THE VALIDITY OF EFFICIENCY AND COMPENSATION HYPOTHESIS FOR G7 COUNTRIES

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Abstract
National economies tend to protect individuals from external risks that depend mostly as a result of globalization of the trade. There is question that needs an answer at that point; the increase in the government expenditures is a result of the fact that increasing population or the compensation hypothesis? In order to answer that question, openness ration, government expenditures, gross domestic product per capita and population will be analyzed in order for G7 using panel data for the period 1980-2015. The empirical test will check the validity of the compensation and efficiency hypothesis. According to test results, only in Japan and Canada compensation hypothesis is valid for the selected period. On the other hand, the increase in the government expenses has no causality relation with the increase in the population.

Keywords: *Compensation Hypothesis, Efficiency Hypothesis, Co-integration, Causality*

JEL Classification: C12, H30, H53

I. INTRODUCTION

The increase in globalization in trade resulted as a change in the risk perception of the individuals in terms of economics. That possible changes in the economic environment forced governments to compensate the possible risks by increasing government expenditures. That policy is questioned a lot in the economics literature; if such policies are efficient or not. Rodrik (1998) argues that trade openness makes economies weaker in terms of external shocks. In order to decrease the effects of such external shocks, governments tend to protect their residents, and to do so governments increase the government share in the economy. In that aspect, it is also critical if that policy works the same in both rich and poor economies. On the other hand, the government size not only enlarges because such policies, but also the population increase might have an effect on the government size. We will investigate the validity of the compensation and efficiency hypothesis for G7 countries. Secondly we will try to find out if the government size depends on population or not. If the developed countries follow the mentioned hypothesis, it might be a good guide for the developing countries. In the first part the economic literature on compensation and efficiency hypothesis will be summarized then the methodology that will be followed will be introduced in the second part. Finally in the last part the empirical results will be commented.

II. THEORETICAL BACKGROUND AND LITERATURE REVIEW

The optimum government size at the beginning considered by Cameron (1978) and lately Ruggie (1982) named it "Compensation Hypothesis". Alesina and Waxziarg, (1998) and also Rodrik (1998) empirically tested the theory. In Rodrik's (1998) model "gs" as government size, "to" trade openness, b_0 and b_1 are constant and the slope parameters respectively and finally ε_t error term with normal distribution and together in the regression;

$$gs_t = b_0 + b_1 to + \varepsilon_t \qquad (1)$$

b_1 is the term that approves the hypothesis that the increase in trade openness will also increase government size. Rodrik's (1998) empirical test also leaded Garret and Mitchell (2001), Islam (2004), Molana et al. (2004), Cavallo (2007) to test the hypothesis. Most studies examined the hypothesis with the current econometric methodology. Benarroch and Pandley (2008, 2012), Ram (2009), Liberati (2007), Garen and Trask

2005) employed panel data analysis, Shahbaz et al. (2010), Islam (2004) employed time series analysis whereas Rodrik (1998) and Cameron (1978) employed simple correlation analysis. The most popular variable in all analysis; trade openness is gathered in a way that all literature agrees; the sum of import and export divided by GDP. On the other hand the optimum government size is a subject that the literature can not agree. Alesina and Waxziarg, (1998), Benarroch and Pandley (2008, 2012), Shelton (2007) offered different ratios for the government size. To start with the definititon; firstly Cameron (1978) offered the total tax revenue/GDP in order to measure the government size. The time period in the study was from 1960 to 1975 for 18 countries and for the selected period a positive correlation was proved. A second approach for government size is the total government expenditure/GDP that is used by Alesina and Waxziarg (1998). Alesina and Waxziarg (1998) the reason for the high government expenditure in the less developed economies is the trial of the government to adapt the world economy. This is also an explanation for the developed economies to have small ratios of government expenditure. Rodrik (1998) on the other hand, argues that when the trade openness increases, economies integrates to the global economy and is more possibly to have an external shock. Further, in order to avoid the external shock effects, government expenditures tends to increase. That brings the question if that argument of Rodrik (1998) is valid only in less developed countries or also in developed countries? Empirical analysis differs according to the income levels of the countries. Shelton (2007) for the period from 1970 to 2000 for 100 countries and Ram (2009) for the period 1960-2000 for 154 countries, both employed panel data analysis, could not offer a significant relation from government expenditures to trade openness. Moreover Benarroch and Pandley (2012), for less developed economies education expenditures of the governments results trade openness. Benarroch and Pandley (2012) also investigate the social security expenses in the same analysis but cannot suggest a significant relation. On the other hand, for developed countries, Islam (2004) focused on developed countries and for United States of America and Canada, when the trade openness increases in these economies, they become more sensitive to external shocks. In order to compensate such possible external shocks, government ratio increases in the economy. On the other hand, for Australia, England, Norway and Sweden there is no evidence to support such relations. Also Cameron (1978), Rodrik (1998), Shahbaz et al. (2010), Petrou (2004) agrees on the positive correlation between government size and trade openness. Liberati (2007), Ram (2009) on the other hand, suggests negative correlation for the mentioned variables according to their analysis.

III. METHODOLOGY

2.1.Cross-section Dependency and Homogeneity

In order to check Cross-section denpendency Lagrange Multiplier (LM) developed by Breusch and Pagan (1980) is employed. i=1,2,…,N cross-section size, t=1,2,…,T time period, α_i and β_i constant term and slope parameters respectively, x_{it} on the other hand kx1 descriptive variable vector; and the panel model;

$$y_{it} = \alpha_i + \beta_i' x_{it} + \varepsilon_{it} \qquad (2)$$

Under the hypothesis there is no cross-section dependency [$H_0 : Cov(\varepsilon_{it}, \varepsilon_{jt}) = 0$] LM test statistics;

$$LM = T\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}^2 \sim \chi^2_{N(N-1)/2} \qquad (3)$$

In the model, $\hat{\rho}_{ij}^2$ is the sample estimate of the pair-wise correlation of the residuals from individual ordinary least squares (OLS) estimation of the Equation (1) for each i. Apart from that, Peseran (2004) offers a new LM test statistics for the size distortions cases where N is big and T is small. After modifying T→∞ and N→∞ the LM statistics;

$$CD = \sqrt{\left(\frac{2T}{N(N-1)}\right)}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}\right) \sim N(0,1) \qquad (4)$$

In the statistics above, CD has zero mean for fixed T and N. Moreover it is robust to heterogeneous dynamic models including multiple breaks in slope coefficients and/or error variances. In other words as long as the unconditional means of the dependent and independent variables are time-invariant and their innovations having symmetric distributions. Another key point here the mean of the Pair-wise correlations. Because it is not zero, Peseran et al., (2008, PUY hereafter) calculates bias-adjusted LM test statistics for large panels;

$$LM_{adj} = \sqrt{\left(\frac{2}{N(N-1)}\right)}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}\,\frac{(T-k)\hat{\rho}_{ij}^2 - \mu_{Tij}}{\sqrt{v_{Tij}^2}} \sim N(0,1) \qquad (5)$$

k is the number of variables, μ_{Tij} exact mean and v_{Tij}^2 exact variance of $(T-k)\hat{\rho}_{ij}^2-\mu_{Tij}$. In the panel data analysis, cross section dependency is first tested to make unit root test. If there is no cross-section dependency, 1st Generation unit Root tests will be applied, where as if there is a cross-section dependency, 2nd Generation Unit Root Tests will be applied. Panel data analysis uses Peseran (2004) CD_{LM} , Breusch-Pagan (1980) CD_{LM1}, Peseran (2004) CD_{LM2} tests to test cross section dependency. CD_{LM1} ve CD_{LM2} are used if the time dimension is greater than horizontal dimension. (T>N). CD_{LM} test is used where cross level is bigger than the time level (N>T). In order to test the slope parameter homogeneity Peseran and Yamagata (2008) evaluated $\tilde{\Delta}$ delta test. Null hypothesis of the test argues that for each "i" the homogeneity is defined as; [$H_0:\beta_i=\beta$].[1]

2.2.Cross-Sectionally Augmented Dickey–Fuller (CADF) Unit Root Test

In order to evaluate the ADF test regression, Pesaran (2007) adds cross-section averages of lagged levels and first-differences of the individual series. The regression that is cross-sectional augmented is named CADF and is formulated as below;

$$\Delta y_{it}=\alpha_i+\rho_i y_{i,t-1}+d_0\bar{y}_{t-1}+\sum_{j=0}^{p}d_{j+1}\Delta y_{t-j}+\sum_{k=1}^{p}c_k\Delta y_{i,t-k}+\varepsilon_{it} \quad (6)$$

Where Δy_t is the average at time t of all N observations. In order to calculate lag orders, Schwarz information criteria are employed. CIPS test statistics is the average of the CADF statistics that is calculated for all countries in the model.

2.3.Panel Cointegration and Causality

In order to see the long term correlation between the variables, the co-integration test developed by Westerlund (2007) will be employed. In the Panel vector auto regression model, $\phi_{1i}\hat{\varepsilon}_{it-1}$ term stands for error correction coefficient;

$$\Delta gs=\delta_{1i}+\sum_{p=1}^{k}\delta_{11ip}\Delta gs_{it-p}+\sum_{p=1}^{k}\delta_{12ip}\Delta to_{it-p}+\sum_{p=1}^{k}\delta_{13ip}\Delta gdp_{it-p}+ \sum_{p=1}^{k}\delta_{14ip}\Delta pop_{it-p}+\phi_{1i}\hat{\varepsilon}_{it-1}+v_{1it} \quad (7)$$

From that model, 4 different alternative regressions will be gathered for each independent variable. In that asymptotic model, the critical values are calculated via bootstrap method, in order to consider the cross section dependency. Null hypothesis is designed as there is no co-integration. Long and short term causality tests are calculated by adding the error correction coefficient in the VAR model. In order to check efficiency or compensation hypothesis in the panel co-integration model, the null hypothesis designed for the short run is $\sum_{p=1}^{k}\delta_{12ip}\Delta to_{it-p}=0$ and for the long run $\phi_{1i}\hat{\varepsilon}_{it-1}=0$ and the null hypothesis argues that there is no granger causality. Emirmahmutoğlu and Köse (2011) find out causality for each "i" value on Fisher test statistics by using bootstrap method. In the test firstly unit root test is employed ($dmax_i$) and for each i value lag length is determined according to the alternative information criteria. For every i;

$$gs_{i,t}=\alpha_{i,t}=\sum_{j=1}^{k_i+d\max_i}\beta_{ij}gs_{i,t-j}+\sum_{j=1}^{k_i+d\max_i}\gamma_{ij}to_{i,t-j}+\varepsilon_{it} \quad (8)$$

For the regression above, the error terms will be identified. As mentioned before, the null hypothesis is there is no causality [$H_0:\gamma_{i1}=\gamma_{i2}=...=\gamma_{ik_i}=0$]. Lately, the critical values will be determined for the error terms via bootstrap method.[2]

IV. EMPIRICAL RESULTS

In this Panel Data analysis, the popular G7 countries, USA, Japan, Germany, United Kingdom, France, Italy and Canada will be analyzed for 1980-2015 period. The variable analyzed for each country will be government size (GS), trade openness (TO), gross domestic product (GDP) and population growth (POP). Even literature has some other definitions, to determine the size of the government Alesina and Waxziarg (1998) will be followed and for government size government expenditure/GDP ratio will be accepted. For trade openness the

[1] Please check Peseran and Yamagata (2008) for test statistics.
[2] For bootstrap statistics please check Emirmahmutoğlu and Köse (2011).

sum of export and import will be considered and their ratio to GDP will be represented in the model. One of the reasons that the government expenditures has a high ratio in the GDP is the structure of the expenditures that it has scale economies and the fewer population in the countries. Based on this reality, Rodrik (1998), Ram (2009) and Liberati (2006) will be followed and population increase will also be included in the model. While investigating the compensation and efficiency hypothesis, another detail in the analysis that we will follow Garret and Mitchell (2001), Shelton (2007) and Gemmell et. al. (2008) is to exclude the details such as tax discounts and social expenses and the relation between trade openness and government expenses will be investigated basically. Data for the variables are obtained from World Bank Statistics. In the analysis, cross section dependency, unit root, co-integration and causality tests will be applied respectively. For the cross section dependency hypothesis, null hypothesis suggests there is no dependency and alternative hypothesis accepts the dependency.

Table 1: Cross Section Dependence Test Results

Constant	TO	GS	GDP	POP
	Statistic	Statistic	Statistic	Statistic
CD_{lm} (BP,1980)	150.82 (0.00)***	80.35 (0.00)***	130.32 (0.00)***	95.23 (0.00)***
CD_{lm} (Pesaran, 2004)	20.03 (0.00)***	9.15 (0.00)***	16.86 (0.00)***	11.45 (0.00)***
CD (Pesaran, 2004)	-4.16 (0.00)***	-4.17 (0.00)***	-4.08 (0.00)***	-3.91 (0.00)***
LM_{adj} (PUY, 2008)	29.09 (0.00)***	1.40 (0.00)***	12.39 (0.00)***	11.46 (0.00)***
Homogeneity tests				
Regression Model: $gs_{it} = \alpha_i + \beta_{1i} to_{it} + \beta_{2i} gdp_{it} + \beta_{3i} pop_{it} + \varepsilon_{it}$			Statistic	
$\tilde{\Delta}$			16.529 (0.00)	
$\tilde{\Delta}_{adj}$			17.865 (0.00)	

Notes: For model $\Delta y_{i,t} = d_i + \delta_i y_{i,t-1} + \sum_{j=1}^{p_i} \lambda_{i,j} \Delta y_{i,t-j} + u_{i,t}$, lag order ($p_i$) is considered as 1. The values in the parenthesis represent the probability ratios. The figures which is ***, **, * show 1 %, 5 % and 10 % levels, respectively.

If the probability ratios followed, co-integration methods that consider cross section dependency and heterogenic methods should be used. The second generation unit root tests will be applied cross-sectionally Augmented Dickey-Fuller (CADF), which can be tested individually for each country to see if the variables are stationary and the time dimension is larger than the horizontal dimension (T> N). In CADF test, the null hypothesis suggests the series have unit roots and the alternative hypothesis suggest there is no unit root. If CADF test statistics has a lower value compared to the critical value, that series will be accepted as stationary. On the other hand, if the for the opposite scenario, null hypothesis is accepted that the series is not stationary.

Table 2: CADF Unit Root Test Results

	Constant		Constant and Trend			Constant		Constant and Trend	
	Lags	CADF-stat	Lags	CADF-stat		Lags	CADF-stat	Lags	CADF-stat
TO					**GDP**				
USA	1	-4.95***	1	-5.48***	USA	4	-9.83***	4	-9.18***
Japan	1	-3.60**	1	-3.92**	Japan	1	-4.06**	2	-3.46**
Germany	1	-3.29*	1	-3.96**	Germany	1	-4.39***	1	-4.33**
United Kingdom	1	-3.73**	1	-4.11**	United Kingdom	1	-3.86**	1	-4.60**
France	1	-3.71**	1	-4.49**	France	1	-4.16***	1	-4.79***
Italy	1	-2.89	1	-2.97*	Italy	1	-4.22***	1	-4.12**
Canada	1	-3.81**	1	-3.61*	Canada	1	-3.68**	1	-4.11**
Panel CIPS		-3.71***		-4.08***	Panel CIPS		-4.88***		-4.94***

GS					POP				
USA	1	-6.00***	1	-6.08***	USA	1	-3.95**	1	-3.95**
Japan	1	-4.05**	1	-4.53**	Japan	1	-4.42***	1	-4.43**
Germany	1	-3.62**	1	-4.08**	Germany	1	-4.43***	1	-4.32**
United Kingdom	1	-4.87***	1	-4.79***	United Kingdom	2	-4.16***	2	-4.61**
France	1	-4.26***	1	-4.37**	France	1	-5.09***	1	-4.96***
Italy	1	-3.90**	1	-4.55**	Italy	1	-4.80***	1	-4.84***
Canada	1	-5.25***	1	-5.52***	Canada	1	-4.15***	1	-4.11**
Panel CIPS		-4.56***		-4.84***	Panel CIPS		-4.43***		-4.46***

Notes: Maximum lag length is considered 4 and the optimal lag length is determined according to Schwarz information criteria. For CADF statistics, the critical values for the constant model -4.11 (%1), -3.36 (%5) and -2.97 (%10) (Pesaran 2007, table I(b), p:275) ; constant and trend model -4.67 (%1), -3.87 (%5) and -3.49 (%10) (Pesaran 2007, table I(c), p:276). For Panel statistics critical values are; constant model -2.57 (%1), -2.33 (%5) and -2.21 (%10) (Pesaran 2007, table II(b), p:280) ; constant and trend model -3.10 (%1), -2.86 (%5) and -2.73 (%10) (Pesaran 2007, table II(c), p:281). Panel statistics are the average values of CADF statistics. The figures which is ***, **, * show 1 %, 5 % and 10 % levels, respectively.

According to the calculated CIPS statistics, the values are bigger than the critical values. That means the alternative hypothesis is accepted. Those results suggest for all panel series there is no unit roots in the level.

Table 3. Panel Co-Integration Test Results that Considers Cross Section Dependency

	Constant			Constant and Trend		
Error Correction	Statistic	Asymptotic p-value	Bootstrap p-value	Statistic	Asymptotic p-value	Bootstrap p-value
Group_tau	-8.410	0.00***	0.00***	-9.532	0.00***	0.00***
Group_alpha	-7.513	0.00***	0.00***	-4.515	0.00***	0.00***
Panel_tau	-7.374	0.00***	0.00***	-8.318	0.00***	0.00***
Panel_alfa	-9.839	0.00***	0.00***	-5.803	0.00***	0.00***

Notes: Null hypothesis is designed as there is no co-integration. Lag length is considered as one for Error Correction test. Bootstrap probability ratio is figured from 1.000 repeated distribution. The Asymptotic probability ratios are gathered from standard normal distribution. The figures which is ***, **, * show 1 %, 5 % and 10 % levels, respectively

When the probability values considered, for both asymptotic and bootstrap test results the alternative hypothesis is accepted, that approves the co-integration between the variables. It is possible to run the causality test upon the co-integration model. Table 4 represents the short run and long run causality test results.

Table 4. Panel VECM Causality Test Results

	Short Run Causality				**Long-run causality**
	Δ (GS)	Δ (TO)	Δ (GDP)	Δ (POP)	ECT(-1)
Δ (GS)	-	3.836 (0.14)	3.938 (0.13)	0.230 (0.89)	-0.570 (0.08)*
Δ (TO)	4.246 (0.11)	-	8.836 (0.01)**	1.100 (0.57)	-0.007 (0.00)***
Δ (GDP)	6.933 (0.03)**	11.164 (0.00)***	-	1.643 (0.43)	-0.005 (0.00)***
Δ (POP)	0.355 (0.83)	1.210 (0.54)	1.771 (0.41)	-	0.006 (0.01)**

Notes: The figures which is ***, **, * show 1 %, 5 % and 10 % levels, respectively

In the short run there are two significant causalities. First one is from GDP to government size and the other one is from again GDP to trade openness. Second causality is bi-directional, that means there is causality from trade openness to GDP. According to Cameron (1978) countries with higher trade openness has a higher industrial concentration. That high industrial concentration makes it necessary to find new markets, and that results in a high export. On the other hand, the theoretical facts that import is a function of the income, imports are also high in such countries. The test result supports the idea that growth is panel countries depends on the export. The error correction term is statistically significant so in the long term the causality from reject all variables on government size. Rodrik (1998) has evidences for the effects globalization on the economies. Globalization results as higher mobility of the production factors and the demand elasticity for production factors increase. That situation has a positive effect on real wages; they increase upon efficiency shocks in the national economy. Moreover the countries that are globally linked have a higher density to feel the external shocks on trade. For the country based results, we will follow Table 5 to see more details.

Table 5. Emirmahmutoğlu and Köse (2011) Panel Causality Test Results

Country	Lag	TO≠>GS	Lag	GDP≠>GS	Lag	POP≠>GS
USA	1	0.628 (0.427)	3	29.130 (0.00)***	2	0.766 (0.681)
Japan	2	6.518 (0.038)**	2	0.398 (0.819)	1	0.264 (0.607)
Germany	1	0.023 (0.877)	2	0.136 (0.934)	3	2.450 (0.484)
United Kingdom	1	0.052(0.819)	1	0.383 (0.535)	3	1.359 (0.715)
France	3	0.798 (0.849)	3	3.956 (0.266)	3	4.949 (0.175)
Italy	1	0.165 (0.684)	1	0.464 (0.495)	3	1.153 (0.764)
Canada	3	14.426 (0.00)***	2	2.444 (0.294)	1	2.258 (0.132)
Fisher Stat.		**35.646 (0.00)*** **		**34.424 (0.00)*** **		**11.939 (0.611)**
Country	**Lag**	**GS≠>TO**	**Lag**	**GS≠>GDP**	**Lag**	**GS≠>POP**
USA	1	1.019 (0.312)	3	0.165 (0.983)	2	0.029 (0.985)
Japan	2	10.250 (0.00)***	2	5.857 (0.053)*	1	0.001 (0.967)
Germany	1	2.103 (0.146)	2	1.020 (0.600)	3	1.383 (0.709)
United Kingdom	1	0.00 (0.986)	1	0.248 (0.618)	3	5.148 (0.161)
France	3	5.155 (0.160)	3	2.325 (0.507)	3	2.678 (0.443)
Italy	1	2.079 (0.149)	1	1.257 (0.262)	3	1.919 (0.589)
Canada	3	14.070 (0.00)***	2	3.437 (0.179)	1	1.081 (0.298)
Fisher Stat.		**22.042 (0.077)***		**15.345 (0.354)**		**9.535 (0.795)**

Notes: The figures which is ***, **, * show 1 %, 5 % and 10 % levels, respectively

Emirmahmutoğlu and Köse (2011) causality test results suggest a causality from trade openness to government size for the countries Japan and Canada. According to Rodrik (1980) the trade openness will create an unsecure environment due to the trade volatility and product mass. In that parallel, the results are concluded as; the governments increase the government expenses in order to protect individuals. On the other hand, Japan and Canada that has comparatively small rate of trade volume compared to other countries in the panel seems to increase the government expenses in order to benefit scale economies. Garret (1995) has an alternative explanation for this situation; globalization increases the political tendencies of individuals and that cause governments to increase the government expenditures. Another important fact, the developed countries represented by G7 countries has usual reflexes on the external risks. Developing countries on the other hand over react to external shocks namely the nominal exchange rate shocks. According to test results, for countries other than Japan and Canada there is no causality. According to Garren and Trask (2005) and also Liberati (2007); with the integration of the national economy to the world economy, the efficiencies and the importance of the national policies are decreasing. That situation will result as a pressure on government to decrease the government size in the economy. Test results also show that only in USA the reason for the government expenditures is the economic growth. It is also remarkable that, population has no significant role in the panel economies. That mostly depends on the fact that, in all panel countries the population is getting older and has no dynamic effect in the economy.

V. RESULTS

Comparatively the new subjects in the literature, the compensation and the efficiency hypothesis are tested for G7 countries with respect to variables openness ratio, government expenses, GDP and population growth rate. The period covers from 1980 to 2015. After the cross-section dependency test, proper unit root, co-integration and causality tests are applied. Unit root test developed by Pesaran (2007) rejects the existence of unit root for the variables in the level. On the other hand, Westerlund(2007) co-integration test results shows that the variables move together in the long term. The significant error correction constant in the co-integration model explains the significant effects of openness ratio, GDP and population change on government size. According to the causality test developed by Emirmahmutoğlu and Köse (2011), there is a bi-directional causality relation from openness ration to the government size. According to the test results, only in Japan and Canada the compensation hypothesis is valid, that means, the government increases the expenditures parallel to openness ratio and that is accepted as a proof for compensation hypothesis. Future studies are encouraged to follow Kimakova (2009), Benarroch and Pandley (2012) to check the compensation and efficiency hypothesis in developing countries considering the different components of government expenditure.

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