PUBLIC DEBT AND GROWTH: AN EMPIRICAL INVESTIGATION

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ABSTRACT

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We investigate the relationship between public debt and growth for a panel sample of 128 countries including 26 advanced, 40 emerging and 62 developing economies for a period of 1960-2011. To this end, we consider not only the conventional fixed effects procedure but also the recently developed cross sectionally augmented distributed lag (CS-DL) mean group (MG) procedure. We also investigate whether the relationship is robust to different country groupings such as advanced, emerging and developing economies and to different debt levels such as suggested. In the study, bivariate equations for debt and growth and conventional growth equations augmented with debt threshold variables are estimated. The results suggest that the negative impact of the public debt on growth appears to be more severe in emerging market countries than both advanced and developing countries. The results also lend a support to the view that the growth is invariant to different public debt levels in advanced countries.

According to our results, not only the debt growth but also the acceleration of the debt negatively affects economic growth. Emerging economies suffer most from the debt whilst the advanced economies suffer the least and a rising debt structure lead to a remarkable slowdown the growth for emerging and developing economies rather than the advanced ones.

Keywords: Public Debt, Growth, Threshold Value, Panel Data, Cross-Section dependence

ÖZ

KAMU BORCU VE BÜYÜME: AMPİRİK BİR İNCELEME

Canbek, Duygu

YüksekLisans, İktisatBölümü

TezYöneticisi: Prof. Dr. Erdal Özmen

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Bu çalışmada kamu borcu ve büyüme arasındaki ilişki 1960- 2011 yılları arasında 26 gelişmiş, 40 gelişmekte olan ve 62 gelişmemiş toplamda 128 ülke için panel veri kullanılarak incelenmiştir. Bu amaçla, sabit etkiler modelinin yanı sıra, yeni geliştirilmiş bir model olan yatay kesit dağıltılmış gecikme modeli (Cross Section Distributed Lag) kullanılmıştır. Ayrıca, borç ve büyüme arasındaki ilişki gelişmiş, gelişmekte ve gelişmemiş ülke grupları ve farklı borç düzeyleri için de ayrıca incelenmiştir. Bunun yanı sıra, kamu borcu eşik değerlerini de içeren iki değişkenli denklemler tahmin edilmiştir. Sonuçlar göstermektedir ki gelişmekte olan ülkeler için kamu borcunun büyüme üzerindeki daraltıcı etkisi gelişmiş ve gelişmekte olan ülkelere nazaran oldukça fazladır. Bunun yanı sıra, sonuçlar gelişmiş ekonomilerde büyümenin farklı borç düzeylerine duyarlı olmadığı görüşünü destekleyecek şekildedir. Ayrıca, sonuçlarımıza göre, kamu borcu büyüme oranının daraltıcı etkisi dışında büyümedeki artış hızının da ekonomide daralmaya yol açtığı gözlemlenmiştir. Bunun yanı sıra, sonuçlar ülke grupları içinde artan borç yapısından en çok etkilenen grubun gelişmekte olan ülkeler, en az etkilenen grubun ise gelişmiş ülkeler olduğunu göstermektedir.

Anahtar Kelimeler: Kamu borcu, Büyüme, Eşik Değeri, Panel Veri, Yatay Kesit Bağımlılığı

To My Family

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CHAPTER 1

INTRODUCTION

The relationship between public debt and growth has been at the center of macroeconomics literature especially after the 2008 global financial crisis. The findings of Reinhart and Rogoff (2010) suggesting that economic growth slows down considerably if the public debt-to-GDP ratio exceeds 90% has spawned a growing literature including Kumar and Woo (2010), Cecchetti *et al*., (2011), Baum, *et al.* (2012), Egert (2012, 2013), Eberhardt and Presbitero (2013), Panizza and Pressbitero (2013) and Chudik *et al.* (2013). Panizza and Pressbitero (2013) provide an excellent survey theoretical and the recent empirical literature based on advanced countries.

Macroeconomic theory often suggests that high levels of public debt lead to slowdown of the economic growth through several channels such as crowding out, higher future distortionary taxation, higher inflation, greater uncertainty and vulnerability to crises (Cecchetti *et al*., 2011), although, it could enhance the economy at reasonable levels (Kumar and Woo, 2010). Reinhart and Rogoff (2010) investigate whether public debt after a given level becomes contractionary. In this vein, Reinhart and Rogoff (2010) grouped their data according to the predetermined levels of debt to GDP ratio brackets which are 30%, 60% and 90%. What they find out is that especially beyond 90%, it is observed that the economy slows down. The recent empirical papers often support the Reinhart and Rogoff's debt 90% threshold. For instance, for a panel of 18 OECD countries, Cecchetti *et al*. (2011) finds the threshold as 86%. Similar results are reported also by Padoan *et al*. (2012) for advanced economies, Kumar and Woo (2010) and Baum *et al.* (2012), for advanced and emerging market economies.

The result on the relation between public debt and growth is yet to be conclusive and often contrasting. Panizza and Pressbitero (2013) find that the presence of thresholds and, non-monotone relationship between debt and growth is not robust to sample selection and empirical techniques. In the same vein, Egert (2012) suggests that the negative nonlinear relationship between debt and growth is sensitive to the choice of empirical modelling procedures. The results by Egert (2013) also suggest that individual country estimates contain substantial cross-country heterogeneity. There is yet to be a consensus about the 90 % threshold level. Caner *et al*. (2010), for instance, show that the threshold level is lower (around 77 %) for a sample of 77 countries. According to Egert (2013) the threshold level is around 20%, beyond which public debt has a negative effect on growth. Chudik *et al*., (2013) suggest cross sectionally augmented distributed lag (CS-DL) approach to the estimation of long-run effects in dynamic heterogeneous panel data models with cross-sectionally dependent errors. The CS-DL results by Chudik *et al*. (2013) indicate that, a permanent increase in the debt to GDP ratio will have negative effects on economic growth in the long run. But if the increase is temporary, then there are no long-run growth effects so long as debt to GDP is brought back to its normal level. Consequently, Chudik *et al*., (2013) do not find a universally applicable threshold level in the relationship between public debt and growth.

In this study, we investigate the relationship between public debt and growth for 128 economies spanning a period of 1960-2011 in an unbalanced panel setting. We also investigate whether the relationship is robust to different country groupings such as advanced, emerging and developing economies. To this end, we first, estimate a static bivariate equation of growth and debt employing a conventional fixed effects (FE) panel data estimation procedure. Then, we consider a conventional growth model augmented by debt to GDP levels and estimate by using the FE panel method. The results from these equations show that the relation between debt to GDP and growth is negative. However, in the case of nonstationary series, cross section dependency and heterogeneity, FE results become unreliable. Therefore, mean group (MG) estimates based on the cross- sectionally augmented distributed lag (CS-DL) approach suggested by Chudik and Pesaran (2013) is also applied to the bivariate regression in a dynamic panel setting. This approach allows one to make a robust estimation in case of endogeneity, nonstationarity, cross section dependency and heterogeneity. To investigate the presence of nonlinear impact of debt on growth, we consider predetermined debt to GDP ratios suggested by Reinhart and Rogoff (2010). For the whole sample of countries, the results are the consistent with the findings of Reinhart and Rogoff (2010). However, when we consider different country groupings, the negative debt-growth relationship appears not to be the case for advanced economies. Our results further suggest that, when rising debt structure is considered, there could be a threshold effect beyond 90 percent for emerging and developing economies but not for advanced economies. The difference can arise from debt compositions of the economic groups as the public debt often is denominated in foreign currency in emerging and developing markets as suggested by Reinhart and Rogoff (2010) and Chudik et al. (2013).

The rest of study is organized as follows. Second part presents the literature review of the relationship between debt and growth. Part 3 presents the data set and some stylized fact between public debt and growth and empirical results. Finally, the last part concludes.

CHAPTER 2

PUBLIC DEBT AND GROWTH: A BRIEF REVIEW OF THE LITERATURE

Reinhart and Rogoff (2010), hereafter RR, sparked a new literature to investigate the relationship between public debt and growth for advanced economies and emerging markets. RR classify public debt to GDP levels of the countries into four groups. The first group is the years when debt to GDP levels below 30 percent (low debt); the second one is the years when debt to GDP levels are between 30 and 60 percent (medium debt); the third one is the years when debt to GDP levels are between 60 and 90 percent (high); and the last one is the years when debt to GDP levels are above 90 percent. They also compute the median and average GDP growth levels for each group. For advanced economies, the RR data cover 20 countries including Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, the United Kingdom, and the United States over the period 1946-2009. 443 observations are available for the first group (low debt), 442 observations for the second one (medium debt), 199 observations for the third one (high debt), and 96 observations for the last one (more than 90 %). There are 1,180 observations in total. Their findings suggest that when debt to GDP level reaches 90 percent threshold; GDP growth becomes lower than the ones for other groups. That is, for the very high debt group, median growth level is almost 1 percent lower than the other groups and the average growth is approximately 4 percent lower.

RR, investigates also the threshold effect for 24 emerging market economies including Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Ghana, India, Indonesia, Kenya, Korea, Malaysia, Mexico, Nigeria, Peru, Philippines, Singapore, South Africa, Sri Lanka, Thailand, Turkey, Uruguay and Venezuela for the period 1946-2009. The number of observations for the low debt group is 502, for the medium debt group it is 385, for the high debt group it is 145 and the very high debt group it is 110. Total number of annual observations is 1142. Their results are similar to ones for advanced economies. What they find out is that both average and median growth become lower, when debt to GDP ratio reaches the 90 percent threshold. That is, average growth is approximately 3 percent lower and median growth is roughly 2 percent lower when debt is very high. For the whole sample of 44 countries over a period of 1946-2009, RR find that when debt to GDP levels above 90 percent, economic growth is notably lower for both advanced and emerging market economies. They claim that because of "debt intolerance", market interest rates start to rise sharply and damage the economy.

Kumar and Woo (2010) search for the threshold effect of public debt on growth of real per capita GDP by estimating a dynamic growth regression model spanning a period of 1970-2007 for 46 advanced and emerging market economies. The model as follows:

$$y_{i,t} - y_{i,t-\tau} = \alpha y_{i,t-\tau} + X_{i,t-\tau}\beta + \gamma Z_{i,t-\tau} + \eta_t + \nu_i + \varepsilon_{i,t}$$

where, τ is a period of a five year time interval (τ = 4), t denotes the end of a period, t-τ denotes the beginning of the period, *I* denotes country, y, is the logarithm of real per capita GDP, ν_i is the country-specific fixed effect, η_t is the time-fixed effect, $\varepsilon_{i,t}$ is the unobservable error term, $X_{i,t-\tau}$ is a vector of economic and financial variables, and $Z_{i,t-\tau}$ is the initial government debt (in percent of GDP).

The variables X include initial level of real GDP per capita to capture the catching up (convergence) process, the log of average years of secondary schooling in the population over age 15 in the initial year as a proxy for human capital, initial financial market depth (liquid liabilities as a percentage of GDP), initial trade openness (sum of export and import as a percentage of GDP), CPI inflation to measure initial inflation, terms of trade growth rate and banking crisis incidence (based on Reinhart and Rogoff (2008)). The equation contains also, population size (a proxy of country size), age dependency ratio (a proxy of population aging), investment, fiscal spending volatility, urbanization, private saving, and checks and balances or constraints on executive decision making (as a proxy of durable institutionalized constraints) for robustness check.

Kumar and Woo (2010) use a number of estimation methodologies such as pooled OLS, robust regression, between estimator (BE), fixed effects (FE) panel regression and system GMM (SGMM) dynamic panel regression. However, it is claimed that there is a tradeoff among the methodologies. For example, any correlation between country specific fixed effects and the regressors may cause the inconsistent estimates by pooled OLS and BE as a result of omitted variable bias or heterogeneity bias. Also, any correlation between regressors and the error term may lead to inconsistent estimations by pooled OLS, BE and FE. Moreover, measurement errors would affect the consistency of pooled OLS, BE, and FE estimators. However, Kumar and Woo (2010) assert that BE performs better than pooled OLS, BE, FE and difference GMM in terms of total bias resulted from both heterogeneity bias and measurement errors. The dynamic panel GMM estimator, on the other hand, may suffer from omitted variable bias, endogeneity, measurement errors and weak instruments problem. Compared to dynamic panel GMM estimators, the SGMM is more robust to weak instrument problem. Also, it is asserted in the article that initial level of government is used to determine the effect on subsequent growth thus they may avoid reverse causality. However, there may be a third variable that jointly determines the growth and public debt. Therefore, it is used the SGMM that proposes suitable lagged levels and lagged first differences by Arellano and Bover (1995) and Blundell and Bond (1998) to address the endogeneity. Therefore, Kumar and Woo say that BE and SGMM are preferred.

Kumar and Woo (2010) also search for nonlinearities by inserting three dummy variables for predetermined ranges of debt into the model such as Dum_30 for debt to GDP level below 30 percent, Dum_30-90 for debt to GDP level between 30 and 90 percent and Dum_90 for debt to GDP level over 90 percent. Results show that, FE and SGMM estimations find coefficients of Dum_30 insignificant. BE, FE, and SGMM estimations of the Dum_30-90 coefficients are, also, insignificant although pooled OLS find the coefficients significant. However, BE, OLS and SGMM estimates shows that coefficients of Dum_90 are negative and significant. The results show while there is a reduction about 0.2 percent when initial debt to GDP growth increases by a 10 percentage point for emerging economies; it is about 0.15 percent for advanced economies only with 90 percent level of debt to GDP. That is, the slowdown of the growth is lower in advanced economies than the emerging market economies if the debt to GDP level is above 90 percent.

Cecchetti, Mohanty and Zampolli (2011) examine the impact of high public debt on economic growth in 18 OECD countries for the period of 1980-2010. Instead of using predetermined threshold levels, they construct a growth threshold model. Also, to minimize endogeneity bias, they take predetermined values of all variables except population growth rate with respect to the five year forward average growth rate. The starting point of their analysis is the specification of the simple growth model:

$$\bar{g}_{i,t+1,t+k} = -\phi y_{i,t} + \beta' X_{i,t} + \mu_i + \gamma_t + \varepsilon_{i,t,t+k}$$

where $\bar{g}_{i,t+1,t+k}$ is k- year forward average of annual growth rates between year t+1 and t+k, that is, $\bar{g}_{i,t+1,t+k} = \frac{1}{k}\Sigma_{j=t+1}^{t+k} g_{i,j} \cong \frac{1}{k}(y_{i,t+k} - y_{i,t})$, and y is the log of real per capita GDP.

X contains gross saving as a share of GDP, population growth, the number of years spent in secondary education, the total dependency ratio, openness to trade (sum of exports and imports over GDP), CPI inflation, the ratio of liquid liabilities to GDP, and a control for banking crisis taking the value of zero if there is no banking crisis in five years. Cecchetti *et al.*, (2011) augments their model with an indicator variable taking zero if the debt level is above τ (threshold value) and one, otherwise to examine the presence of a threshold. Consequently, their model is:

$$\bar{g}_{i,t+1,t+k} = -\phi y_{i,t} + \beta' X_{i,t} + \lambda_{-} d_{i,t} I(d_{i,t} < \tau) + \lambda_{+} d_{i,t} I(d_{i,t} \geq \tau) + \mu_i + \gamma_t + \varepsilon_{i,t,t+k}$$

Cecchetti, Mohanty and Zampolli (2011) consider least squares dummy variable (LSDV), instrumental variable (IV) and generalized method of moments (GMM) estimation methods and prefer to employ the LSDV procedure as suggested by Judson and Owen (1999). Cecchetti, Mohanty and Zampolli (2011) estimate the threshold for public debt at around 85% of GDP. At this debt level, a 10 percent debt to GDP increase ends up with a 10-15 points of reduction in growth.

Baum, Westpal and Rother (2012) investigate the presence of a nonlinear relationship between public debt and GDP growth for 12 euro area countries which are Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain for periods of 1990-2007 and1990-2010. They use both a static and dynamic threshold panel methodologies to compare the results in terms of robustness. They analyze the short run impact of debt for the annual data. The model is as follows:

$$\begin{aligned} y_{i,t} &= \mu_i + \chi y_{i,t-1} + \alpha_1 OPEN_{i,t-1} + \alpha_2 GCF_{i,t-1} + \alpha_3 EMU_{i,t} \\ &+ \beta_1 d_{i,t-1} I(d_{i,t-1} \leq d^*) + \beta_2 d_{i,t-1} I(d_{i,t-1} \geq d^*) + u_{it} \end{aligned}$$

where $y_{i,t}$ is the GDP growth rate of country i at time t, $y_{i,t-1}$ is lagged value of the GDP growth (excluded in their static model), OPEN is the trade openness measure, GCF is the ratio of gross capital formation to GDP, EMU is the dummy variable which signals the EMU membership, d is the debt-to-GDP series, with d being the debt to-GDP threshold value. Baum et al., (2012) estimate their model by using Hansen (1999) and Caner and Hansen (2004) procedures which allow for an endogeneity and an exogenous threshold variable. However, country specific effects are not suitable for Caner and Hansen (2004) methodology. Although mean differencing eliminates the country specific effects, correlation between lagged dependent variable and mean of the individual error terms emerges and this leads estimations to be inconsistent. To overcome the problem, they make some orthogonal deviations suggested first by Kremer *et al*. (2009).

The results by Baum *et al*., (2012) for both static and dynamic growth equations suggest that there is a significant debt threshold value approximately 0.66 at the 10% level for 12 euro area countries for the period 1990-2007. However, when the crisis years are included, the threshold levels are estimated at 0.71 and 0.96 by static and dynamic models, respectively. For robustness check, Baum *et al*., (2012) augment their dynamic model with lagged values of some other variables including population growth, old age dependency ratio, unemployment, secondary school education, GDP per capita, general government budget balance, primary budget balance, GCF private, long term interest rates and short term interest rates. To deal with possible endogeneity problem, they also consider instrumental and GMM estimation procedures. The threshold level appears to be robust to all these alternative specifications and estimation procedures.

Egert (2012) tests for the presence of a nonlinear relationship between debt and growth for 20 advanced and 16 emerging market economies for periods of 1790-2009 and 1946 to 2009 as suggested by Reinhart and Rogoff (2010) and for the period 1790 and 1939. In order to examine the nonlinearity, initially, the following bivariate regression equation is estimated:

$$\Delta y_t = \alpha + \beta debt_t + \varepsilon_t$$

where Δy_t is annual real GDP growth, on the other hand, debt is public debt to GDP ratio. The model estimated by pooled panel with country fixed effects. Then, Egert (2012) estimate two, three and four regime threshold models as alternatives.

The four regime threshold model is constructed by adopting the thresholds suggested by RR as exogenous variables:

$$\Delta y_t = \begin{cases} \alpha_1 + \beta_1 DEBT_t + \varepsilon_t & if \quad DEBT < 30\% \\ \alpha_2 + \beta_2 DEBT_t + \varepsilon_t & if \quad 30\% \leq DEBT < 60\% \\ \alpha_3 + \beta_3 DEBT_t + \varepsilon_t & if \quad 60\% \leq DEBT < 90\% \\ \alpha_4 + \beta_4 DEBT_t + \varepsilon_t & if \quad DEBT > 90\% \end{cases}$$

Egert (2012) suggests that the use of exogenous threshold values may not be appropriate and thus employs, also, endogenous threshold estimation procedure proposed by Hansen (1999). To this end, a grid search is used to determine threshold values endogenously. Then, by using bootstrapping method, the model is tested against the alternatives. The alternative models (two and three regime models) are specified as follows:

$$\Delta y_t = \begin{cases} \alpha_1 + \beta_1 DEBT_t + \varepsilon_t & if \quad DEBT < T \\ \alpha_2 + \beta_2 DEBT_t + \varepsilon_t & if \quad DEBT > T \end{cases}$$

where T is the threshold value for two regime model and

$$\Delta y_t = \begin{cases} \alpha_1 + \beta_1 DEBT_t + \varepsilon_t & if \quad DEBT < T_1 \\ \alpha_2 + \beta_2 DEB_tT_t + \varepsilon_t & if \quad T_1 \leq DEBT < T_2 \\ \alpha_3 + \beta_3 DEBTT_t + \varepsilon_t & if \quad DEBT \geq T_2 \end{cases}$$

T_1 is lower and T_2 is the upper threshold values in the three regime model.

The results for annual data display that for the period of 1790-1939, the coefficients are insignificant for all economies for 16 emerging market economies for the period of 1946 and 2009. The rest, on the other hand, is significant and shows a negative relationship between debt and growth. That is, the coefficients of growth decrease by 2 to 5 points as the debt ratio increases. For the two and three regime models, the results of Egert (2012) suggest that growth decreases as the public debt increases. However, four regime model displays that growth decreases more for the debt ranged from 60% to 90% than the debt lower than 60% and higher than 90%.

Egert (2012) considers, also, other determinants of growth in order to examine the nonlinearity in the long run. The data includes 29 OECD countries for a period of 1960-2009. The models are as follow:

$$\Delta cap_t = \begin{cases} \alpha_1 + \sum_{j=1}^{n-1} \beta_j X_{j,t-1} + \varphi_1 debt_{t-1} + \varepsilon_t & if \quad debt < T \\ \alpha_2 + \sum_{j=1}^{n-1} \beta_j X_{j,t-1} + \varphi_2 debt_{t-1} + \varepsilon_t & if \quad debt \geq T \end{cases}$$

$$\Delta cap_t = \begin{cases} \alpha_1 + \sum_{j=1}^{n-1} \beta_j X_{j,t-1} + \varphi_1 debt_{t-1} + \varepsilon_t & if \quad debt < T_1 \\ \alpha_2 + \sum_{j=1}^{n-1} \beta_j X_{j,t-1} + \varphi_2 debt_{t-1} + \varepsilon_t & if \quad T_1 \leq debt < T_2 \\ \alpha_3 + \sum_{j=1}^{n-1} \beta_j X_{j,t-1} + \varphi_3 debt_{t-1} + \varepsilon_t & if \quad debt \geq T_2 \end{cases}$$

where debt represents general government debt, and X includes lagged values of GDP per capita (cap_{-1}), investment to GDP ratio (inv), average years of schooling, population growth, inflation and openness. The models are estimated by Bayesian averaging of classical estimates as it allows estimating all possible combinations of explanatory variables (Sala-i-Martin *et al.*, 2004). For 5 year averages, there is an indication of some nonlinearty, however; largest slowdown of growth observed when public debt is lowest. On the other hand, for 8 year averages, there is negative relationship above 35% debt to GDP. Finally, for 10 year averages, relationship between debt and growth could be positive or negative. That is, the results are very sensitive to the number of observations. They also consider a new sample containing only 13 OECD countries. For this group, nonlinearity is observed at the higher levels of debt only when 8 year averages are used.

To conclude, there is some evidence indicating the nonlinear relationship between debt and growth. However, threshold value is very sensitive to country coverage, time dimension and data frequency. Egert (2012) asserts that determining the nonlinearity is very complex since nonlinear effects might change over time, across countries and economic conditions. Therefore, more research should be made to understand the relationship between debt and growth.

Panizza, and Pressbitero (2012) discuss the relationship between debt and growth by referring to the recent literature and note that the findings in the literature are not robust to small changes in sample, specifications and estimation techniques. Another problem is the heterogeneity. They, also, note that most of the empirical approaches ignore the endogeneity problem in the literature. Therefore, they address the issue whether there is a causal relationship between debt and growth. First, they indicate that the correlation between debt and growth is negative, especially when debt approaches the 100 percent of GDP. However, it is not enough to say that public debt deteriorates the economic growth. Although public debt can lead growth slowdown through a crowding out effect, low growth can be the cause of high public debt. They describe the endogeneity simply as following:

$$G = a + bD + u$$

$$D = m + kG + \upsilon$$

where G is growth and D is public debt. Then the OLS estimate the coefficient of public debt as

$$\hat{b} = \frac{b\sigma_\upsilon^2 + k\sigma_u^2}{\sigma_\upsilon^2 + k^2\sigma_u^2}$$

And the bias produced by the OLS estimation is

$$E(\hat{b}) - b = \frac{k(1-bk)}{\sigma_\upsilon^2 / k^2 + \sigma_u^2}$$

Therefore, they use valuation effect (VE) by the interacting foreign currency debt and movements in the exchange rate as an instrument for debt to GDP ratio. They claim that there is a strong positive correlation between the public debt and the instrument after applying a number of weak instrument tests. Also, they say the instrument effect growth through two ways. First, valuation effect correlated with the share of foreign currency debt could lead to financial and macroeconomic instability so it could deteriorate the economic growth. Second, the correlation between effective exchange rate and trade weighted effective exchange rate could affect the economic growth. After that, they explore their bivariate model to multivariate model by following same data and approach of Cecchetti *et al*. (2011).

$$Growth_{i,t+1,t+6} = \alpha y_{i,t} + \beta(\frac{debt}{GDP})_{i,t} + \gamma' X_{i,t} + \mu_i + \tau_t + \varepsilon_{i,t}$$

where the explanatory variables are lagged values the public debt, log of initial GDP per capita, national gross saving, population growth, secondary education, openness, inflation, age dependency ratio, banking crisis dummy and the liquid liabilities to GDP. OLS estimates report that ten percent increase in debt reduces growth by 18 points. Then, since the instrument is strongly correlated with debt, they insert the instrument variable for debt into the model. In this case, the negative correlation between debt and growth disappears. That is, coefficient of the instrument turns out to be insignificant. The reason for that could be the inefficient IV estimator. However, after a number of tests, they claim that their estimation strategy does not suffer from the weakness of the instrumental variable. Therefore, they conclude that they cannot say whether there is a causal relationship between debt and growth.

Eberhardt and Presbitero (2013), analyze the nonlinear impact of debt on growth for 105 developing, emerging and advanced economies over the period of 1972-2009. They use ECM (Error Correction Model) to estimate parameters in the long run and short run. The basic static equation is as follows:

$$y_{it} = \alpha_i + \beta_i^K cap_{it} + \beta_i^D debt_{it} + u_{it}$$

and $u_{it} = \lambda_i' f_t + \varepsilon_{it}$

where y is GDP, cap is capital stock and debt is public debt, f_t is unobserved common factor and β_i^J (for j= K, D) allows coefficients to be differ across countries to deal with heterogeneity.

On the other hand, the dynamic ECM representation of the model is as follows:

$$\begin{aligned}
&\Delta y_{it} = \alpha_{it} + \rho_i(y_{i,t-1} - \beta_i^K cap_{i,t-1} - \beta_i^D debt_{i,t-1} - \lambda_i^{'} f_{t-1}) \\
&+ \gamma_i^K \Delta cap_{i,t} + \gamma_i^D \Delta debt_{i,t} + \gamma_i^{'} \Delta f_{t-1} + \varepsilon_{it}
\end{aligned}$$

$$\begin{aligned}
&\Leftrightarrow \Delta y_{it} = \pi_{0i} + \pi_i^{EC} y_{i,t-1} + \pi_i^K cap_{i,t-1} + \pi_i^D debt_{i,t-1} + \pi_i^{F'} f_{t-1} \\
&+ \pi_i^k \Delta cap_{i,t} + \pi_i^d \Delta debt_{i,t} + \pi_i^{f'} \Delta f_{t-1} + \varepsilon_{it}
\end{aligned}$$

It is asserted that ECM representation provides to investigate both long run and short run impacts and speed of adjustment to the long run equilibrium. Also, cointegration analysis can be made to test the significance of the error correction term. The aim is to examine the nonlinear impact of debt on growth in cross country dimension. Due to the cross section dependency, dynamic CCE model is used. It indicates that there is nonlinearity just when debt to GDP ratio is 90% in the long run.

In addition to cross section dependency, heterogeneity is taken into account by using heterogeneous dynamic ECM in the article. Also, the threshold effect is examined not only for cross country aspect but also for within country. Within country relationship is examined by using two different approaches such as an asymmetric dynamic model where some tipping points are used as 52%, 75 % and 90% debt to GDP and a static model with square and cube of the debt. First, the asymmetric long run dynamic model is as follows:

$$y_{it} = \alpha_i + \beta_i^K cap_{it} + \beta_i^{D+} debt_{it}^{+} + \beta_i^{D-} debt_{it}^{-} + \lambda_i^{'} f_t + \varepsilon_{it}$$

$$debt_{it} = debt_{i0} + \beta_i^{D+} debt_{it}^{+} + \beta_i^{D-} debt_{it}^{-}$$

where $debt_{i0}$ is the threshold value captured by the constant term, $debt_{it}^{+}$ and $debt_{it}^{-}$ represent the positive and negative changes in the debt accumulation accordingly.

The ECM representation of this model is

$$\Delta y_{it} = \pi_{0i} + \pi_i^{EC} y_{i,t-1} + \pi_i^{K} cap_{i,t-1} + \pi_i^{D+} debt_{i,t-1}^{+} + \pi_i^{D-} debt_{i,t-1}^{-} + \pi_i^{F'} f_{t-1}$$
$$+ \pi_i^{k} \Delta cap_{i,t-1} + \pi_i^{d+} \Delta debt_{i,t}^{+} + \pi_i^{d-} \Delta debt_{i,t}^{-} + \pi_i^{f'} \Delta f_{t-1} + \varepsilon_{it}$$

It is asserted that a common threshold does not exist in case of both observed and unobserved heterogeneity. That is, there is no evidence for nonlinear impact of debt on growth above the debt threshold values which are taken as 52%, 75%, and 90% of GDP.

Second, the nonlinear static model constructed in the article is as follows:

$$y_{it} = \alpha_i + \beta_i^{K} inv_{it} + \beta_i^{DL} debt_{it} + \beta_i^{DS} debt_{it}^{2} + \beta_i^{DC} debt_{it}^{3} + \lambda_i^{'} f_t + \varepsilon_{it}$$

The square and cube values of debt term are added to the static linear model. The model is estimated by mean group (MG) and common correlated effects mean group (CMG). However, it is asserted that MG estimation suffers from cross section dependency. It is claimed that although country specific estimation results cannot be reliable due to the heterogeneity, there is more evidence for that there is no nonlinear relationship between debt and growth.

Although they claim that there is no a common threshold for all countries, they suggest that there is some difference in impact of debt on growth across countries because factors which determine the nonlinearity such as debt composition and financial vulnerability are specific to the each country. Therefore, economic policies should be specific to the each country.

Chudik *et al.* (2013) examine the long run relationship between debt, and growth for 40 countries including advanced, emerging and developing economies for a period of 1965-2010 by using a dynamic growth model. In case of that debt is financed through money creation, the relation between inflation and growth is, also, considered. Moreover, the heterogeneity and cross section dependency across countries are taken into account. They use cross section augmented autoregressive distributed lag (CS-ARDL) estimator developed by Chudik and Pesaran (2013a) and cross section distributed lag (CS-DL) estimator developed in this article are used to overcome heterogeneity and cross section dependency in the dynamic growth model. Also, they compare performance of both models by using Monte Carlo experiments. They claim that although both models have some drawbacks, CS-DL estimator performs better when the sample size is small. In addition, choosing correct order is crucial to get robust estimates in ARDL, unlike CS-DL. Also CS-DL is robust to serial correlation, any other possible breaks in the error processes and nonstationarity. However, in case of reverse causation, CS-DL is not robust anymore on the contrary to ARDL. Nevertheless, it compensates other estimation problems more so performs better than the CS-DL according to the results for Monte Carlo experiments. ARDL performs better only when time dimension of the data is sufficiently large. They start the analysis by estimating a simple ARDL model, first. The model is the following

$$\Delta y_{it} = c_i + \sum_{l=1}^{p} \varphi_{il} \Delta y_{it-l} + \sum_{l=0}^{p} \beta'_{il} \Delta x_{it-l} + u_{it}$$

where y_{it} is the log of real GDP, x_{it} equals to $(\Delta d_{it}, \pi_{it})'$, d_{it} is the log of debt to GDP ratio and π_{it} is the inflation rate. Also, same lag order (p) that is in a range of 1 to 3 is used for all variables and countries. It is reported that one percent increase in debt leads growth to decrease by 0.044 and 0.083 percent depending on the lag selected.

On the other hand, ARDL estimation assumes cross sections to be independent. Yet, CD (Cross section Dependence) test suggested by Pesaran (2004) indicates that there is cross sectional dependency for p=1, 2, 3. Therefore, CS-ARDL estimation suggested by Chudik and Pesaran (2013a) is used to get more reliable results in the article. Then the model turns out to be the following

$$\Delta y_{it} = c_i + \sum_{l=1}^{p} \varphi_{il} \Delta y_{it-l} + \sum_{l=0}^{p} \beta'_{il} \Delta x_{it-l} + \sum_{l=0}^{3} \psi'_{il} \bar{z}_{t-l} + e_{it}$$

where $\bar{z}_t = (\overline{\Delta y_t}, \bar{x}'_t)'$ and all other variables are the same. It is reported that adverse effect of debt on growth is between 0.079 and 0.120 in the long run according to the CS-ARDL estimation results.

However, it is asserted that CS-DL estimator performs better than the CS-ARDL estimator for a small sample when T is moderate. The estimated model turns out to be the following:

$$\Delta y_{it} = c_i + \theta'_i x_{it} + \sum_{l=0}^{p-1} \delta'_{il} \Delta x_{it-l} + \omega_{iy} \overline{\Delta y_t} + \sum_{l=0}^{3} \omega'_{i,xl} \bar{x}_{t-l} + e_{it}$$

where the regression as defined before and p=1, 2, 3. The mean group (MG) estimates of the CS-DL model indicate that the negative effect of the debt on growth is range from 0.067 and -0.087. Also, it is claimed that if the increase in debt is permanent, the effect of debt on growth is negative. However, if it is temporary, then, the adverse effect of debt on growth disappears in the long run.

To analyze the nonlinearity, a threshold dummy is inserted into the model. Then the model becomes the following:

$$\Delta y_{it} = c_{i\tau} + \gamma_{i\tau} I_{it}(\tau) + \theta'_{i\tau} x_{it} + \sum_{l=0}^{2} \delta'_{il,\tau} \Delta x_{it-l} + \omega_{iy,\tau} \overline{\Delta y_t} + \sum_{l=0}^{3} \omega'_{i,xl,\tau} \bar{x}_{t-l} + e_{it}$$

where $I_{it}(\tau)$ is the threshold dummy defined by the indicator variable $I(d_{it} \geq \log \tau)$ which takes 1 if debt level is above the threshold value (τ =30%, 40%, …, 90%) and zero otherwise. However, MG estimation results do not indicate any threshold value. Since data does not indicate any threshold value, nonlinear impact of debt analyzed for countries with rising debt structure. Then model specification for this is the following:

$$\Delta y_{it} = c_{i\tau} + \gamma_{i\tau} I_{it}(\tau) + \gamma_{i\tau}^{+}\left[I_{it}(\tau) \times \max(0, \Delta d_{it})\right] + \theta'_{i\tau}\, x_{it} + \sum_{l=0}^{2} \delta'_{il,\tau} \Delta x_{it-l}$$
$$+ \omega_{iy,\tau} \overline{\Delta y_t} + \sum_{l=0}^{3} \omega'_{i,xl,\tau} \bar{x}_{t-l} + e_{it}$$

where $\left[I_{it}(\tau) \times \max(0, \Delta d_{it})\right]$ is the interactive threshold dummy variable and the others same. The MG estimation results show that although coefficient of the interactive threshold dummy variable ($\hat{\gamma}_{\tau}^{+}$) is negative and statistically significant when the upward debt is above 60%, coefficient of the threshold dummy ($\hat{\gamma}_{\tau}$) is not statistically significant. Therefore, they remove it and estimate the model again. This time above the threshold value of 60%, both the coefficient of debt growth ($\hat{\theta}_{\Delta d,\tau}$) and the coefficient of the interactive threshold dummy variable ($\hat{\gamma}_{\tau}^{+}$) are statistically significant. To sum up, they claim that the relationship between rising debt and growth is strongly negative in the long run rather than the level of debt and growth beyond certain thresholds.

CHAPTER 3

PUBLIC DEBT AND GROWTH: EMPIRICAL RESULTS

3.1. Public Debt and Growth: Stylized Facts

Since 1980s, there is an upward trend in public debt in advanced economies. Figure 1 show the public debt to GDP ratios for 128 economies which includes 26 advanced, 40 emerging and 62 developing economies. List of the countries is presented by in the appendix B. Figure 1.1 represents the public debt to GDP levels for cross section means of 128 economies for period of 1960-2011. It is seen that there is a notable increase in public debt during 1980s. It reaches the peak at about 75% and there appears to be declining trend after the mid 1990's.

Figure 1.2 presents the cross section means of debt to GDP ratios for 26 advanced economies. The debt levels appear to be modest during the 1960's and 1970's. After the mid 1980's the debt ratios has increased sharply reaching a peak around 75 % especially after the recent global financial crisis of 2008. The figure shows that debt to GDP ratio of advanced economies increased by more than 400% from 1960 to 2011.

Public debt of emerging market and developing countries before the 1980's show a similar pattern with that of the advanced countries as shown by Figures 1.3 and 1.4. There is a rapid increase during 1980s for 40 emerging economies as Figure 1.3 indicates and it reaches peak at around a level of 70% in 1987. In addition, debt to GDP ratio of emerging markets increases by almost 300% from 1960 to 2011 although it becomes at a level of 50% in 2011. Figure 1.4 shows the debt to GDP ratios for a period of 1960 and 2011 for 62 developing economies. In 2011, the debt to GDP ratio is almost 40% while it is about 15% in 1960. It indicates the similar results for 1980s. That is, there is a tremendous increase public debt to GDP from 1980 until 1994 and reaches about 90%. Yet, it started to lessen approximately by 50% starting from the 1995. Briefly, emerging and developing economies manage to lessen public debt to GDP ratios during the last decade although they sustain very high levels during 1980s and 1990s. For advanced economies, on the other hand, public debt to GDP continues to increase.

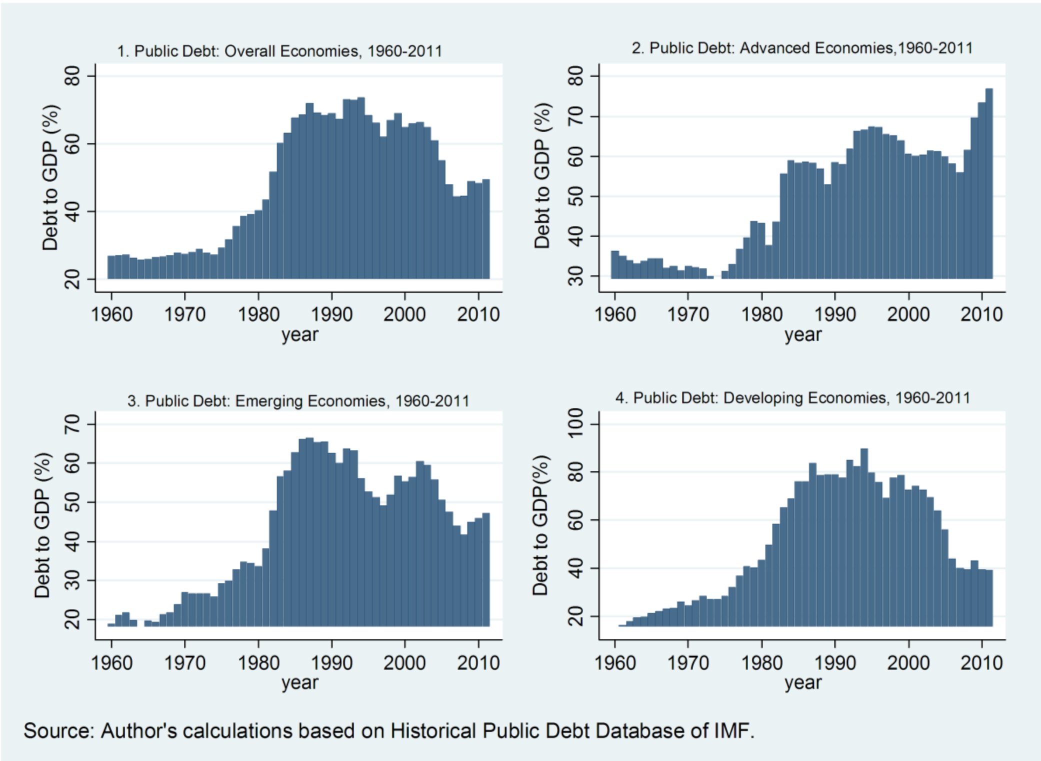

Figure 1.Public Debt to GDP, 1960-2011

According to Azzimonti *et al*. (2013), dynamics of upward trend in public debt has changed since 1980. One potential reason could be the increasing financial integration. They find that there is a positive relationship between financial integration and debt. That is, economies tend to borrow more when they are integrated more to the international financial system. On the other hand, Abbas *et al*. (2011) examine changes in public debt by using data which includes 174 countries for a period of 1791 and 2009. The research shows that the public debt increases, historically, during World War I (1914-1918), Great Depression (1930s) and World War II (1941-1945). However, these increases are temporary. Permanent increase starts, on the other hand, in mid-1970s as Figure 1 shows. The increasing public debt trend for all economies and economic groups is due to ending the Bretton Woods system and two oil price shocks (1973 and 1979) according to the Abbas *et al*. (2011).

The relationship between debt and growth analyzed graphically for the threshold values suggested by Reinhart and Rogoff (2013). Figure 2, Figure 3, Figure 4 and Figure 5 represent scatter plots of the relationship between debt and growth for the debt to GDP levels of below 30 percent, between 30 and 60 percent, between 60 and 90 percent and above 90 percent for overall, advanced, emerging and developing economies, correspondingly. Reinhart and Rogoff find that there is a structural break when debt to GDP is beyond 90 percent. In other words, the negative impact of debt on growth increase notably when debt to GDP exceed 90 percent. Scatter plot diagram of public debt and growth for overall economies (Figure 2) indicates that corresponding levels of economic growth are mostly positive for the debt to GDP level below 30%. Similarly, for debt levels between 30 to 60% and 60 to 90%, positive values of economic growth are more intense although it is less compared to the debt to GDP below 30%. However, trend do not indicate any negative relationship between debt and growth. On the other hand, negative values are overweight when debt to GDP is beyond 90%. Also, as debt increases, corresponding growth rates decline beyond 90%. For advanced economies (Figure 3), corresponding growth rates are mostly positive and follow almost a linear line below 30% level of debt. For emerging (Figure 4) and developing economies (Figure 5), the lines lie above the zero, horizontally, similar to advanced economies. That is, there is no sign of a trend for debt to GDP below 30%. Similar patterns are observed for the debt to GDP 30 to 60% and 60 to 90% in the economic groupings. That is to say, it is not observed a positive or a negative pattern in terms of the relationship between debt and growth. On the other hand, beyond 90%, trend turns out to be negative for all groups. In other words, lower growth rates are observed as the debt to GDP increases beyond 90% for all economic groupings.

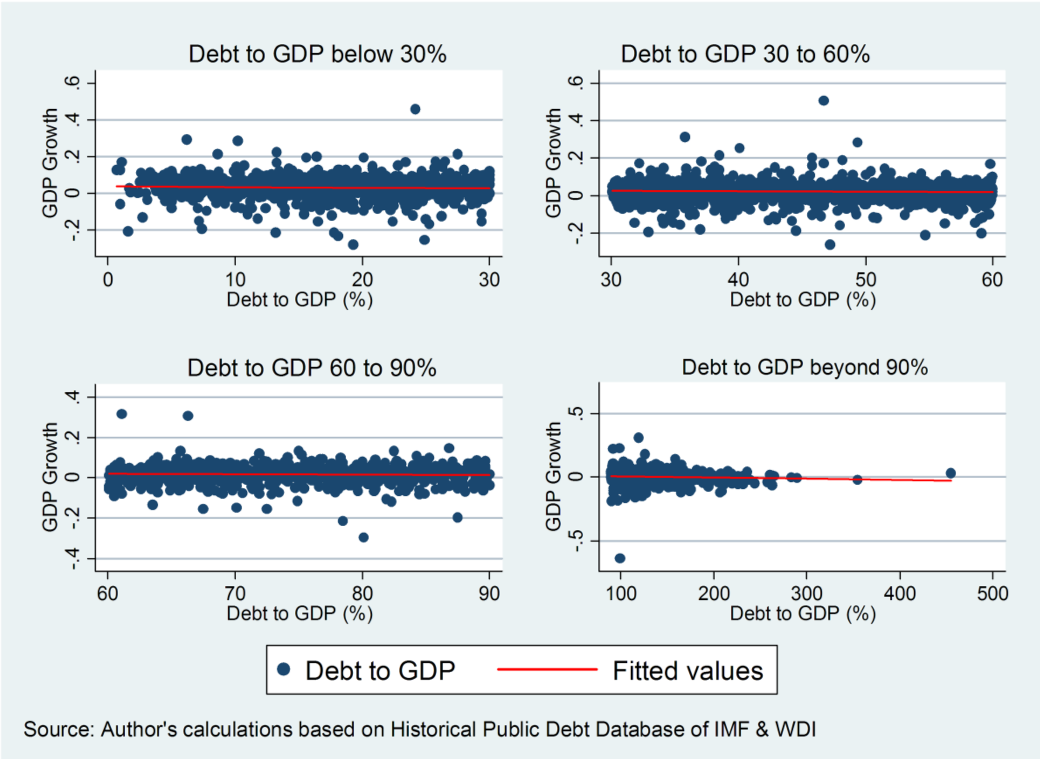

Figure 2.Public Debt and Growth: Overall Economies, 1960-2011

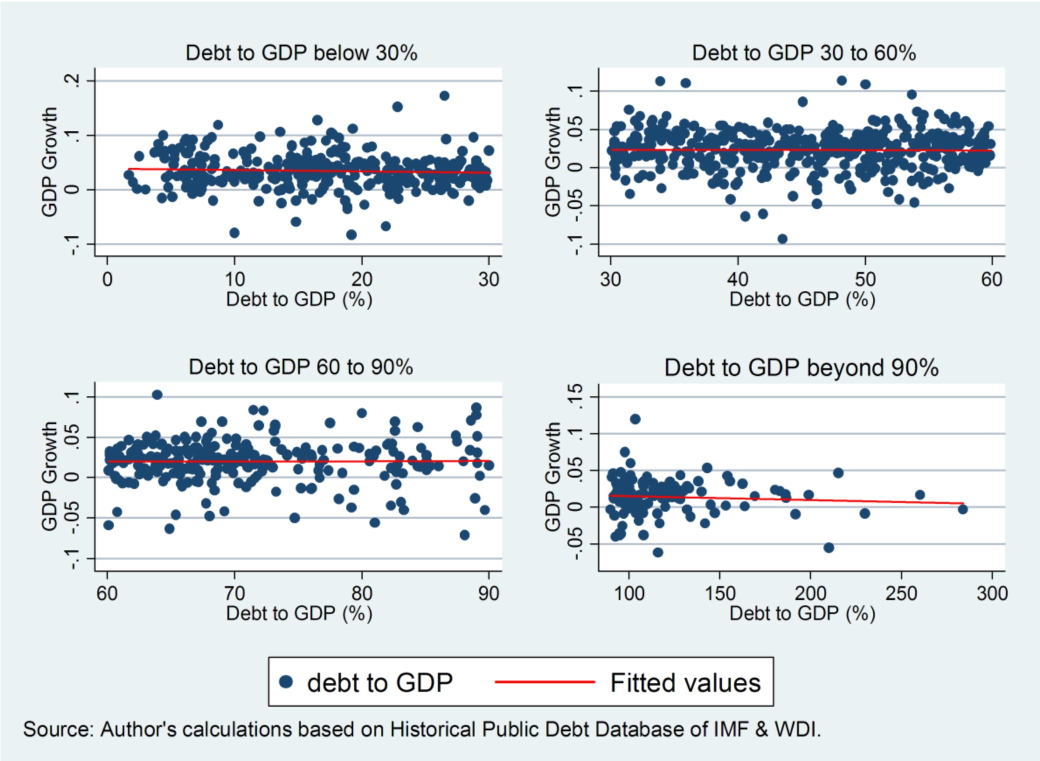

Figure 3.Public Debt and Growth: Advanced Economies, 1960-2011

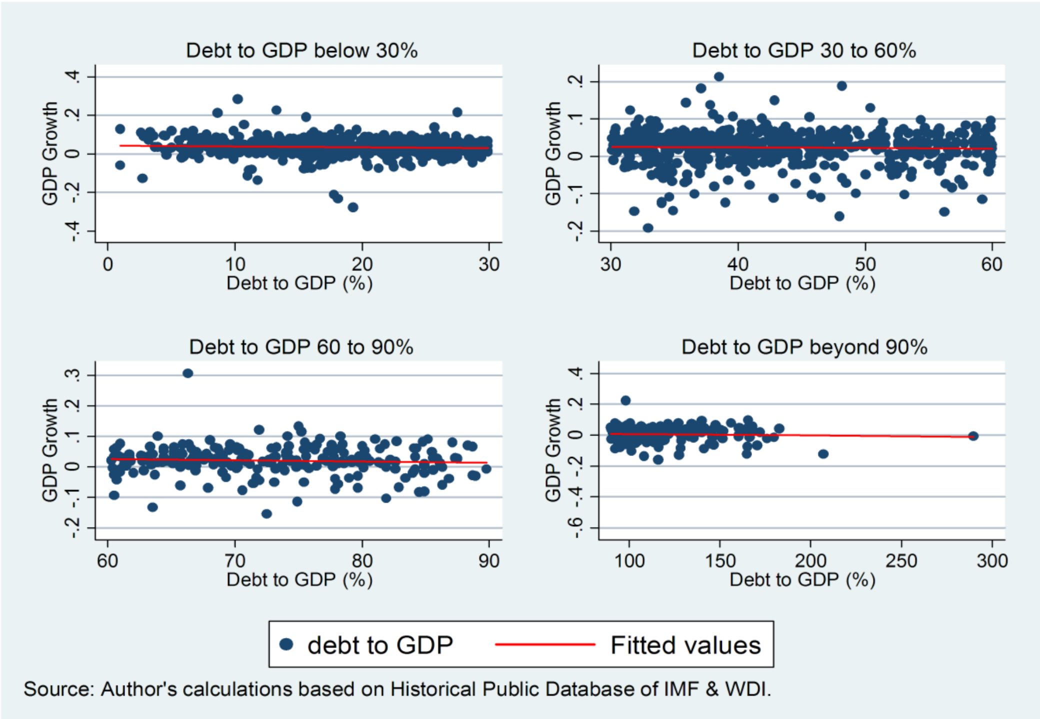

Figure 4.Public Debt and Growth: Emerging Economies, 1960-2011

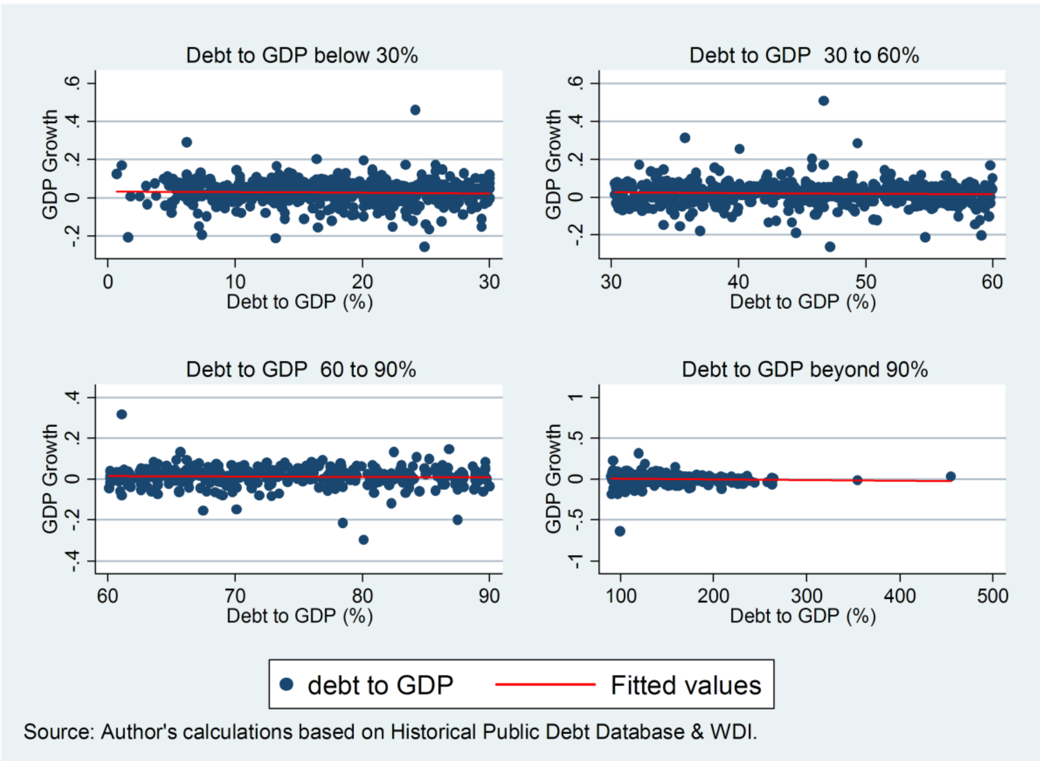

Figure 5.Public Debt and Growth: Developing Economies, 1960-2011

3.2. Public Debt and Growth: Empirical Results

In this study, relationship between debt and growth estimated by the FE estimation of a conventional growth equation augmented with public debt levels:

$$\Delta y_{it} = \alpha + X'_{it}\beta + u_{it}$$

where Δy_{it} is real GDP per capita growth denoted by the first difference of natural logs of real GDP. $X_{i,t}$ represents the explanatory variables such as debt (public debt/GDP), gcf (gross capital formation/GDP), openness ((imports + exports/GDP)), inf (consumer price index inflation) llgdp (liquid liabilities/GDP), fxr (de facto exchange rate regime classification), fint (financial integration), education (secondary school enrollment rate). In addition, dummies are used to classify the countries such as emm for emerging economies, adv for advanced economies, dev for developing economies. Then, interactive dummies are created such as debt*adv, debt*emm, debt*dev for advanced, emerging and developing economies correspondingly in order to be able to compare different economic groupings. However, FE procedure assumes that cross sections are independent. When we apply Pesaran's CSD test to our sample, results indicate that our data is suffered from cross section dependency. Therefore, we follow a recent procedure which is cross sectionally augmented distributed lag estimator (CS-DL) developed by Chudik et al. (2013). CS-DL estimator is robust to cross section dependency, heterogeneity, serial correlation, nonstationarity and other possible breaks in the error processes.

Data on gross capital formation as a share GDP (gcf), real gross domestic product per capita (rgdp), exports and imports to measure openness as share of GDP (open) are from the World Development Indicators (WDI) database. As a proxy for human capital, data on education is taken from Barro-Lee 5-year grouped total secondary school attainment as a percentage of total population aged 15 and over ,also, the data is interpolated to annual observations Public debt data is taken from the Historical Public Debt Database of IMF's fiscal affairs department. As an indicator to financial development liquid liabilities (M3) to GDP is taken from the World Bank's Financial Development and Structure Dataset (updated Nov. 2013). For *de facto* exchange rate regime (fxr), monthly coarse classification of Ilzetzki, Reinhart, and Rogoff (2010) classification is used. Financial integration is proxied by sum of total foreign assets and liabilities to GDP from the updated version of "External Wealth of Nations Mark II" created by Lane and Milesi-Ferreti (2006). The data covers up 128 economies classified as 26 advanced economies, 40 emerging economies and 62 developing economies spanning a period of 1960-2011. In the appendix A, it is presented the list of countries classified according to the MSCI index. Also, the countries which cannot be grouped by MSCI are classified according to the IMF classification.

3.2.1. Fixed Effects Estimation Results

We start with the estimation of the following bivariate equation to investigate the relationship between public debt and economic growth:

$$\Delta y_{it} = \alpha + \beta debt_{it} + u_{it}$$

where Δy_{it} is real income growth computed by the first log difference of real gross domestic product and debt is the ratio of public debt to real gross domestic product whilst the subscripts i and t denote country and time, respectively.

Table 1 reports the fixed effects[1] (fe) estimation results of the bivariate equation for different country groupings. The results suggest that there is a negative relationship between public debt and growth. For the whole sample, one unit increase in the debt ratio leads to a decline in economic growth rate by around

[1]The critical difference between FE and random effects (RE) procedures is that the FE allows for correlation between the unobserved heterogeneity and the explanatory variable(s) whereas RE requires these to be uncorrelated. Hausman (1978) proposed a test statistic to choose between these two methods. In this test statistics, the null hypothesis claims that time invariant effect is uncorrelated with the explanatory variables. If it is not rejected then both FE and RE produce consistent estimation results. If the Hausman test statistics is significant, then the null hypothesis is rejected and FE estimation is used. The Hausman test suggested the use of the fixed effects procedure rather than the random effects.

0.03 points. The impact of public debt is estimated as -0.033 for advanced economies, -0.034 for emerging economies and -0.023 for developing economies. These results suggest that the negative impact of public debt is lowest in developing economies whilst the impact is almost the same for emerging market and advanced economies. The results from Table 1 may be interpreted as consistent with the findings of Egert (2012) from the FE estimation of bivariate equations. Egert (2012) find that, the adverse impact of debt is 0.020 for advanced economies and 0.026 for emerging economies during 1946-2009.

In order to be able to see whether the differences are statistically significant among country groupings, we consider country specific dummy variables. For advanced economies, adv takes 1 if the country is an advanced economy, zero otherwise. Similarly, emm takes 1 if the country is emerging and dev takes 1 if the country is developing economy, zero otherwise. Then, interaction terms are added to the model such as debt*adv, debt*emm and debt*dev. To avoid dummy variable trap, we remove one of the group. Then, the removed group becomes the reference group. Therefore, the coefficient of debt variable shows the impact of debt on growth for the reference group. The results represented by Table 2. First column of the Table 2 shows the FE estimates of the debt on growth where the reference group is the advanced economies. Therefore, the coefficient of debt shows the adverse impact of debt on growth for advanced economies. The coefficient of debt*emm indicates the difference between emerging and advanced economies in terms of the impact of debt. Similarly, the coefficient of debt*dev shows the difference between developing and advanced economies in terms of the impact of debt. In the second and third columns of the table 2 shows the models in which emerging and developing economies are taken as the reference group, respectively. However, results indicate that the differences are statistically insignificant in terms of the impact of debt on growth.

Table 1.Bivariate Regression Analysis: FE Estimates of Debt and Growth

Variables	(All Economies)	(Advanced Economies)	(Emerging Economies)	(Developing Economies)
debt	-0.027*** (0.002)			
debt		-0.033*** (0.006)		
debt			-0.034*** (0.005)	
debt				-0.023*** (0.003)
α	0.036*** (0.001)	0.026*** (0.001)	0.027*** (0.001)	0.027*** (0.001)
R^2	0.029	0.097	0.033	0.019
F	135.1	118.6	49.1	38.7
N	128	26	40	62
NT	4672	1130	4672	4672

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively. F is the F statistic to test the null hypothesis that all the slope coefficients are jointly zero. N and NT are, correspondingly, the numbers of countries and observations for the sample.

Table 2.Bivariate Regression Analysis: FE Estimates of Debt and Growth for different Country Groupings

Variables	(Reference group: Advanced Economies)	(Reference group: Emerging Economies)	(Reference group: Developing Economies)
debt	-0.033*** (0.005)	-0.034*** (0.005)	-0.023*** (0.003)
debt*emm	-0.0007 (0.007)		-0.011 (0.006)
debt*dev	0.01 (0.006)	0.011 (0.006)	
debt*adv		0.0007 (0.007)	-0.01 (0.006)
α	0.036*** (0.001)	0.036*** (0.001)	0.036*** (0.001)
R^2	0.030	0.030	0.030
F	46.62	46.62	46.62
N	128	128	128
NT	4672	4672	4672

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively. F is the F statistic to test the null hypothesis that all the slope coefficients are jointly zero. N and NT are, correspondingly, the numbers of countries and observations for the sample.

We proceed with the fixed effects estimation of a conventional growth model augmented with public debt variable:

$$\Delta y_{it} = \alpha + X'_{it}\,\beta + u_{it}$$

where Δy_{it} is real GDP per capita growth and $X_{i,t}$ contains explanatory variables such as debt, gcf (gross capital formation/GDP), openness ((imports + exports/GDP)), inf (consumer price index inflation), llgdp (liquid liabilities/GDP) to proxy financial development, fxr (*de facto* exchange rate regime classification), fint (international financial integration) and education (secondary school enrollment rate) as already defined. In addition, we use the dummies for different country groupings.

Table 3, Table 4, Table 5 and Table 6 present the FE estimation results for overall, advanced, emerging and developing economies, respectively. The results for the whole sample presented by Table 3 suggest that the impact of public debt on growth is negative. The results from Table 3 suggest that international financial integration (fint), education and financial development (llgdp) are statistically insignificant in explaining growth. The impact of investments as proxied by gross capital formation (gcf) is positive as expected. Exchange rate regime flexibility (fxr) variable appears to have a negative coefficient. This may be interpreted as exchange rate flexibility increases growth decreases[2]. The results from Table 3 further suggest that growth declines with inflation and openness. The estimation of the general equation with sequential reduction of the statistically insignificant variables provides a stronger support for these results.

Table 4 reports the estimation results for the advanced economies sample. The negative impact of the public debt on growth appears to be almost the same for the whole sample (-0.020) and advanced economies (-0.017). The levels of financial development, education and openness may be expected to be stable and not to vary substantially between advanced countries. Consistent with this, these variables are found to be statistically insignificant in the equations for the advanced countries sample. The impact of investment is positive and openness is negative. Growth of the advanced countries appears to be invariant to the prevailing exchange rate regime.

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[2] Ilzetzki, Reinhart and Rogoff (2010) classifies de facto exchange rate regimes on a 1-15 scale with higher values denoting more flexible exchange rate arrangements. Ilzetzki et al., (2010) notes that classifying episodes of severe macroeconomic instability with very high inflation and exchange rate change as a conventional exchange rate regime may be misleading and thus these episodes are classified as “freely falling” with a scale of 15. The negative exchange rate regime coefficient in the growth regression may be also due to the inclusion of several macroeconomic instability and crises episodes, and thus should be interpreted with a caution.

Table 5 reports the results for the emerging market economies sample. The negative impact of the public debt on growth appears to be more severe in emerging market countries as suggested by the estimated debt coefficient (-0.024) which is considerably lower than that for the advanced economies (-0.017). These results may be interpreted as virtually consistent with those of Kumar and Woo (2010) and Cecchetti, Mohanty and Zampolli (2011). Kumar and Woo (2010) find the impact of debt as -0.020 for the whole sample (46 emerging and advanced economies) and -0.015 just for advanced economies spanning a period of 1970-2009. In the same vein, Cecchetti, Mohanty and Zampolli (2011) reports almost similar results to our findings. That is, the negative impact of debt on growth is ranging from 0.0164 to 0.020 for 18 OECD countries over a period of 1980-2006 depending on the control variables used. On the other hand, findings of Eberhart and Presbitero (2013) are slightly lower than our findings (Table 1.1). They find the adverse impact of debt as 0.034 according to the FE estimates of linear bivariate regression for 105 countries including advanced, emerging and developing groupings over 1972 to 2009.

An increase in investment and a decrease in inflation appear to stimulate growth whilst higher international financial integration worsens. The result for international financial integration may be consistent with the frequent financial crisis in financially integrated emerging market countries during the recent decades. The results for developing countries are reported by Table 6. The negative impact of public debt on growth may be interpreted as slightly lower in developing countries than emerging market countries. As developing countries are often the countries with low levels of international financial integration, financial integration changes do not matter for developing countries. Inflation, trade openness and higher exchange rate regime flexibility tend to affect growth in developing countries adversely. Higher investment, on the other hand, stimulates growth in this country grouping.

Table 3. Growth Models: FE Estimates for the Whole Sample

Equation / Variables	(3.1)	(3.2)	(3.3)	(3.4)
debt	-0.019***	-0.016***	-0.013***	-0.020***
	(0.005)	(0.0041)	(0.004)	(0.003)
fint	0.0002			
	(0.0002)			
fxr	-0.004**	-0.005***	-0.005***	-0.004***
	(0.0014)	(0.0012)	(0.001)	(0.0008)
gcf	0.175***	0.172***	0.179***	0.157***
	(0.021)	(0.019)	(0.018)	(0.014)
inf	-0.002***	-0.002***	-0.001***	-0.001***
	(0.001)	(0.0004)	(0.0002)	(0.0001)
llgdp	0.0014	0.001		
	(0.006)	(0.005)		
open	-0.007	-0.013*	-0.01**	-0.006*
	(0.007)	(0.005)	(0.004)	(0.003)
education	-0.013	-0.010	-0.014	
	(0.009)	(0.008)	(0.007)	
α	0.008	0.013	0.012	0.009*
	(0.001)	(0.009)	(0.008)	(0.005)
R^2	0.079	0.082	0.077	0.075
F	17.77	25.07	32.18	49.60
N	112	113	119	121
NT	1767	2084	2430	3201

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively. F is the F statistic to test the null hypothesis that all the slope coefficients are jointly zero. N and NT are, correspondingly, the numbers of countries and observations for the sample.

Table 4.Growth Models: FE Estimates for Advanced Economies

Equation / Variable	(4.1)	(4.2)	(4.3)	(4.4)	(4.5)	(4.6)
debt	0.005 (0.007)	-0.016** (0.006)	-0.018*** (0.005)	-0.018*** (0.005)	-0.017*** (0.005)	-0.017*** (0.005)
fint	0.0002 (0.001)	0.0001 (0.0001)	0.0001 (0.0002)	0.0001* (0.0001)	0.0001* (0.0001)	0.0001* (0.0001)
fxr	-0.001 (0.002)	0.001 (0.002)	0.0005 (0.002)	0.0002 (0.002)	0.0004 (0.001)	
gcf	0.232*** (0.04)	0.15*** (0.03)	0.16*** (0.029)	0.160*** (0.028)	0.165*** (0.027)	0.17*** (0.027)
inf	-0.009 (0.01)	-0.003 (0.01)	-0.003 (0.01)	-0.003 (0.01)		
llgdp	-0.003 (0.01)	0.0004 (0.01)				
open	-0.003 (0.01)	-0.004 (0.006)	0.002 (0.005)			
education	-0.03 (0.01)					
α	-0.001 (0.02)	-0.005 (0.01)	-0.001 (0.001)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)
R^2	0.116	0.091	0.108	0.107	0.107	0.112
F	1.62	2.39	2.46	3.85	4.04	4.07
N	25	25	25	25	25	25
NT	526	661	696	705	750	754

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively. F is the F statistic to test the null hypothesis that all the slope coefficients are jointly zero. N and NT are, correspondingly, the numbers of countries and observations for the sample.

Table 5.Growth Models: FE Estimates for Emerging Economies

Equation / Variables	(5.1)	(5.2)	(5.3)	(5.4)	(5.5)
debt	-0.025** (0.008)	-0.029*** (0.007)	-0.027*** (0.007)	-0.026*** (0.006)	-0.024*** (0.006)
fint	-0.003 (0.003)	-0.003 (0.003)	-0.005* (0.002)	-0.003 (0.002)	-0.005* (0.002)
fxr	-0.002 (0.002)	-0.002 (0.002)	-0.002 (0.002)	-0.002 (0.002)	
gcf	0.135*** (0.036)	0.117*** (0.027)	0.122*** (0.027)	0.134*** (0.026)	0.126*** (0.026)
inf	-0.002*** (0.001)	-0.002*** (0.001)	-0.002*** (0.001)	-0.002*** (0.001)	-0.002*** (0.001)
llgdp	-0.003 (0.01)	-0.003 (0.01)			
open	0.006 (0.01)	0.004 (0.01)	0.004 (0.01)		
education	0.001 (0.01)				
α	0.01 (0.015)	0.018* (0.009)	0.02* (0.008)	0.016* (0.008)	0.014 (0.007)
R^2	0.095	0.084	0.082	0.080	0.080
F	3.70	4.32	4.35	4.37	4.16
N	37	37	37	37	37
NT	633	851	892	920	951

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively. F is the F statistic to test the null hypothesis that all the slope coefficients are jointly zero. N and NT are, correspondingly, the numbers of countries and observations for the sample.

Table 6.Growth Models: FE Estimates for Developing Economies

Equation / Variables	(6.1)	(6.2)	(6.3)	(6.4)
debt	-0.026** (0.009)	-0.033*** (0.007)	-0.028*** (0.006)	-0.020*** (0.005)
fint	0.0003 (0.0008)	0.00004 (0.0004)	0.0001 (0.000)	
fxr	-0.008* (0.003)	-0.007** (0.002)	-0.008*** (0.002)	-0.007*** (0.002)
gcf	0.182*** (0.04)	0.162*** (0.03)	0.158*** (0.03)	0.150*** (0.02)
inf	-0.0008 (0.002)	-0.0003 (0.0004)	-0.0003 (0.0002)	-0.0004* (0.0002)
llgdp	0.03 (0.019)	0.011 (0.015)		
open	-0.029* (0.014)	-0.013 (0.01)	-0.017* (0.008)	-0.018** (0.006)
education	-0.04 (0.03)			
α	0.03 (0.02)	0.015 (0.01)	0.02* (0.01)	0.02* (0.008)
R^2	0.084	0.082	0.079	0.073
F	1.63	2.69	1.95	2.56
N	51	53	56	57
NT	608	842	935	1264

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively. F is the F statistic to test the null hypothesis that all the slope coefficients are jointly zero. N and NT are, correspondingly, the numbers of countries and observations for the sample.

In Tables 7, 8, 9 and 10, report the results of the estimation of the growth equations augmented with debt threshold dummy variables for different country groupings. To this end, we define dummy variables such as d30 for debt level beyond 30% but lower that 60%, d60 for debt level between 60% and 90 % and d90 for debt beyond 90%, respectively for overall, advanced emerging and developing economies in order to see the impact of debt on growth at different debt levels. In these equations, the intercept term represents the base category which is the debt lower 30 %.

For the whole sample, the negative impact of debt level on growth increases (in absolute value) when the debt level is between 30 % and 60 % (moderate level) and beyond 90% (severely high level) as suggested by the negative and significant d60 and d90 coefficients in Table 7. This impact, with respect to the low debt level, appear not to change significantly for the debt level between 60 % and 90 % (high level) and the reference low level group (below 30 %). For these groups of countries debt level appear not to significantly affect growth. The reason for the high level group may be due to the fact that this group contains mainly advanced countries. The impacts of investments (gcf), exchange rate regime (fxr) and inflation remain significant in the equation augmented with the debt threshold variables in Table 7.

Table 8 reports the results for advanced economies. The debt threshold variables are negative and significant in the equation without the control variables (Eq. 7.1) suggesting that the negative affect of debt increases with the debt level. However, the debt threshold variables become statistically insignificant when the control variables (investments and international financial integration) are added to the model (Eq. 7.2). Consequently, the results may be interpreted as lending a support to the view that the growth is invariant to different public debt levels in advanced countries.

Table 9 reports the results for emerging markets. According to (Eq. 9.1) the negative impact of the debt is insignificant at low and high levels. This impact is, however, negative at moderate and severely high levels. Beyond 90 % severely high level, the adverse impact of debt notably increases. The results change, on the other hand, when the significant control variables are added to the equation. According to equation 9.2, public debt affects economic growth at moderate levels adversely. For developing economies, public debt enhances growth at low levels as suggested by positive and significant intercept term coefficient (Eqs. 10.1 and 10.2). This impact does not change at the high levels. For severely high and moderate debt levels, on the other hand, public debt leads to a significant decline in growth.

Our estimation results do not support the findings of Reinhart and Rogoff (2010). According to the Reinhart and Rogoff (RR) results, only beyond 90% debt to GDP, debt leads growth to decrease markedly for both advanced and emerging economies. The average growth slows down by 0.004 for advanced economies and 0.003 for emerging markets. However, their research does not provide an empirical support for their results. On the other hand, Kumar and Woo (2010) search for any threshold effect by using dummies for debt levels suggested by RR. FE estimates indicate debt dummies for low, high and very high debt are insignificant. However, BE (Between Estimator) and SGMM (System Generalized Method of Moments) estimation results yields that beyond 90% debt to GDP, growth decreases by 0.018. Egert (2012) finds as the debt increases, growth worsens more. However, Egert does not find any threshold impact for debt levels as suggested by RR. The findings, also, suggest that emerging economies suffers more from debt than the advanced economies.

Table 7.FE Estimates of the Growth Equations with different Debt Levels: All Countries

Equation / Variables	(7. 1)	(7.2)
d30	-0.010*** (0.002)	-0.009*** (0.002)
d60	-0.006** (0.002)	-0.003 (0.002)
d90	-0.015*** (0.003)	-0.01** (0.003)
fxr		-0.004*** (0.001)
gcf		0.156*** (0.01)
inf		-0.001*** (0.0002)
α	0.032*** (0.002)	0.002 (0.004)
R^2	0.026	0.074
F	41.11	44.29
N	128	123
NT	4672	3479

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively. F is the F statistic to test the null hypothesis that all the slope coefficients are jointly zero. N and NT are, correspondingly, the numbers of countries and observations for the sample.

Table 8.FE Estimates of the Growth Equations with different Debt Levels: Advanced Economies

Equation Variables	(8.1)	(8.2)
d30	-0.015*** (0.002)	-0.006* (0.003)
d60	-0.008*** (0.002)	-0.005 (0.003)
d90	-0.013*** (0.003)	-0.006 (0.005)
fint		0.0002* (0.0001)
gcf		0.167*** (0.03)
α	0.04*** (0.002)	-0.012 (0.010)
R^2	0.100	0.111
F	40.62	18.10
N	26	25
NT	1130	754

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively. F is the F statistic to test the null hypothesis that all the slope coefficients are jointly zero. N and NT are, correspondingly, the numbers of countries and observations for the sample.

Table 9.FE Estimates of the Growth Equations with different Debt Levels: Emerging Economies

Equation Variables	(9.1)	(9.2)
d30	-0.01** (0.003)	-0.010** (0.004)
d60	-0.006 (0.004)	-0.003 (0.005)
d90	-0.02** (0.005)	-0.009 (0.006)
fint		-0.005* (0.002)
gcf		0.130*** (0.03)
inf		-0.002*** (0.001)
α	0.04*** (0.002)	0.010 (0.01)
R^2	0.028	0.079
F	13.99	12.92
N	40	37
NT	1483	951

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively. F is the F statistic to test the null hypothesis that all the slope coefficients are jointly zero. N and NT are, correspondingly, the numbers of countries and observations for the sample.

Table 10.FE Estimates of the Growth Equations with different Debt Levels: Developing Economies

Equation	(10.1)	(10.2)
Variables		
d30	-0.007* (0.004)	-0.012** (0.004)
d60	-0.005 (0.004)	-0.001 (0.005)
d90	-0.015*** (0.005)	-0.014* (0.006)
fxr		-0.007*** (0.002)
gcf		0.152*** (0.02)
inf		-0.0004* (0.0002)
open		-0.017** (0.006)
α	0.03*** (0.003)	0.020* (0.008)
R^2	0.017	0.074
F	11.34	13.75
N	62	57
NT	2059	1264

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively. F is the F statistic to test the null hypothesis that all the slope coefficients are jointly zero. N and NT are, correspondingly, the numbers of countries and observations for the sample.

To sum up, FE estimation results indicate that debt has an adverse impact on growth which is consistent with the literature. FE estimates of bivariate regression indicate that emerging markets and advanced economies suffer most from the debt. However, FE estimates of bivariate regression with country specific dummies display that the differences among economies in terms of the impact of debt on growth statistically insignificant. Also, when we insert dummies for different debt levels such as 30 to 60 % (moderate), 60 to 90 % (high) and beyond 90% (severely high), results declare that at some levels, the impacts of debt are statistically insignificant for different groupings. Moreover, when the models are extended to contain the basic variables suggested by the conventional growth literature, some of the significant estimates of bivariate regressions turn out to be insignificant.

3.2.2. CS-DL Estimation Results

The FE estimation procedure assumes that cross sections are independent. Table 11 report the Cross-Section Dependence (CSD) test of Pesaran (2004) which is based on the average of the pair-wise correlations of the OLS residuals from the individual-country bivariate regressions of growth on debt. The null hypothesis of the CSD is cross-section independence and the test is distributed as standard normal. For all country groupings, Pesaran's CSD test statistics strongly rejects the null hypothesis that cross sections are independent. Consequently, the FE estimates may not be reliable as they suffer from cross sectional dependency.

In this section, we consider the recent cross sectionally augmented distributed lag (CS-DL) approach to the estimation of the long-run coefficients in dynamic heterogeneous panels with cross-section dependent errors proposed by Chudik *et al.* (2013). The CS-DL approach is based on augmentation of the distributed lag (DL) regressions with cross-sectional averages of the regressors, the dependent variable and a sufficient number of their lags. Chudik *et al.* (2013) show that, the CS-DL procedure is robust to the possibility of unit roots in regressors, heterogeneity or homogeneity of short and/or long-run coefficients, serial correlation and cross-sectional dependence. Furthermore, the CS-DL approach does not require specifying the individual lag orders and is robust to possible breaks in the processes and it performs well even in case of reverse causation since the bias becomes very small as the sample size increases according to the

Monte Carlo experiments. Therefore, for further analysis, CS-DL approach developed by Chudik *et al*. (2013) is applied to the bivariate regression analysis of debt and growth.

To estimate the CS-DL mean group bivariate model for public debt and growth, we consider the following model:

$$\Delta y_{it} = \alpha_i + \theta'_i \, \Delta debt_{it} + \sum_{l=0}^{p-1} \delta_{il}^{'} \Delta\Delta debt_{it-l} + \omega_{iy} \Delta ybar_t + \sum_{l=0}^{3} \omega_{i,xl}^{'} \Delta debtbar_{t-l} + e_{it}$$

where $\Delta debt_{it}$ is debt growth, $\Delta\Delta debt_{it-l}$ is the log differences of debt growth, $\Delta ybar_t$ is the cross section means of the growth and $\Delta debtbar_{t-l}$ is the lags of the debt growth cross section means. Different truncation lag orders are used, p=1, 2, 3 and three lags of the cross sectional averages of the regressors in all specifications as suggested by Chudik *et al.* (2013).

Table 12 presents the CS-DL mean group estimates of debt and growth for the whole sample. The results indicate that debt growth adversely affects real income growth and the adverse impact of debt on growth ranges between 0.07 and 0.08 depending on the lag levels. Furthermore, the results suggest that not only the debt growth but also the acceleration of the debt (ΔΔdebt) negatively affects economic growth. Another interesting finding by Table 12 is that, an increase in the cross-section means of real output such as proxied by Δybar has a positive impact on growth.

Tables 13, 14 and 15, respectively, presents the CS-DL results for the advanced, emerging and developing economies. The results for the advanced economies indicate that the adverse impact of debt is range from 0.041 and 0.054. For emerging economies this impact is higher and it ranges from 0.078 and 0.097. For developing economies, on the other hand, the negative impact appears to be between that of advanced economies and emerging market economies which is about 0.07. Consequently, the results suggest that that emerging economies suffer most from the debt whilst the advanced economies suffer the least. Our results are consistent with the findings of Chudik *et al.* (2013). They find a negative relationship between debt to GDP growth and economic growth ranging from -0.068 to -0.087 for 40 countries over 1965-2010 period.

Table 11.Pesaran CSD Test Results for Bivariate Regression of Debt and Growth

Country Grouping	Pesaran's CSD Test
Overall Economies	61.9 (0.000)
Developing Economies	22.3 (0.000)
Emerging Economies	17.9 (0.000)
Advanced Economies	443.1 (0.000)
p values in parenthesis.	

Table 12.CS-DL MG Estimates with Debt/GDP Growth for the Whole Sample

Equation / Variables	(12.1)	(12.2)	(12.3)
Δdebt	-0.080*** (0.0113)	-0.082*** (0.0137)	-0.070*** (0.0165)
$\Delta\Delta$debt	-0.082*** (0.00871)	-0.079*** (0.00917)	-0.074*** (0.00861)
Δybar	0.777*** (0.109)	0.719** (0.102)	0.865*** (0.117)
Δdebtbar	0.067* (0.0324)	0.049 (0.0322)	0.051 (0.0288)
$\Delta debtbar_{t-1}$	-0.004 (0.0166)	0.007 (0.0165)	0.02 (0.0171)
$\Delta debtbar_{t-2}$	-0.02 (0.0132)	-0.01 (0.0144)	-0.03 (0.0152)
$\Delta debtbar_{t-3}$	0.013 (0.017)	-0.012 (0.0153)	-0.017 (0.0198)
$\Delta\Delta debt_{t-1}$		-0.002 (0.005)	-0.01 (0.01)
$\Delta\Delta debt_{t-2}$			-0.009 (0.007)
α	0.009** (0.003)	0.009** (0.003)	0.007* (0.003)
χ^2	257.4	269.8	298.8
N	128	126	124
NT	4305	4159	4010

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively. N and NT are, correspondingly, the numbers of countries and observations for the sample. χ^2 is the Wald χ^2 statistic to test the null hypothesis that all the slope coefficients are jointly zero.

Table 13.CS-DL MG Estimates with Debt/GDP Growth: Advanced Economies

Equation / Variables	(13.1)	(13.2)	(13.3)
Δdebt	-0.041*	-0.054***	-0.052***
	(0.017)	(0.016)	(0.016)
ΔΔdebt	-0.064***	-0.065***	-0.07***
	(0.014)	(0.014)	(0.015)
Δybar	0.920***	0.924***	0.917***
	(0.101)	(0.102)	(0.113)
Δdebtbar	0.044	0.05	0.0516
	(0.033)	(0.034)	(0.037)
$\Delta debtbar_{t-1}$	-0.002	-0.007	-0.002
	(0.025)	(0.028)	(0.029)
$\Delta debtbar_{t-2}$	-0.027	-0.02	-0.023
	(0.023)	(0.028)	(0.033)
$\Delta debtbar_{t-3}$	0.019	0.006	-0.016
	(0.018)	(0.015)	(0.02)
$\Delta\Delta debt_{t-1}$		-0.003	-0.015
		(0.006)	(0.010)
$\Delta\Delta debt_{t-2}$			-0.010
			(0.012)
α	0.003	0.001	0.002
	(0.002)	(0.002)	(0.002)
χ^2	332.6	333.4	271
N	26	25	25
NT	1036	1006	985

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively. N and NT are, correspondingly, the numbers of countries and observations for the sample. χ^2 is the Wald χ^2 statistic to test the null hypothesis that all the slope coefficients are jointly zero.

Table 14.CS-DL MG Estimates with Debt/GDP Growth: Emerging Economies

Equation / Variables	(14.1)	(14.2)	(14.3)
Δdebt	-0.094*** (0.025)	-0.097*** (0.029)	-0.078* (0.044)
$\Delta\Delta$debt	-0.084*** (0.015)	-0.087*** (0.015)	-0.082*** (0.017)
Δybar	0.936*** (0.169)	0.804*** (0.133)	0.659*** (0.107)
Δdebtbar	0.065 (0.037)	0.04 (0.032)	-0.018 (0.036)
Δdebtbar $_{t-1}$	-0.014 (0.029)	0.006 (0.037)	0.026 (0.029)
Δdebtbar $_{t-2}$	0.009 (0.022)	-0.017 (0.024)	-0.033 (0.037)
Δdebtbar $_{t-3}$	0.003 (0.02)	-0.004 (0.019)	-0.020 (0.028)
$\Delta\Delta$debt $_{t-1}$		-0.012 (0.01)	-0.024 (0.024)
$\Delta\Delta$debt $_{t-2}$			-0.0138 (0.0171)
α	0.005 (0.005)	0.008 (0.005)	0.012* (0.005)
χ^2	147	134.6	184.8
N	40	40	40
NT	1351	1305	1258

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively N and NT are, correspondingly, the numbers of countries and observations for the sample. χ^2 is the Wald χ^2 statistic to test the null hypothesis that all the slope coefficients are jointly zero.

Table 15.CS-DL MG Estimates with Debt/GDP Growth: Developing Economies

Equation / Variables	(15.1)	(15.2)	(15.3)
Δdebt	-0.067*** (0.013)	-0.071*** (0.015)	-0.070*** (0.021)
ΔΔdebt	-0.070*** (0.011)	-0.064*** (0.010)	-0.063*** (0.012)
Δybar	0.665*** (0.132)	0.699*** (0.115)	0.743*** (0.142)
Δdebtbar	0.060* (0.030)	0.055 (0.030)	0.036 (0.025)
$\Delta debtbar_{t-1}$	-0.004 (0.017)	0.0005 (0.016)	0.015 (0.021)
$\Delta debtbar_{t-2}$	-0.024 (0.015)	-0.007 (0.018)	-0.015 (0.019)
$\Delta debtbar_{t-3}$	0.022 (0.019)	-0.008 (0.017)	-0.013 (0.022)
$\Delta\Delta debt_{t-1}$		0.0005 (0.007)	-0.0001 (0.013)
$\Delta\Delta debt_{t-2}$			-0.005 (0.010)
α	0.011** (0.004)	0.008* (0.003)	0.008* (0.004)
χ^2	93.4	105	87
N	62	61	59
NT	1918	1848	1767

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively.. N and NT are, correspondingly, the numbers of countries and observations for the sample. χ^2 is the Wald χ^2 statistic to test the null hypothesis that all the slope coefficients are jointly zero.

To investigate whether the impact of debt differs at different levels, we consider the exogenous debt level thresholds such as 30 to 60 (moderate level), 60 to 90 (high level) and beyond 90percent (severely high level) suggested by Reinhart and Rogoff (2010). The model is the following:

$$\Delta y_{it} = \alpha_{i\tau} + \gamma_{i\tau} d\tau_{it} + e_{it}$$

where $d\tau_{it}$ is the dummy which takes 1 if debt to GDP level is in range of the predetermined debt level threshold (τ =30 to 60%, 60 to 90%, beyond 90%) and zero otherwise.

The results for the whole sample are presented by Table 16. Equation 16.1 estimates the regression for the all debt levels. The results indicate that at moderate level, the impact of debt is -0.006. At high level, it is similar and equals -0.005. However, the negative impact is larger and equals to -0.008 at severely high levels. MG estimates of the coefficients of the dummies which are d30, d60 and d90 are -0.010, -0.015 and -0.020 respectively for the whole sample (Eqs. 16.2, 16.3 and 16.4).The results by Table 16 suggests that the adverse impact of debt increases with the debt level for the whole sample of countries.

Also, the threshold effect is analyzed by using the mean group (MG) estimates for different economic groupings. Table 17, Table 18 and Table 19 show the results respectively for advanced, emerging and developing economies. For advanced economies the results are similar to the results for the whole group. That is, the coefficients of debt 30 to 60%, 60 to 90% and beyond 90% are -0.01, -0.016 and -0.020, respectively (Eqs. 17.2, 17.3 and 17.4). However, the results of the regression which includes all debt levels (Eq. 17.1) indicate that beyond 90 percent, the impact is insignificant. On the other hand, at moderate and high debt levels, impacts are significant and equal to -0.007 and -.0.011. For emerging markets, only the impact of debt beyond 90% is significant and equals to -0.01 (Eq.18.1). On the other hand, economic growth slows down approximately by 0.03 points at the severely high level (Eq.18.4). Also, the impacts are almost the same to the advanced economies for debt at moderate and high levels of debt (Eqs. 18.2 and 18.3). Results for developing economies are represented by the Table 19. According to the equation 19.1, the impact of debt is significant only at severely high level (beyond 90%) and equals to -0.011. On the other hand, the results by equations 19.2 and 19.3, the impact of debt on growth is same for debt 30 to 60% and 60 to 90 % which is -0.012. However, it is -0.018 for debt beyond 90%. Results of the first equations of the different debt level indicate that for emerging and developing economies, economy worsens at only severely high levels of debt. On the other hand, for advanced economies, the negative impact of debt is significant at just moderate and high levels. When we examine the impacts of debt at different levels separately, the results show that the impact of debt for developing economies is similar to advanced economies and at all debt levels. The only notable distinction is observed for emerging economies when debt is beyond 90% (Eq. 18.4). At this level, economy worsens much more for emerging economies compared to advanced and developing economies. In the same vein, Chudik *et al.* (2013) find similar results. They find the impact of debt to GDP at 30 to 40% as -0.008. It is -0.010 at 40 to 50% debt to GDP level and -0.012 at 50 to 60%. On the other hand, the coefficients of debt to GDP at 70 to 80%, 80 to 90% and beyond 90% are -0.016, -0.020 and -0.021 correspondingly, for 40 countries over a period of 1965-2010.

Although mean group estimates of debt levels allows for heterogeneity, mean group estimates of the debt levels do not consider possible cross section dependency. Therefore, the dummies for debt levels are inserted into the CS-DL model and the model turns out to be following:

$$\Delta y_{it} = \alpha_{i\tau} + \gamma_{i\tau} d\tau_{it} + \theta'_{i\tau}\,\Delta debt_{it} + \sum_{l=0}^{2} \delta'_{il,\tau} \Delta\Delta debt_{it-l} + \omega_{iy,\tau} \Delta ybar_t$$

$$+ \sum_{l=0}^{3} \omega'_{i,xl,\tau} \Delta debtbar_{t-l} + e_{it}$$

Table 20 displays the results for the all countries. Results by equation 20.1 indicate that when the debt level dummies are jointly included, they are insignificant in the equation. However, when only the single dummies are included, debt beyond 90 % slows down economy by 0.012 points (Eq. 20.4). However, the coefficients of d30 and d60 are insignificant (Eqs.20.2 and 20.3). Results for different country groupings are shown by Tables 21, 22 and 23. However, except the coefficient of debt beyond 90% (Eq. 23.4) for developing economies (-0.012), all coefficients of debt levels are insignificant. These results are consistent with the findings of Chudik *et al.* (2013) that is no significant impacts of debt levels on growth.

Chudik *et al.* (2013) claims that rising debt effects the growth adversely rather than the level of debt. In other words, if the increase in debt is not permanent then it could enhance the growth under certain circumstances. However, if it is permanent then it could slow down the growth. Therefore, interaction dummies created for positive values of the debt to GDP growth to the model in order to see the effect of the rising debt. Then, the model turns out to be the following:

$$\Delta y_{it} = \alpha_{i\tau} + \gamma_{i\tau} d\tau_{it} + \gamma_{i\tau}^{+} \Delta debt^{+} d\tau_{it} + \theta'_{i\tau}\, \Delta debt_{it} + \sum_{l=0}^{2} \delta_{il,\tau}^{'} \Delta\Delta debt_{it-l}$$

$$+ \omega_{iy,\tau} \Delta ybar_{t} + \sum_{l=0}^{3} \omega_{i,xl,\tau}^{'} \Delta debtbar_{t-l} + e_{it}$$

where $\Delta debt^{+} d\tau_{it}$ $(d\tau_{it} \times \max(0, \Delta debt))$ is the interactive threshold variable which shows the positive debt growth for the certain debt level. Estimation results of the CS-DL MG regressions with debt level dummy and interactive effects for the whole sample presented by Table 24. Equation 24.1 shows positive values of debt growth for debt levels at moderate, high and severely high debt levels are insignificant. However, only the coefficient of d90 is statistically significant and equals to -0.013 (Eq. 24.4). Next, it is applied to the different groupings. Table 25, Table 26 and Table 27 indicates the results for advanced, emerging and developing economies, respectively. Estimates of the interaction terms are only statically significant for emerging markets at 90 percent level and equals -0.07 (Eq. 26.4). On the other hand, for emerging economies, there is a notable significant negative impact of rising debt for high debt levels (60 to 90%) and equals to -0.133. Also, according to the equation 26.4, the coefficient of rising debt at severely high debt level (beyond 90%) is -0.070. For developing economies, coefficient of d90 is statistically significant and equals -0.012 (27.4). On the other hand, Chudik *et al.* (2013) find that coefficients of rising debt for debt to GDP 60 to 70%, 80 to 90% and beyond 90% are significant and equals to -0.116, -0.192 and -0.140 respectively. Also, the coefficients of all debt levels are insignificant.

Then, since most of the debt level dummies are insignificant, the model is estimated by using CS-DL MG with just interactive dummies for different debt levels. Table 28 displays the results for the all countries sample. It shows that increasing debt beyond 90 percent debt to GDP, growth worsens by 0.108 (Eq. 28.4). In addition, Table 29, Table 30 and Table 31 display the results for advanced, emerging and developing economies, respectively. For advanced economies, there is no statistically significant threshold effect of rising debt on growth at any debt level. However, interactive dummies at severely high debt level (beyond 90%), coefficients are statistically significant for emerging and developing economies and equal respectively to -0.094 and -0.097 (Eqs. 29.4 and 30.4). That is, rising debt structure lead growth to slow down remarkably for emerging and developing economies rather than the advanced ones. On the other hand, Chudik *et al.* (2013) find that beyond 60%, all the coefficients of interactive terms are significant. That is, the impacts of rising debt for 60 to 70%, 70 to 80%, 80 to 90 % and beyond 90% debt to GDP are -0.113, -0.158, -0.171 and -0.159 correspondingly.

Table 16.MG Estimates with different Debt Levels for the Whole Sample

Equation / Variables	(16.1)	(16.2)	(16.3)	(16.4)
d30	-0.006*	-0.01***		
	(0.003)	(0.002)		
d60	-0.005*		-0.015***	
	(0.003)		(0.003)	
d90	-0.008**			-0.02***
	(0.003)			(0.004)
α	0.03***	0.03***	0.025***	0.025***
	(0.002)	(0.002)	(0.002)	(0.003)
χ^2	42.91	31.6	29.3	33
N	128	125	98	67
NT	4672	4600	3760	2489

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively. N and NT are, correspondingly, the numbers of countries and observations for the sample. χ^2 is the Wald χ^2 statistic to test the null hypothesis that all the slope coefficients are jointly zero.

Table 17.MG Estimates with different Debt Levels: Advanced Economies

Equation / Variables	(17.1)	(17.2)	(17.3)	(17.4)
d30	-0.007*	-0.010***		
	(0.003)	(0.003)		
d60	-0.011**		-0.016***	
	(0.004)		(0.004)	
d90	0.0007			-0.020***
	(0.003)			(0.004)
α	0.032***	0.031***	0.030***	0.030***
	(0.003)	(0.003)	(0.003)	(0.004)
χ^2	16.72	12.47	18.33	19.66
N	26	25	22	11
NT	1130	1093	986	494

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively. N and NT are, correspondingly, the numbers of countries and observations for the sample. χ^2 is the Wald χ^2 statistic to test the null hypothesis that all the slope coefficients are jointly zero.

Table 18.MG Estimates with different Debt Levels: Emerging Economies

Equation / Variables	(18.1)	(18.2)	(18.3)	(18.4)
d30	-0.006 (0.003)	-0.010*** (0.003)		
d60	-0.005 (0.005)		-0.017** (0.006)	
d90	-0.01* (0.004)			-0.029*** (0.008)
α	0.030*** (0.004)	0.030*** (0.003)	0.025*** (0.005)	0.029*** (0.005)
χ^2	14.5	11.5	8	12.9
N	40	39	30	19
NT	1483	1464	1161	721

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively. N and NT are, correspondingly, the numbers of countries and observations for the sample. χ^2 is the Wald χ^2 statistic to test the null hypothesis that all the slope coefficients are jointly zero.

Table 19.MG Estimates with different Debt Levels: Developing Economies

Equation / Variables	(19.1)	(19.2)	(19.3)	(19.4)
d30	-0.005 (0.004)	-0.012*** (0.003)		
d60	-0.002 (0.003)		-0.012** (0.004)	
d90	-0.011* (0.005)			-0.018*** (0.005)
α	0.030*** (0.003)	0.030*** (0.003)	0.020*** (0.004)	0.020*** (0.004)
χ^2	19.18	12	10	12.4
N	62	61	46	37
NT	2059	2043	1613	1274

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively. N and NT are, correspondingly, the numbers of countries and observations for the sample. χ^2 is the Wald χ^2 statistic to test the null hypothesis that all the slope coefficients are jointly zero.

Table 20.CS-DL MG Estimates with different debt levels for the Whole Sample

Equation	(20.1)	(20.2)	(20.3)	(20.4)
Variables				
Δdebt	-0.062***	-0.07***	-0.07***	-0.05**
	(0.017)	(0.02)	(0.02)	(0.02)
$\Delta\Delta$debt	-0.075***	-0.08***	-0.083***	-0.07***
	(0.009)	(0.009)	(0.01)	(0.01)
$\Delta\Delta$debt$_{t-1}$	-0.012	-0.015	-0.01	-0.007
	(0.01)	(0.01)	(0.013)	(0.013)
$\Delta\Delta$debt$_{t-2}$	-0.01	-0.008	-0.012	-0.007
	(0.008)	(0.007)	(0.01)	(0.011)
Δybar	0.68***	0.83***	0.77***	0.84***
	(0.109)	(0.117)	(0.137)	(0.133)
Δdebtbar	0.006	0.05	0.06*	0.07*
	(0.0293)	(0.0262)	(0.0308)	(0.0353)
Δdebtbar$_{t-1}$	0.012	0.02	0.003	-0.01
	(0.0179)	(0.02)	(0.02)	(0.025)
Δdebtbar$_{t-2}$	-0.026	-0.04*	-0.01	-0.03
	(0.0159)	(0.02)	(0.02)	(0.03)
Δdebtbar$_{t-3}$	-0.029	-0.018	-0.055*	-0.03
	(0.02)	(0.025)	(0.03)	(0.025)
d30	0.009	-0.004		
	(0.003)	(0.003)		
d60	-0.0001		-0.005	
	(0.0032)		(0.004)	
d90	-0.006			-0.012*
	(0.004)			(0.005)
α	0.012**	0.01**	0.008	0.006
	(0.004)	(0.004)	(0.004)	(0.005)
χ^2	272.68	298.8	214.3	126.3
N	117	120	95	64
NT	3922	3942	3246	2139

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively.. N and NT are, correspondingly, the numbers of countries and observations for the sample. χ^2 is the Wald χ^2 statistic to test the null hypothesis that all the slope coefficients are jointly zero.

Table 21.CS-DL MG Estimates with different Debt Levels: Advanced Economies

Equation Variables	(21.1)	(21.2)	(21.3)	(21.4)
Δdebt	-0.055** (0.018)	-0.05** (0.015)	-0.07** (0.024)	-0.08* (0.033)
$\Delta\Delta$debt	-0.072*** (0.016)	-0.07*** (0.016)	-0.08*** (0.018)	-0.12*** (0.03)
$\Delta\Delta$debt $_{t-1}$	-0.01 (0.010)	-0.01 (0.009)	-0.001 (0.012)	-0.02 (0.018)
$\Delta\Delta$debt $_{t-2}$	-0.007 (0.011)	-0.006 (0.0115)	-0.005 (0.0124)	-0.008 (0.0234)
Δybar	0.91*** (0.090)	0.91*** (0.104)	0.91*** (0.0929)	1.058*** (0.127)
Δdebtbar	0.042 (0.028)	0.054 (0.030)	0.066 (0.043)	0.113 (0.062)
Δdebtbar $_{t-1}$	-0.012 (0.028)	-0.021 (0.025)	-0.016 (0.028)	0.012 (0.044)
Δdebtbar $_{t-2}$	-0.012 (0.034)	-0.001 (0.022)	0.006 (0.023)	-0.004 (0.037)
Δdebtbar $_{t-3}$	-0.018 (0.021)	-0.005 (0.02)	-0.024 (0.023)	-0.010 (0.044)
d30	0.0009 (0.002)	-0.002 (0.003)		
d60	0.0004 (0.004)		0.0001 (0.004)	
d90	-0.004 (0.003)			-0.001 (0.005)
α	0.004 (0.004)	0.003 (0.003)	0.004 (0.003)	0.0005 (0.002)
χ^2	292.2	308.8	342.5	7019
N	24	23	21	10
NT	974	945	867	427

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively. N and NT are, correspondingly, the numbers of countries and observations for the sample. χ^2 is the Wald χ^2 statistic to test the null hypothesis that all the slope coefficients are jointly zero.

Table 22.CS-DL MG Estimates with different Debt Levels: Emerging Economies

Equation	(22.1)	(22.2)	(22.3)	(22.4)
Variables				
Δdebt	-0.082*	-0.103*	-0.12**	-0.12***
	(0.043)	(0.04)	(0.05)	(0.031)
$\Delta\Delta$debt	-0.082***	-0.090***	-0.102***	-0.090***
	(0.015)	(0.016)	(0.017)	(0.017)
$\Delta\Delta \text{debt}_{t-1}$	-0.025	-0.014	-0.011	-0.005
	(0.025)	(0.024)	(0.03)	(0.02)
$\Delta\Delta \text{debt}_{t-2}$	-0.015	-0.012	-0.011	0.005
	(0.018)	(0.017)	(0.023)	(0.017)
Δybar	0.566***	0.617***	0.527**	0.614***
	(0.140)	(0.114)	(0.168)	(0.164)
Δdebtbar	-0.047	0.002	0.013	0.065
	(0.043)	(0.032)	(0.045)	(0.047)
$\Delta \text{debtbar}_{t-1}$	0.045	0.037	0.034	0.004
	(0.032)	(0.030)	(0.039)	(0.052)
$\Delta \text{debtbar}_{t-2}$	-0.034	-0.002	-0.016	-0.004
	(0.031)	(0.0201)	(0.0225)	(0.0274)
$\Delta \text{debtbar}_{t-3}$	-0.031	-0.029	-0.054	-0.013
	(0.034)	(0.026)	(0.038)	(0.040)
d30	0.001	-0.003		
	(0.004)	(0.003)		
d60	0.005		-0.001	
	(0.005)		(0.005)	
d90	-0.0028			-0.010
	(0.005)			(0.008)
α	0.016*	0.012*	0.010*	0.012
	(0.007)	(0.006)	(0.005)	(0.007)
χ^2	225.25	166.1	143.2	120.4
N	40	30	30	19
NT	1258	1243	982	619

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively. N and NT are, correspondingly, the numbers of countries and observations for the sample. χ^2 is the Wald χ^2 statistic to test the null hypothesis that all the slope coefficients are jointly zero.

Table 23.CS-DL MG Estimates with different Debt Levels: Developing Economies

Equation / Variables	(23.1)	(23.2)	(23.3)	(23.4)
Δdebt	-0.044*	-0.070*	-0.05	-0.005
	(0.024)	(0.032)	(0.025)	(0.024)
$\Delta\Delta$debt	-0.053***	-0.064***	-0.056***	-0.031*
	(0.012)	(0.016)	(0.014)	(0.013)
$\Delta\Delta$debt $_{t-1}$	-0.011	-0.004	-0.009	-0.021
	(0.016)	(0.015)	(0.017)	(0.018)
$\Delta\Delta$debt $_{t-2}$	-0.01	-0.005	-0.012	-0.012
	(0.012)	(0.011)	(0.014)	(0.015)
Δybar	0.706***	0.703***	0.654**	0.764***
	(0.156)	(0.142)	(0.201)	(0.175)
Δdebtbar	0.015	0.038	0.049	0.009
	(0.024)	(0.0296)	(0.0323)	(0.0364)
Δdebtbar $_{t-1}$	-0.002	0.022	0.009	0.007
	(0.024)	(0.029)	(0.028)	(0.023)
Δdebtbar $_{t-2}$	-0.02	-0.028	-0.021	-0.019
	(0.019)	(0.019)	(0.024)	(0.027)
Δdebtbar $_{t-3}$	-0.03	-0.015	-0.04	-0.076*
	(0.023)	(0.024)	(0.031)	(0.033)
d30	0.003	-0.005		
	(0.004)	(0.004)		
d60	0.0015		-0.006	
	(0.006)		(0.006)	
d90	-0.011			-0.012*
	(0.008)			(0.008)
α	0.008	0.012*	0.009	0.006
	(0.005)	(0.006)	(0.006)	(0.008)
χ^2	67.35	84.7	49.3	85.8
N	53	58	44	35
NT	1690	1754	1397	1093

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively. N and NT are, correspondingly, the numbers of countries and observations for the sample. χ^2 is the Wald χ^2 statistic to test the null hypothesis that all the slope coefficients are jointly zero.

Table 24.CS-DL MG Estimates with different Debt Levels and Interactive Effects for the Whole Sample

Equation	(24.1)	(24.2)	(24.3)	(24.4)
Variables				
Δdebt	-0.081***	-0.078***	-0.060***	-0.046***
	(0.019)	(0.022)	(0.02)	(0.017)
$\Delta\Delta$debt	-0.084***	-0.085***	-0.08***	-0.06***
	(0.014)	(0.014)	(0.015)	(0.013)
$\Delta\Delta$debt $_{t-1}$	0.002	-0.009	-0.014	-0.005
	(0.01)	(0.010)	(0.011)	(0.013)
$\Delta\Delta$debt $_{t-2}$	-0.0002	-0.005	-0.014	-0.002
	(0.009)	(0.00736)	(0.00902)	(0.0105)
Δybar	0.548***	0.721***	0.718***	0.788***
	(0.0906)	(0.108)	(0.138)	(0.136)
Δdebtbar	0.0157	0.032	0.061**	0.070*
	(0.0287)	(0.026)	(0.030)	(0.036)
Δdebtbar $_{t-1}$	0.006	0.0242	-0.00170	-0.0204
	(0.019)	(0.021)	(0.022)	(0.023)
Δdebtbar $_{t-2}$	-0.001	-0.0306*	-0.00925	-0.0169
	(0.016)	(0.018)	(0.019)	(0.025)
Δdebtbar $_{t-3}$	0.0001	-0.003	-0.04	-0.03
	(0.016)	(0.025)	(0.027)	(0.024)
d30	-0.042	-0.002		
	(0.043)	(0.003)		
Δdebt$^+$d30	0.118	-0.014		
	(0.127)	(0.022)		
d60	0.038		0.0005	
	(0.042)		(0.005)	
Δdebt$^+$d60	-0.137		-0.060	
	(0.127)		(0.040)	
d90	-0.0005			-0.013*
	(0.007)			(0.008)
Δdebt$^+$d90	-0.0001			0.017
	(0.043)			(0.092)
α	0.015***	0.014***	0.009**	0.007
	(0.003)	(0.004)	(0.004)	(0.004)
χ^2	164.2	288.6	167.8	141.1
N	102	119	95	64
NT	3695	3930	3246	2139

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively. N and NT are, correspondingly, the numbers of countries and observations for the sample. χ^2 is the Wald χ^2 statistic to test the null hypothesis that all the slope coefficients are jointly zero.

Table 25.CS-DL MG Estimates with different Debt Levels and Interactive Effects: Advanced Economies

Equation / Variables	(25.1)	(25.2)	(25.3)	(25.4)
Δdebt	-0.06*	-0.060**	-0.055*	-0.07
	(0.025)	(0.023)	(0.024)	(0.038)
$\Delta\Delta$debt	-0.080***	-0.085***	-0.074***	-0.124***
	(0.022)	(0.022)	(0.021)	(0.032)
$\Delta\Delta$debt $_{t-1}$	-0.008	-0.009	-0.005	-0.019
	(0.011)	(0.009)	(0.010)	(0.021)
$\Delta\Delta$debt $_{t-2}$	0.0003	-0.004	-0.005	-0.001
	(0.012)	(0.012)	(0.013)	(0.025)
Δybar	0.867***	0.910***	0.881***	0.957***
	(0.102)	(0.105)	(0.091)	(0.111)
Δdebtbar	0.036	0.050	0.056	0.105
	(0.028)	(0.033)	(0.035)	(0.055)
Δdebtbar $_{t-1}$	-0.013	-0.023	-0.018	0.016
	(0.028)	(0.026)	(0.024)	(0.035)
Δdebtbar $_{t-2}$	-0.011	0.001	0.011	-0.016
	(0.037)	(0.025)	(0.025)	(0.040)
Δdebtbar $_{t-3}$	-0.019	-0.006	-0.031	0.003
	(0.024)	(0.019)	(0.023)	(0.045)
d30	-0.0001	-0.004		
	(0.00385)	(0.004)		
Δdebt^{+}d30	0.029	0.027		
	(0.039)	(0.028)		
d60	-0.003		-0.002	
	(0.004)		(0.003)	
Δdebt^{+}d60	-0.002		-0.008	
	(0.066)		(0.048)	
d90	0.006			-0.012
	(0.018)			(0.046)
Δdebt^{+}d90	-0.006			0.349
	(0.197)			(0.679)
α	0.005	0.004	0.003	0.002
	(0.005)	(0.004)	(0.003)	(0.003)
χ^2	272.4	293.4	425.5	7707
N	24	23	21	10
NT	974	945	867	427

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively. N and NT are, correspondingly, the numbers of countries and observations for the sample. χ^2 is the Wald χ^2 statistic to test the null hypothesis that all the slope coefficients are jointly zero.

Table 26.CS-DL MG Estimates with different Debt Levels and Interactive Effects: Emerging Economies

Equation / Variables	(26.1)	(26.2)	(26.3)	(26.4)
Δdebt	-0.15***	-0.137*	-0.129*	-0.126***
	(0.044)	(0.059)	(0.058)	(0.032)
$\Delta\Delta$debt	-0.131**	-0.106**	-0.116**	-0.091***
	(0.041)	(0.038)	(0.038)	(0.025)
$\Delta\Delta \text{debt}_{t-1}$	-0.002	0.004	-0.009	0.007
	(0.018)	(0.027)	(0.026)	(0.016)
$\Delta\Delta \text{debt}_{t-2}$	-0.007	-0.004	-0.008	0.006
	(0.016)	(0.018)	(0.021)	(0.015)
Δybar	0.612***	0.612***	0.517***	0.582***
	(0.137)	(0.122)	(0.143)	(0.169)
Δdebtbar	0.03	-0.003	0.001	0.062
	(0.027)	(0.038)	(0.039)	(0.048)
$\Delta \text{debtbar}_{t-1}$	0.048	0.045	0.024	0.0014
	(0.03)	(0.031)	(0.033)	(0.052)
$\Delta \text{debtbar}_{t-2}$	0.001	-0.004	-0.016	0.013
	(0.021)	(0.021)	(0.023)	(0.032)
$\Delta \text{debtbar}_{t-3}$	0.012	-0.002	-0.038	-0.010
	(0.02)	(0.036)	(0.038)	(0.039)
d30	-0.004	0.008		
	(0.005)	(0.012)		
Δdebt^{+}d30	0.102	-0.011		
	(0.056)	(0.053)		
d60	0.01		0.013	
	(0.006)		(0.010)	
Δdebt^{+}d60	-0.133*		-0.120	
	(0.059)		(0.080)	
d90	-0.001			-0.006
	(0.005)			(0.0103)
Δdebt^{+}d90	-0.006			-0.070*
	(0.029)			(0.042)
α	0.012	0.016**	0.010*	0.014
	(0.007)	(0.005)	(0.005)	(0.009)
χ^2	138.65	171.7	85.1	217.5
N	40	39	30	19
NT	1258	1243	982	619

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively. N and NT are, correspondingly, the numbers of countries and observations for the sample. χ^2 is the Wald χ^2 statistic to test the null hypothesis that all the slope coefficients are jointly zero.

Table 27.CS-DL MG Estimates with Different debt levels and Interactive Effects: Developing Economies

Equation	(27.1)	(27.2)	(27.3)	(27.4)
Variables				
Δdebt	-0.044	-0.078	-0.030	-0.010
	(0.033)	(0.041)	(0.028)	(0.022)
$\Delta\Delta$debt	-0.042*	-0.072**	-0.044*	-0.037**
	(0.018)	(0.027)	(0.018)	(0.014)
$\Delta\Delta\text{debt}_{t-1}$	0.002	-0.020	-0.009	-0.025
	(0.019)	(0.0309)	(0.017)	(0.017)
$\Delta\Delta\text{debt}_{t-2}$	-0.003	-0.012	-0.014	-0.018
	(0.013)	(0.015)	(0.013)	(0.013)
Δybar	0.468***	0.533***	0.597**	0.697***
	(0.132)	(0.161)	(0.198)	(0.173)
Δdebtbar	0.009	0.020	0.048	0.011
	(0.04)	(0.040)	(0.033)	(0.036)
$\Delta\text{debtbar}_{t-1}$	-0.016	0.007	-0.005	0.001
	(0.024)	(0.033)	(0.029)	(0.023)
$\Delta\text{debtbar}_{t-2}$	-0.002	0.006	-0.019	-0.011
	(0.025)	(0.039)	(0.023)	(0.026)
$\Delta\text{debtbar}_{t-3}$	-0.015	-0.072	-0.038	-0.080*
	(0.02)	(0.065)	(0.031)	(0.032)
d30	-0.083	-0.012		
	(0.091)	(0.011)		
Δdebt^{+}d30	0.201	0.053		
	(0.262)	(0.100)		
d60	0.08		-0.006	
	(0.089)		(0.006)	
Δdebt^{+}d60	-0.172		-0.019	
	(0.04)		(0.0372)	
d90	-0.0006			-0.012*
	(0.012)			(0.007)
Δdebt^{+}d90	-0.061			-0.021
	(0.05)			(0.049)
α	0.013	0.013	0.011	0.006
	(0.007)	(0.007)	(0.006)	(0.008)
χ^2	69.85	95	47.9	81.3
N	45	57	44	35
NT	1567	1742	1397	1093

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively. N and NT are, correspondingly, the numbers of countries and observations for the sample. χ^2 is the Wald χ^2 statistic to test the null hypothesis that all the slope coefficients are jointly zero.

Table 28.CS-DL MG Estimates with Interactive Effects for the Whole Sample

Equation / Variables	(28.1)	(28.2)	(28.3)	(28.4)
Δdebt	-0.084**	-0.069***	-0.065***	-0.042*
	(0.0258)	(0.020)	(0.019)	(0.018)
$\Delta\Delta$debt	-0.067***	-0.074***	-0.071***	-0.056***
	(0.012)	(0.013)	(0.013)	(0.013)
$\Delta\Delta debt_{t-1}$	0.005	-0.011	-0.005	-0.006
	(0.017)	(0.009)	(0.01)	(0.013)
$\Delta\Delta debt_{t-2}$	-0.002	-0.008	-0.006	-0.002
	(0.010)	(0.007)	(0.008)	(0.010)
Δybar	0.624***	0.816***	0.827***	0.914***
	(0.127)	(0.120)	(0.122)	(0.156)
Δdebtbar	0.016	0.056*	0.075**	0.087*
	(0.0296)	(0.027)	(0.027)	(0.037)
$\Delta debtbar_{t-1}$	0.008	0.014	0.002	-0.016
	(0.019)	(0.019)	(0.021)	(0.023)
$\Delta debtbar_{t-2}$	0.002	-0.019	-0.015	-0.021
	(0.018)	(0.016)	(0.017)	(0.023)
$\Delta debtbar_{t-3}$	-0.045	-0.015	-0.040	-0.036
	(0.027)	(0.020)	(0.024)	(0.028)
$\Delta debt^{+}d30$	-0.051	-0.021		
	(0.0643)	(0.021)		
$\Delta debt^{+}d60$	0.047		-0.065	
	(0.120)		(0.031)	
$\Delta debt^{+}d90$	-0.040			-0.108**
	(0.023)			(0.039)
α	0.012**	0.008**	0.005	0.003
	(0.004)	(0.003)	(0.003)	(0.003)
χ^2	216.74	278.9	185.1	134.7
N	117	120	95	64
NT	3922	3942	3246	2139

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively.. N and NT are, correspondingly, the numbers of countries and observations for the sample. χ^2 is the Wald χ^2 statistic to test the null hypothesis that all the slope coefficients are jointly zero.

Table 29.CS-DL Estimates with Interactive Effects: Advanced Economies

Equation Variables	(29.1)	(29.2)	(29.3)	(29.4)
Δdebt	-0.062** (0.022)	-0.065** (0.022)	-0.057* (0.024)	-0.071 (0.040)
ΔΔdebt	-0.081*** (0.019)	-0.089*** (0.021)	-0.073*** (0.020)	-0.124*** (0.031)
ΔΔdebt $_{t-1}$	-0.01 (0.013)	-0.007 (0.010)	-0.006 (0.011)	-0.018 (0.022)
ΔΔdebt $_{t-2}$	-0.004 (0.012)	-0.004 (0.012)	-0.004 (0.013)	-0.005 (0.025)
Δybar	0.840*** (0.099)	0.928*** (0.115)	0.889*** (0.100)	0.953*** (0.117)
Δdebtbar	0.034 (0.034)	0.060 (0.041)	0.055 (0.038)	0.112 (0.064)
Δdebtbar $_{t-1}$	-0.001 (0.027)	-0.024 (0.028)	-0.006 (0.024)	0.01 (0.040)
Δdebtbar $_{t-2}$	-0.008 (0.038)	0.003 (0.028)	0.005 (0.027)	-0.006 (0.035)
Δdebtbar $_{t-3}$	-0.019 (0.021)	-0.008 (0.019)	-0.021 (0.022)	-0.006 (0.043)
Δdebt^{+}d30	0.014 (0.035)	0.028 (0.024)		
Δdebt^{+}d60	-0.021 (0.045)		-0.031 (0.042)	
Δdebt^{+}d90	-0.015 (0.034)			-0.043 (0.086)
α	0.004 (0.003)	0.0002 (0.002)	0.003 (0.003)	0.002 (0.004)
χ^2	451	405	484.	10399
N	24	23	21	10
NT	974	945	867	427

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively. N and NT are, correspondingly, the numbers of countries and observations for the sample. χ^2 is the Wald χ^2 statistic to test the null hypothesis that all the slope coefficients are jointly zero.

Table 30.CS-DL MG Estimates with Interactive Effects: Emerging Economies

Equation / Variables	(30.1)	(30.2)	(30.3)	(30.4)
Δdebt	-0.108*	-0.116*	-0.129*	-0.104***
	(0.05)	(0.056)	(0.054)	(0.027)
ΔΔdebt	-0.10**	-0.106**	-0.124**	-0.0721***
	(0.037)	(0.036)	(0.040)	(0.021)
ΔΔdebt $_{t-1}$	-0.016	-0.015	-0.016	0.006
	(0.020)	(0.024)	(0.022)	(0.017)
ΔΔdebt $_{t-2}$	-0.012	-0.013	-0.013	0.009
	(0.016)	(0.017)	(0.020)	(0.017)
Δybar	0.513***	0.588***	0.519***	0.555***
	(0.124)	(0.114)	(0.141)	(0.161)
Δdebtbar	-0.048	-0.015	0.002	0.050
	(0.035)	(0.031)	(0.040)	(0.050)
Δdebtbar $_{t-1}$	0.051	0.049	0.020	0.006
	(0.03)	(0.03)	(0.038)	(0.053)
Δdebtbar $_{t-2}$	-0.027	-0.007	-0.02	-0.005
	(0.032)	(0.018)	(0.022)	(0.029)
Δdebtbar $_{t-3}$	-0.014	-0.026	-0.039	0.0001
	(0.032)	(0.030)	(0.035)	(0.039)
Δdebt^{+}d30	-0.002	-0.001		
	(0.056)	(0.045)		
Δdebt^{+}d60	-0.010		-0.025	
	(0.061)		(0.084)	
Δdebt^{+}d90	-0.018			-0.094*
	(0.025)			(0.048)
α	0.0165**	0.012**	0.010*	0.0096
	(0.00536)	(0.005)	(0.005)	(0.005)
χ^2	138.65	208	100.6	130
N	40	39	30	19
NT	1258	1243	982	619

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively. N and NT are, correspondingly, the numbers of countries and observations for the sample. χ^2 is the Wald χ^2 statistic to test the null hypothesis that all the slope coefficients are jointly zero.

Table 31.CS-DL MG Estimates with Interactive Effects: Developing Economies

Equation	(31.1)	(31.2)	(31.3)	(31.4)
Variables				
Δdebt	-0.050*	-0.046	-0.033	-0.006
	(0.024)	(0.027)	(0.025)	(0.022)
ΔΔdebt	-0.049***	-0.044**	-0.043**	-0.03
	(0.014)	(0.016)	(0.015)	(0.013)
ΔΔdebt $_{t-1}$	-0.003	-0.004	-0.006	-0.02
	(0.015)	(0.013)	(0.015)	(0.017)
ΔΔdebt $_{t-2}$	-0.009	-0.007	-0.01	-0.012
	(0.011)	(0.010)	(0.013)	(0.014)
Δybar	0.731***	0.695***	0.759***	0.776***
	(0.169)	(0.140)	(0.181)	(0.168)
Δdebtbar	0.026	0.035	0.054	0.035
	(0.028)	(0.029)	(0.032)	(0.038)
Δdebtbar $_{t-1}$	-0.004	-0.003	0.002	0.008
	(0.023)	(0.024)	(0.028)	(0.025)
Δdebtbar $_{t-2}$	-0.01	-0.022	-0.022	-0.028
	(0.021)	(0.020)	(0.022)	(0.028)
Δdebtbar $_{t-3}$	-0.033	-0.020	-0.055	-0.056*
	(0.026)	(0.022)	(0.028)	(0.024)
Δdebt^{+}d30	-0.012	-0.041		
	(0.033)	(0.031)		
Δdebt^{+}d60	0.287		-0.002	
	(0.256)		(0.037)	
Δdebt^{+}d90	-0.303			-0.097*
	(0.251)			(0.057)
α	0.005	0.009	0.003	0.003
	(0.006)	(0.005)	(0.004)	(0.004)
χ^2	75.39	103	599	56.6
N	53	58	44	35
NT	1690	1754	1397	1093

Notes: The values in parentheses are the standard errors. *, **, *** denote the significance at the 5, 1 and 0.1 %, respectively. N and NT are, correspondingly, the numbers of countries and observations for the sample. χ^2 is the Wald χ^2 statistic to test the null hypothesis that all the slope coefficients are jointly zero.

To sum up, we use FE estimates and CS-DL mean group (Chudik *et al.,* 2013) estimates to analyze the relationship between debt and growth. Both CS-DL mean group and FE estimates yield that there is a negative relationship between debt and growth. Also, emerging economies are suffered most whilst advanced economies are suffered the least from debt among all country groupings according to the results by both estimation techniques. We, also, investigate the relationship between debt and growth at different debt levels which are 30 to 60% (moderate levels), 60 to 90% (high levels) and beyond 90% (severely high levels) suggested by Reinhart and Rogoff (2010). However, we do not find strong evidence indicating any threshold value that leads growth to decrease tremendously according to the FE estimation results. Also, CS-DL estimates yield similar results for the relationship between debt and growth at different debt levels. However, for rising debt structure beyond 90% debt to GDP, there is a notable decrease in growth in emerging and developing economies whilst it is not in advanced economies according to the CS-DL estimates. That is, growth is invariant to different debt levels for advanced economies. Moreover, CS-DL estimates indicate that acceleration of debt has notable adverse impact on growth.

CHAPTER 4

CONCLUSION

The relationship between public debt and growth has been at the center of macroeconomics literature, again, especially after the 2008 global financial crisis. Public debt has been an important policy issue especially for developing and emerging market countries during the 1980s and 1990s. The vulnerability of these countries to external shocks was often exacerbated by high fiscal deficits, underdeveloped domestic bond markets, large currency and maturity mismatches and liability dollarization. The recent global financial crisis of the 2008-2009 has led to substantial increases in fiscal deficits and public debts of advanced countries. Consequently, the consequences of high public debt became a crucial policy issue, also, for advanced economies. The findings of Reinhart and Rogoff (2010) suggesting that that economic growth slows down considerably if the public debt-to GDP ratio exceeds 90 % has spawned a growing literature. The literature, often with conflicting results, is yet to be conclusive.

In this study, the relationship between debt and growth is analyzed for 128 economies including 26 advanced, 40 emerging and 62 developing economies spanning a period of 1960-2011. We also investigate whether the relationship is robust to different country groupings such as advanced, emerging and developing economies and to different debt levels such as suggested by Reinhart and Rogoff (2010). To this end, we first, estimate a static bivariate equation of growth and debt employing a conventional fixed effects (FE) panel data estimation procedure. The results suggest that the negative impact of the public debt on growth appears to be more severe in emerging market countries than both advanced and developing countries.

We then consider a conventional growth model augmented by debt levels and estimate by using the FE panel method. The conventional growth model included gross capital formation/GDP, openness, consumer price inflation, financial development (liquid liabilities/GDP), *de facto* exchange rate regime classification, financial integration level and education (secondary school enrollment rate) as explanatory variables. The results from these equations show that the relation between debt and growth is negative and the negative impact of public debt on growth is slightly lower in developing countries than emerging market countries. For the whole sample, the negative impact of debt level on growth increases (in absolute value) when the debt level is between 30 % and 60 % (moderate level) and beyond 90% (severely high level). The results may also lend a support to the view that the growth is invariant to different public debt levels in advanced countries.

The FE estimation procedure assumes that cross sections are independent, however; according to our results from the CSD tests the independence of the cross-sections is rejected. Consequently, the FE estimates may not be reliable as they suffer from cross sectional dependency. We, therefore, prefer to employ also the recently developed cross sectionally augmented distributed lag (CS-DL) mean group (MG) estimation procedure which is robust to presence of cross-section dependence and nonstationarity. The results suggest that not only the debt growth but also the acceleration of the debt negatively affects economic growth. According to the results, emerging economies suffer most from the debt whilst the advanced economies suffer the least and a rising debt structure lead to a remarkable slowdown the growth for emerging and developing economies rather than the advanced ones.

The findings of this study indicate that there is a negative relationship between debt and growth. This adverse impact is higher for emerging and developing economies than the advanced economies. For threshold analysis, exogenous threshold values such as 30, 60, 90 percent suggested by Reinhart and Rogoff

(2010) are adopted. Although dummy for the debt level beyond 90 percent is statistically significant for the model including all economies, it is statistically significant only for developing economies when it is estimated for the different country groupings. However, this adverse impact is rather small and do not suggest any threshold effect. Chudik *et al.* (2013) claim that threshold effect could be resulted from the rising debt structure rather than high debt level. Therefore, interaction terms created by using debt growth and dummies for debt levels are added into the model. It is observed that the coefficient of the interaction term of debt to GDP growth and 90 percent debt level dummy is statistically significant for emerging economies and its adverse impact is 0.07. In case of debt level dummy of 90 percent threshold is significant but does not indicate any threshold effect. Therefore, in the last model, dummy variable removed and model estimated for interaction terms. The results show that beyond 90 percent debt to GDP growth rising debt has a remarkable adverse effect for emerging and developing economies.

To conclude, the findings of this research do not provide a strong support to the Reinhart and Rogoff (2010) argument that there is a certain threshold debt level beyond which debt adversely affects economic growth in advanced countries. However, there could be a threshold effect beyond 90 percent debt to GDP for rising debt in emerging and developing economies which is consistent with the findings of Chudik *et al.* (2013). The reason for this can be that that the public debt of emerging economies is denominated by foreign currency unlike advanced economies as Reinhart and Rogoff (2010) and Chudik *et al.* (2010) suggests. Bebczuk *et al*. (2006) find that foreign currency debt is directly associated with lower growth rates when the real exchange rate depreciates. Therefore, besides rising debt structure, debt composition can be important for economies.

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APPENDICES

A. TURKISH SUMMARY

Kamu borcu ve büyüme arasındaki ilişki özellikle 2008-2009 finansal krizi sonrası yeniden önem kazandı. Makul düzeylerdeki kamu borcu büyümeye olumlu yönde etki sağlasa da (Kumar &Woo (2010)), yüksek kamu borcunun dışlama etkisi, gelecekteki yüksek vergilendirme, yüksek enflasyon, ekonomide belirsizlik, kırılganlık gibi kanallarla ekonomide daralmaya yol açabilmektedir (Cecchetti, dd. (2011)). Bu bağlamda Reinhart&Rogoff (2010) hangi düzeydeki kamu borcunun ekonomik büyümeyi olumsuz etkilediğini bulmak için kamu borcunun GSMH'ya oranını dört gruba ayırmışlardır. Kamu borcu GSMH oranının %30'un aşağısı, kamu borcu GSMH oranının %30 ve %60 arası, %60 ve 90% arası ve kamu borcu/GSMH oranının %90'ın üzeri olduğu durumları gruplandırmış ve büyümeyle olan ilişkisini incelemişlerdir. Sonuç olarak kamu borcunun gayri safi milli hasılaya oranı %90 düzeyini aştığında diğer düzeylere kıyasla önemli oranda azaldığını bulmuşlardır. Bu çalışmayı takiben Kumar&Woo (2010), Cecchetti, dd. (2011), Baum, dd. (2012), Egert (2012), Eberhart&Presbitero (2013) ve Chudik, dd. (2013) gibi çeşitli veri setleri ve tahmin yöntemleri kullanarak kamu borcu/GSMH ve büyüme arasındaki ilişkiyi incelemişler. Sonuçlar kullanılan veri seti, zaman aralığı, tahmin yöntemlerine bağlı olarak farklılık göstersede, çalışmaların çoğu kamu borcu/GSMH'nin yaklaşık olarak %90'ı aştığı durumda ekonomideki daralmanın kıyasla daha fazla olduğunu göstermektedir. Kumar&Woo(2010) toplamda 46 gelişmiş ve gelişmekte ekonomi için 1970-2007 zaman aralığında dinamik büyüme modelini OLS, BE, FE, GMM ve SGMM gibi çeşitli tahmin yöntemlerini kullanarak tahmin etmişlerdir. Ayrıca, Reinhart&Rogoff (2010)'un gruplandırdığı biçimde borç/GSMH oranlarını %30 ve aşağısı, %30 ve %60 arası, %60 ve %90 arası ve borç/GSMH oranının %90'nın üzeri olacak şekilde kukla değişkenler kullanmışlardır. Borç/GSMH oranının sadece %90'nın üzerinde olduğu durumda anlamlı olduğunu ve gelişmiş ekonomiler için katsayının -0.015 olduğunu, gelişmekte olan ekonomiler için ise bu katsayının -0.020 olduğunu bulmuşlardır. Cecchetti, dd. (2011), 18 OECD ülkesi için 1980-2010 zaman aralığını dikkate alarak borç/GSMH oranının büyüme üzerindeki etkisini incelemişlerdir. Hansen (1999) panel eşik tahmin yöntemini kullanarak borç/GSMH oranının büyüme üzerindeki etkisi için tahmin ettikleri eşik değeri %85'tir. Baum, dd. (2012) ise 12 avrupa bölgesi için 1990-2007 ve 1990-2010 zaman aralıklarını kullanarak borç/GSMH oranının büyüme üzerindeki doğrusal olmaya etkisini incelemişlerdir. Hanse (1999) ve Caner&Hansen (2004) tahmin yöntemlerini kullanmışlardır. 1990-2007 dönemi için hem dinamik hem dinamik olmayan büyüme modelleriyle eşik değerini %66 olarak tahmin etmişlerdir. Kriz yıllarınıda dahil ederek 1990-2010 dönemi için dinamik model tahmin sonucu eşik değerini %96 olarak belirlerken, dinamik olmayan modelin tahmin sonuçları bu değerin %71 olduğunu göstermektedir. Eberhardt & Presbitero (2013) 105 gelişmiş, gelişmekte olan ve gelişmemiş ekonomiler olmak üzere ve 1972-2009 zaman aralığını için borç/GSMH oranının büyüme üzerindeki etkisini incelemişlerdir ve CCE tahmin yöntemini kullanmışlardır. %90 üzeri borç/GSMH düzeyinde doğrusal olmayan etkiler olabileceğini ancak bunun tüm ekonomiler için aynı olduğunu söylemenin doğru olmadığını belirtmişlerdir. Chudik, dd. (2013) ise yatay kesit bağımlılığını dikkate alan yeni bir tahmin yöntemi geliştirerek farklı borç/GSMH düzeylerinin büyüme üzerindeki etkisini araştırmışlardır. Sonuçlar farklı borç/GSMH düzeyleri için bir eşik değeri olduğunu göstermemektedir. Ancak artan borç/GSMH oranları için eşik değerini %60 olarak bulmuşlardır.

Bu bağlamda, bu çalışmada kamu borcu ve büyüme arasındaki ilişki 1960-2011 yılları arasında 26 gelişmiş, 40 gelişmekte olan ve 62 gelişmemiş toplamda 128 ülke için panel veri kullanılarak incelenmiştir. Kamu borcunun GSMH'ya oranının yıllara göre düzeyini incelediğimizde tüm ülkeler için özellikle 1980 sonrası hızla artmıştır (Figure 1). Gelişmekte olan ve gelişmemiş ekonomiler 2000'li yıllar itibariyle bu oranı azaltmayı başarmışlardır. Ancak gelişmiş ülkeler yüksek kamu borcu/GSMH düzeylerini sürdürmüş, 2008-2009 finansal kriz sonrası daha da arttırmışlardır. Ayrıca borç/GSMH oranlarını Reinhat&Rogoff (2010) gruplandırdığı biçimde gruplandırdık. Yani borç/GSMH oranının %30'un altında olduğu, %30 ve %60 arasında, %60 ve 90% arasında ve %90 üzerinde olduğu durumlar olmak üzere dört gruba ayırdık ve büyüme ile korelasyonlarını inceledik. Tüm ülkeler için borç/GSMH oranı arttıkça daha düşük büyüme oranlarıyla ilişkili olduğunu gözlemledik (Figure 2). Ayrıca borç/GSMH oranı %90 düzeyini aştığında bu ilişkinin negatif ilişkili olduğunu gözlemledik (Figure 2). Aynı gruplandırmayı farklı ülke grupları için yaptığımızda yine benzer sonuçları gözlemledik (Figure 3, Figure 4, Figure 5). Yani gelişmiş ülkeler, gelişmekte olan ülkeler ve gelişmemiş ülkeler için borç/GSMH oranı arttıkça daha düşük büyüme oranlarıyla ilişkili oldukları ve borç/GSMH oranı %90 lık eşik değerini aştığında negatif bir korelasyon olduğu gözlemlenmiştir.

Regresyon analizi yaparken önce sabit etkiler (Fixed Effects) tahmin yöntemini kullandık. İlk olarak büyüme ve borç/GSMH arasındaki ilişkiyi incelerken sabit etkiler tahmin yöntemiyle tahin edilen model:

$$\Delta y_{it} = \alpha + \beta debt_{it} + u_{it}$$

Δy büyümeyi, $debt$ ise borç/GSMH'ya oranını göstermektedir. Sonuçlara göre kamu borcundan en çok etkilenen ülkeler gelişmiş ve gelişmekte olan ülkelerdir (Table 1). Daha sonra modeli genişleterek çok değişkenli model tahmin ettik.

$$\Delta y_{it} = \alpha + \beta X_{it} + u_{it}$$

X değişkeni borç/GSMH oranı, finansal bütünleşme (fint), kur esnekliği (fxr), yatırım (gcf), enflasyon (enf), finansal gelişmişlik düzeyi (llgdp), ticari açıklık (open) ve eğitim (education) değişkenlerini içermektedir. Sonuçlara göre kamu borcunu büyüme üzerindeki olumsuz etkisi en çok grup gelişmekte olan ekonomilerdir (Eq. 5.5). Bu olumsuz etkinin en az olduğu grup ise gelişmiş ülkelerdir (Eq. 4.6). Ayıca yatırımın tüm gruplar üzerindeki etkisi tüm ülkeler için istatiksel olarak anlamlı olup ekonomiyi genişletici yöndedir. Enflasyonun etkisi ise yine tüm gruplar için anlamlı olup ekonomiyi daralıcı yöndedir. Finansal bütünleşmenin etkisi gelişmiş ekonomiler için pozitif iken gelişmekte olan ülkeler için etkisi negatiftir (Eq. 4.6, Eq. 5.5). Nedeni ise geçmiş yıllarda gelişmekte olan ülkelerdeki finansal krizlerin etkisi olarak açıklanabilir. Gelişmemiş ülkelerin uluslararası finansal bütünleşmelerinin çoğunlukla az olmaları sebebiyle finansal bütünleşme istatiksel olarak anlamsız çıkmıştır. Diğer taraftan kur rejimi esnekliği (fxr) gelişmemiş ekonomiler için anlamlı ve ekonomi de daraltıcı bir etkiye sahiptir (Eq. 6.4). Borcun gayri safi milli hasılaya oranını da içeren büyüme modelini tahmin ettikten sonra borç oranları Reinhart&Rogoff'un gruplandırdığı biçimde ayrıştırmak için kukla değişkenler kullandık. Bu bağlamda d30 kukla değişkeni %30 ve %60 arası borç/GSMH oranlarını, d60 kukla değişkeni %60 ve %90 arası borç/GSMH oranlarını, d90 kukla değişkeni ise borç/GSMH oranının %90'nın üzerinde olduğu durumları göstermektedir. Borç/GSMH oranının %30'un altında olduğu durumlar için yaratılan kukla değişkeni ise kukla değişken tuzağından kurtulmak için modelden çıkarılmıştır ve etkisi sabit terimin içinde yer almaktadır. Sadece büyüme ve borç/GSMH oranlarını gösteren kukla değişkenleri kullanarak modeli tahmin ettiğimizde bir eşik değeri gözlemlenmedi. Gelişmiş ekonomiler için d30, d60 ve d90'ın katsayıları sırasıyla -0.015, -0.008 ve -0.013'tür (Eq. 8.1). Gelişmekte olan ekonomiler için d30, d60 ve d90'ın katsayıları sırasıyla -0.01, -0.006 ve -0.02 dir ancak d60'ın katsayısı istatiksel olarak anlamsızdır (Eq. 9.1). Gelişmemiş ülkeler için d30, d60 ve d90'ın katsayıları ise sırasıyla -0.007, -0.005, -0.015 ve gelişmekte olan ekonomilere benzer olarak d60'ın katsayısı istatiksel olarak anlamsızdır. Modellere büyüme modellerinde anlamlı çıkan değişkenler eklendiğinde sonuçlar daha farklı çıkmaktadır. Örneğin gelişmiş ekonomilerde d60 ve d90'nın katsayıları istatiksel olarak anlamsız olurken, d30'un katsayısı -0.006 olmuştur (Eq. 8.2). Gelişmekte olan ekonomiler için ise d30'un katsayısı anlamlı ve bir önceki modelle aynı kalırken önceden anlamlı çıkan d90 bu modelde istatiksel olarak anlamsızdır (Eq. 9.2). Gelişmemiş ekonomiler için ise d30'un katsayısı -0.012 olurken d90'ın katsayısı önceki modelle neredeyse aynıdır ve -0.014'tür (Eq. 10.2). Sonuç olarak Sabit etkiler yöntemini kullanarak tahmin ettiğimiz modeller kamu borcunun gayri safi milli hasılaya oranını ve büyüme arasında negatif bir ilişki olduğunu göstermektedir. Ayrıca sonuçlar gelişmekte olan ekonomiler borçtan en çok etkilenen grup olduğunu göstermektedir. Ancak Reinhart&Rogoff'un gruplandırdığı biçimde borç/GSMH oranlarını d30 kukla değişkeni %30 ve %60 arası borç/GSMH oranlarını, d60 kukla değişkeni %60 ve %90 arası borç/GSMH oranlarını, d90 kukla değişkeni ise borç/GSMH oranının %90'nın üzerinde olduğu durumları gösterecek şekilde gruplandırdığımızda eşik değeri gösterebilcek bir sonuç gözlemlenmiştir.

Sabit etkiler tahmin yöntemi yatay kesitlerin bağımsız olduğunu varsayar. Ancak Peseran'ın (2004) yatay kesit bağımlılık testinin sonuçları yatay kesit bağımsız olduğu hipotezini reddederek yatay kesit bağımlılığı olduğunu göstermektedir (Table 11). Yatay kesit bağımlılığı sebebiyle sabit etkiler tahmin yöntemi güvenilir olmayan sonuçlar üretmiş olabilir. Bu sebeple Chudik, dd. (2013) tarafından yeni geliştirilmiş olan yatay kesit bağımlığını dikkate alan dağıtılmış gecikme tahmin yöntemi (Cross Sectionally Augmented Distributed Lag (CS-DL)) kullanılmıştır. Model bağımlı değişkenin ve açıklayıcı değişkenlerin yatay kesit ortalamalarını ve onların yeterli sayıdaki gecikmelerini içermektedir. Ayrıca Chudik, dd. (2013) CS-DL tahmin yönteminin birim kök olması durumunda, katsayıların heterojenliği durumunda ve serisel korelasyon durumunda güvenilir sonuçlar verdiğini göstermiştir.

CS-DL tahmin yöntemini kullanarak tahmin edilen model şöyledir:

$$\Delta y_{it} = \alpha_i + \theta'_i \Delta debt_{it} + \sum_{l=0}^{p-1} \delta'_{il} \Delta\Delta debt_{it-l} + \omega_{iy} \Delta ybar_t + \sum_{l=0}^{3} \omega'_{i,xl} \Delta debtbar_{t-l} + e_{it}$$

$\Delta debt$ borcun gayri safi milli hasılaya oranının büyümesini, $\Delta ybar$ büyümenin yatay kesit ortalaması, $\Delta debtbar$ borcun gayri safi milli hasılaya oranının büyümesini yatay kesit ortalamasını, $\Delta\Delta debt_{it-l}$ borcun gayri safi milli hasılaya oranının büyümesinin gecikmelerinin farklarını göstermektedir. CS-DL tahmin yönteminin sonuçlarına göre borç/GSMH büyümesinin en çok gelişmekte olan ülkeleri olumsuz etkilediği gözlemlenmiştir (Table 14). Sonuçlara göre, borç/GSMH büyümesinin ekonomik büyüme üzerindeki etkisinin en az olduğu grup ise gelişmiş ekonomilerdir (Table 13). Bu etkinin farklı borç düzeylerine göre farklı olup olmadığını görebilmek amacıyla modele Reinhart&Rogoff'un borç/GSMH oranlarını gruplandırdığı biçimde için kukla değişkenleri ekledik. Bu bağlamda önceden de belirtildiği üzere d30 kukla değişkeni %30 ve %60 arası borç/GSMH oranlarını, d60 kukla değişkeni %60 ve %90 arası borç/GSMH oranlarını, d90 kukla değişkeni ise borç/GSMH oranının %90'nın üzerinde olduğu durumları gösteren kukla değişkenlerini yatay kesit bağımlılığını da kontrol edebilmek için modele ekledik. Bu durumda model aşağıdaki gibidir:

$$\Delta y_{it} = \alpha_{i\tau} + \gamma_{i\tau} d\tau_{it} + \theta'_{i\tau}\,\Delta debt_{it} + \sum_{l=0}^{2} \delta'_{il,\tau} \Delta\Delta debt_{it-l} + \omega_{iy,\tau} \Delta ybar_t$$
$$+ \sum_{l=0}^{3} \omega'_{i,xl,\tau} \Delta debtbar_{t-l} + e_{it}$$

$d\tau$ borç/GSMH oranları için kukla değişkenleri göstermektedir (τ =30, 60,90). $d\tau$ borç/GSMH oranı belirlenen borç düzeyi aralığında ise 1 değerini alırken, bu aralığın dışındaysa sıfır değerini almaktadır.

Sonuçlar, kukla değişkenler içinden sadece gelişmemiş ekonomiler için borç/GSMH oranının %90 düzeyini aştığında istatistiksel olarak anlamlı olduğunu ve -0.012'ye eşit olduğunu göstermektedir (Eq. 23.4). Ancak bu etki çok küçüktür ve eşik değerinin %90 olabileceği göstermemektedir. Gelişmiş ekonomiler ve gelişmekte olan ekonomiler için ise farklı borç/GSMH oranlarının ekonomik büyüme üzerindeki etkisinin farklı olmadığı sonucunu ortaya koymuştur (Table 21, Table 22).

Chudik, dd. (2013) borç/GSMH oranlarından ziyade sürekli artan borcun büyümeye etkisinin daha olumsuz olabileceğini öne sürmüşlerdir. Borç/GSMH oranının ekonominin daraldığı durumlarda artması ekonomiyi canlandırabilmektedir. Ancak bu etki kalıcıysa ve borç/GSMH oranı artmaya devam ediyorsa bu durumda bir eşik değeri olabilir (Chudik dd., 2013). Bu sebeple modele etkileşim etkileri eklenmiştir ve model şu şekildedir:

$$\Delta y_{it} = \alpha_{i\tau} + \gamma_{i\tau} d\tau_{it} + \gamma^{+}_{i\tau} \Delta debt^{+} d\tau_{it} + \theta'_{i\tau} \Delta debt_{it} + \sum_{l=0}^{2} \delta'_{il,\tau} \Delta\Delta debt_{it-l}$$

$$+ \omega_{iy,\tau} \Delta ybar_{t} + \sum_{l=0}^{3} \omega'_{i,xl,\tau} \Delta debtbar_{t-l} + e_{it}$$

$\Delta debt^{+} d\tau_{it}$ $(d\tau_{it} \times \max(0, \Delta debt))$ belirtilen borç/GSMH eşiği için borç büyümesinin pozitif olduğunu göstermektedir.

Gelişmiş ekonomiler için sonuçlara baktığımızda borç/GSMH oranları için oluşturulan kukla değişkenlerin (d30, d60, d90) ve oluşturulan etkileşim etkilerinin ($\Delta debt^{+} d\tau, \tau$ =30, 60, 90) tümü istatistiksel olarak anlamsızdır (Table 25). Diğer bir değişle belirtilen düzeylerde bir eşik değeri gözlemlenmemektedir. Gelişmekte olan ekonomiler için ise borç/GSMH oranının %90'ı aştığı durumda borç/GSMH oranı artmaya devam ettiğinde büyüme üzerindeki etkisi, diğer bir değişle $\Delta debt^{+} d90$'nın katsayısı, -0.070'e eşittir ve istatiksel olarak anlamlıdır (Eq. 26.4). Gelimemiş ülkeler için ise sadece borç/GSMH oranının %90 üzerinde olduğu durumu ifade eden kukla değişkeni (d90) anlamdır (-0.012) ve bir eşik değeri ifade edebilmek için oldukça küçük bir etkidir (Eq.27.4).

Farklı borç/GSMH oranlarını gösteren kukla değişkenlerin büyük çoğunlukla anlamsız olması ve anlamlı olduğu durumda da bir eşik değeri ifade etmemesi sebebiyle modelden çıkarılarak model sadece etkileşim etkilerini içerecek biçimde yeniden tahmin edilmiştir. Gelişmiş ülkeler için etkileşim etkilerini gösteren tüm terimlerin katsayıları anlamsızdır (Table 29). CS-DL tahmin sonuçlarına göre, gelişmekte olan ülkelere baktığımızda borç/GSMH oranının %90'ı aştığı durumda borç/GSMH oranı büyümeye devam ediyorsa ekonomideki daralma oldukça fazladır ve $\Delta debt^{+} d90$'nin katsayısı -0.094'ye eşittir (Eq. 30.4). Gelişmemiş ülkeler için CS-DL tahmin sonuçları gelişmekte olan ülkelerle benzerlik göstermekte ve $\Delta debt^{+} d90$'nin katsayısı -0.097'ye eşittir. Yani gelişmemiş ülkeler için de borç/GSMH oranının %90'ı aştığı durumda borç/GSMH oranı büyümeye devam ediyorsa ekonomideki daraltıcı etkisi oldukça büyüktür.

CS-DL tahmin yönteminin sonuçları borç/GSMH oranından ziyade artan borç yapısı için gelişmekte olan ve gelişmemiş ekonomilerde %90 düzeyinde bir eşik değerinden söz edilebilir. Bu bağlamda bulgularımız Reinhart&Rogoff'un bulguları için güçlü bir dayanak oluşturmamaktadır. Diğer taraftan borcun ekonomiyi daraltıcı yönde etkisi literatüdeki bulgularla benzelik göstermektedir.

Sonuç olarak borç ve büyüme arasındaki ilişki 26 gelişmiş, 40 gelişmekte olan ve 62 gelişmemiş ülke için 1960-2011 yılları için incelenmiştir. Ayrıca bu ilişkinin Reinhart&Rogoff (2010)'un gruplandırdığı biçimde farklı borç düzeyleri için d30 kukla değişkeni %30 ve %60 arası borç/GSMH oranlarını, d60 kukla değişkeni %60 ve %90 arası borç/GSMH oranlarını, d90 kukla değişkeni ise borç/GSMH oranının %90'nın üzerinde borç/GSMH kukla değişkenleri yardımıyla etkisi incelenmiştir. Sabit etkiler tahmin yönteminin sonuçları borç/GSMH oranın büyüme üzerindeki etkisini tüm ülke grupları için negatif bulurken farklı borç düzeyleri için etkinin eşik etkisi göstermediği sonucunu ortaya koymuştur. Ayrıca Sabit etkiler tahmin yöntemi sonuçlarına göre gelişmekte olan ekonomilerin borç/GSMH oranının büyüme üzerindeki olumsuz etkisinin en fazla olduğu gruptur. Bunun yanı sıra borç/GSMH değişkenini de içeren büyüme modeli tahmin ettiğimizde finansal bütünleşme (fint), kur esnekliği (fxr), yatırım (gcf), enflasyon (enf), finansal gelişmişlik düzeyleri (llgdp), ticari açıklık (open) ve eğitim (education) değişkenleri arasından gelişmiş ekonomiler için finansal bütünleşmenin ve yatırımın katsayıları (0.0001, 0.17) anlamlıdır ve ekonomik büyümeyi olumlu etkilemektedirler (Eq. 4.6). Borç/GSMH'nın etkisi ise ekonomiyi daraltıcı yönde olup katsayısı -0.017'ye eşittir (Eq. 4.6). Gelişmekte olan ekonomiler için ise finansal bütünleşme (fint), kur esnekliği (fxr), yatırım (gcf), enflasyon (enf), finansal gelişmişlik düzeyleri (llgdp), ticari açıklık (open) ve eğitim (education) değişkenleri arasından finansal bütünleşme , enflasyon ve borç/GSMH'nın etkileri ekonomiyi daraltıcı yönde olup katsayıları sırasıyla

-0.005, -0.002, -0.24'tür. Yatırımın katsayısı ise pozitif olup 0.126'ya eşittir (Eq. 5.5). Gelişmemiş ülkeler açısından ise, finansal bütünleşme (fint), kur rejimi esnekliği (fxr), yatırım (gcf), enflasyon (enf), finansal gelişmişlik düzeyleri (llgdp), ticari açıklık (open) ve eğitim (education) değişkenleri arasından borç/GSMH, kur rejimi esnekliği, enflasyon ve ticari açıklık anlamlıdır ve ekonomiyi daraltıcı yönde etkileri olduğu saptanmıştır. Yatırımı etkisi ise ekonomiyi genişletici yöndedir ve katsayısı 0.150'dir (Eq. 6.4). Bu modellere farklı borç/GSMH oranları için kukla değişkenler eklendiğinde herhangi bir eşik etkisi gözlenmemiştir. Sabit etkiler tahmin yöntemi yatay kesitlerin bağımsız olduğu varsayımı yapmaktadır. Ancak Pesaran (2004) yatay kesit bağımsızlığı testini uyguladığımızda yatay kesitlerin bağımlı olduğu görülmektedir. Bu sebeple Chudik, dd. (2013) tarafından geliştirilmiş yeni bir tahmin yöntemi olan yatay kesit dağıtılmış geciktirilme (Cross Sectionally Augmented Distributed Lag) tahmin yöntemi kullanılmış. Yatay kesit bağımlılığı durumda güvenilir olan bu tahmin yöntemi serilerin durağan olmaması durumda uzun dönem heterojen katsayılar için güvenilir tahminler ortaya koyan dinamik bir modeldir. CS-DL tahmin yönteminin sonuçlarına göre gelişmiş ülkeler için borç/GSMH büyüme oranının büyüme üzerindeki daraltıcı etkisi seçilen gecikme düzeyine bağlı olarak -0.041 ile -0.054 arasındadır (Table 13). Gelişmekte olan ülkeler için bu etki yaklaşık olarak -0.08 ile -0.01 arasındadır (Table 14). Gelişmemiş ülkeler için ise borç/GSMH büyüme katsayısı ise yaklaşık olarak -0.07 düzeyindedir (Table 15). Bu sonuçlar doğrultusunda borç/GSMH büyüme oranının en çok gelişmekte olan ülke ekonomileri olumsuz etkilediği söylenebilir. Yine sabit etkiler tahmin yöntemindekine benzer şekilde Reinhart&Rogoff'un belirttiği faklı borç/GSMH düzeyleri için kukla değişkenler CS-DL modeline eklenerek etkileri incelendiğinde eşik değeri etkisine rastlanmamıştır. Chudik, dd (2013) borç/GSMH oranlarından ziyade artan borç oranı için bir eşik değeri olabileceğini öne sürmektedir. Bu sebeple belirtilen eşik düzeyleri (d30, d60, d90) için artan borç oranı için etkileşim etkileri modele eklenmiştir ($\Delta debt^{+}d30$, $\Delta debt^{+}d60$, $\Delta debt^{+}d90$). CS-DL tahmin sonuçlarına göre gelişmiş ülke ekonomilerinde artan borç oranı için herhangi bir eşik değeri saptanamamıştır. Ancak sonuçlar gelişmekte olan ve gelişmemiş ekonomiler için borç/GSMH oranı %90'ı aştığında artan borç oranı için eşik değerinden söz edilebilir. Diğer bir değişle gelişmekte olan ve gelişmemiş ülke ekonomileri için $\Delta debt^{+}d90$'ın katsayısı anlamlıdır ve ekonomi üzerinde daraltıcı etkisi oldukça fazladır.

B. COUNTRY GROUPINGS

List of Countries

Advanced Economies

Australia
Austria
Belgium
Canada
Denmark
Finland
France
Germany
Hong Kong SAR,
China
Iceland
Ireland
Israel
Italy
Japan
Luxembourg
Malta
Netherlands
New Zealand
Norway
Portugal
Singapore
Spain
Sweden
Switzerland
United Kingdom
United States

Emerging Economies

Albania
Algeria
Argentina
Azerbaijan
Brazil
Bulgaria
Chile
China
Colombia
Costa Rica
Cote d'Ivoire
Croatia
Cyprus
Czech Republic
Dominica
Dominican
Republic
Ecuador
Egypt,
Arab Rep.
Greece
Hungary
India
Indonesia
Korea, Rep.
Latvia
Lebanon
Malaysia
Mexico
Morocco
Peru
Philippines
Poland
Romania
Russian
Federation
South Africa
Syrian Arab
Republic
Thailand
Trinidad and
Tobago
Turkey
Uruguay
Venezuela, RB

Developing Economies

Armenia
Bangladesh
Barbados
Belarus
Benin
Bolivia
Bosnia and
Herzegovina
Botswana
Cameroon
Cape Verde
Chad
Comoros
Congo, Dem.
Rep.
Congo, Rep.
El Salvador
Equatorial
Guinea
Estonia
Ethiopia
Fiji
Gabon Estonia
Ethiopia
Fiji
Gabon
Gambia, The
Georgia
Ghana
Guatemala
Guinea
Haiti
Honduras
Iran, Islamic Rep.
Jamaica
Kenya
Kyrgyz Republic
Lithuania
Malawi
Mali
Mauritania
Mauritius
Moldova
Mozambique
Nepal Niger
Nigeria
Oman
Pakistan
Panama
Papua New
Guinea
Paraguay
Rwanda
Senegal
Serbia
Slovak Republic
Slovenia
Sri Lanka
Sudan
Tanzania
Togo
Tunisia
Uganda
Ukraine
Vietnam
Yemen, Rep.
Zambia
Zimbabwe

TEZ FOTOKOPİSİ İZİN FORMU

ENSTİTÜ

Fen Bilimleri Enstitüsü	
Sosyal Bilimler Enstitüsü	x
Uygulamalı Matematik Enstitüsü	
Enformatik Enstitüsü	
Deniz Bilimleri Enstitüsü	

YAZARIN

Soyadı : CANBEK
Adı : DUYGU
Bölümü: IKTISAT

TEZİN ADI (İngilizce) : PUBLIC DEBT AND GROWTH: AN EMPRICAL INVESTIGATION

TEZİN TÜRÜ : Yüksek Lisans [x] Doktora [ ]

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