form of charts as follows. The impulse response analysis expresses the response of

another variable to an innovation of one standard deviation occurring in a variable, and the time dependent change of the same response.

Figure 3: Impulse-Response Analysis



When one examines the results of the impulse response analysis, it seems to be in compatibility with the causality relationships obtained by PVAR. Against a shock occurring in the subsidies and transfer expenses, the health expenditures response by reduction, and the same reaction goes on for three terms. An innovation in the health expenditures results in the increase of educational expenditures, and the government debt reacts by increase to any shock experienced in the educational expenditures, and the same reaction also goes on for three terms.

4. CONCLUSION

The enhanced level of national income, and the social expenditures incurred for the development and improvement of human capital have come with an elongation of the human life induced by the levels of economic development thanks to the in-

creased use of technologies in such fields as medicine, communication, transportation, etc. The increasing population also needs increasing the education, health, subvention and transfer expenditures. However, the increase of the defense expenditures as from 9/11/2001 has results in transferring some part of the resources to the defense expenditures, as otherwise it would be possible to reserve such transferred resources for the public expenditures, social security programs, etc. The public expenditures increasing in both the military and social fields would be met by substituting each other or by means of increasing the public revenues and hence the increase of the public expenditures, or through borrowing, depending on their degree of importance. This study has used the dynamic panel data methods to elaborate if the military, educational and medical expenditures, subsidies and other transfer expenditures have an effect on the central government debts in the group of high income OECD countries, and if there are causality relationships among the expenditure variables.

The stationarity of variables was studied through LLC and IPS tests, and all the variables are stationary at level. The debt equation was used to study the simultaneous effect of the variables of education, health, military, subsidies and transfer expenditures on the central government debts. One may say that the GDP Growth, Inflation and Tax Revenue coefficients are negative and statistically significant, and any increase in such variables causes the decrease in DEBT. The crisis terms were found to have an effect to increase the government debt. While the increases in education and military (defense) expenditures have a positive effect on the debt, the health expenditures negatively affects on the government debt. When this effect is negative, it may be such interpreted that the debt is reduced in parallel with the increasing human productivity, production and income as a result of the increased health expenditures. An increase in the subsidies and transfer expenditures could not be found to have no significant effect on DEBT. According to the PVAR results estimated by GMM, a bidirectional relationship has been determined among the subsidies and transfer expenditures and the health expenditures. The increase of subsidies and transfer expenditures results in improvement and sustainability of the welfare level and humanistic life level, whereby the health expenditures are reduced. This negative relationship could be seen even in the impulse response analysis. An increase in the health expenditures may create a decreasing effect, which in turn change the subsidies and transfer expenditures. There is a causality relationship from the health expenditures towards the educational expenditures. The impulse response analysis has defined this relation as positive, and it may be interpreted as the effect of productivity increase. Furthermore, one may claim that the health and education investments are interrelated, and such investments are concurrently realized in the welfare periods.

Furthermore, a causality relation has been determined from the military expenditures towards the educational ones. An increase in the military expenditures may create a decreasing effect on the educational expenditures. However, a number of causality relationships have been found towards the debt from the military, the subsidies and transfer, and the educational expenditures. The increases in expenditure

items may result in increasing the external indebtedness. This is in compatibility with, and may be seen from the impulse response analysis. Finally, the increased debt may come with saving in the defense expenditures, and a reduction in the defense budgets. When one examines the results of the impulse response analysis, they are found in compatibility with the causality relationships obtained through PVAR.

In consequence, considering any possible effects on the human capital and productivity by the reduction of foreign dependency in the educational and military expenditures, and decrease of the military expenditures of low productivity and low effect of technological expansion, and an increase in the subsidies, transfer and health expenses, one may recommend diminishing only the extravagant health and social expenditures.

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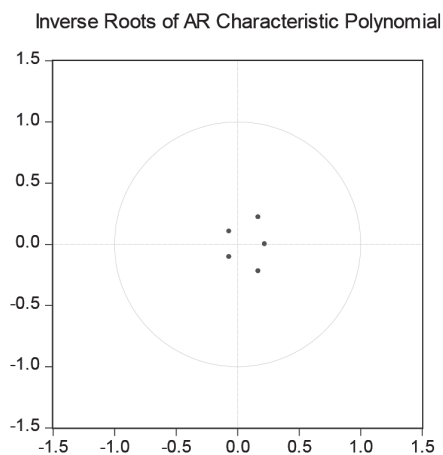
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APPENDIX 1

VAR Lag Order Selection Criteria

Lag	FPE	AIC
0	8.12e-12	-11.34687
1	6.89e-12*	-11.51187*
2	7.09e-12	-11.48621
3	9.11e-12	-11.24008
4	9.69e-12	-11.18875
5	8.57e-12	-11.32867



Roots of Characteristic Polynomial

Root	Modulus
0.169192 - 0.220062i	0.277585
0.169192 + 0.220062i	0.277585
0.221036	0.221036
-0.067711 - 0.105141i	0.125057
-0.067711 + 0.105141i	0.125057

No root lies outside the unit circle.
 VAR satisfies the stability condition.