

Master's Thesis

Public Debt and Growth in Tajikistan

by

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CERTIFICATION PAGE

I, Rajabov Atoullo, (Student ID 51217604) hereby declare that the contents of this Master's Thesis are original and true, and have not been submitted at any other university or educational institution for the award of degree or diploma. All the information derived from other published or unpublished sources has been cited and acknowledged appropriately.

RAJABOV Atoullo
July 25, 2019

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LIST OF ABBREVIATIONS

ADF – Augmented Dickey Fuller

ARDL – Autoregressive Distributed Lag

ARMA – Autoregressive Moving Average

ASPRT- Agency on statistics under the President of the Republic of Tajikistan

CIS – Commonwealth of Independent States

DF-GLS – Dickey Fuller Generalized Least Squares

FSU – Former Soviet Union

GDP – Gross Domestic Product

GMM – Generalized Method of Moments

GoT – Government of the Republic of Tajikistan

HIPC – Heavily indebted poor countries

IMF – International Monetary Fund

MoF – Ministry of Finance of the Republic of Tajikistan

NBT – National Bank of Tajikistan

OLS – Ordinary Least Squares

PDMS – Public debt management strategy of the Republic of Tajikistan

USD – United States Dollar

VAR – Vector Autoregression

VECM – Vector Error Correction Model

WB – World Bank

WEO – World Economic Outlook

SUMMARY

In recent years public debt of Tajikistan has exceeded a general safe level for the first time since 2005. The latest joint IMF and the WB Debt Sustainability Analysis enlisted Tajikistan from group of low risk to high risk of debt distress countries, and advise GoT to reduce accumulated public debt. Conversely, Tajikistan requires huge amount of investments for development projects to strengthen the economy, create better living standards and reduce poverty, which can be difficult to accomplish without borrowing. Respectively, GoT adopted a new higher threshold level of public debt to GDP in the latest PDMS.

This study attempts to assess questions that instantaneously rise with above contour, namely how increasing public debt impact economic growth in Tajikistan and whether new adopted threshold level for public debt is valid. To answer these questions with data drawbacks paper conducts quantitative analysis using time-series and panel data techniques with 3 separate sets of data.

The empirical result revealed that external debt stock and service has negative impact on growth both in the short run and in the long run, while external debt disbursement has only positive long run effect in Tajikistan. Also, negative relation for domestic debt and growth was found, although results of main empirical model were insignificant. Estimation of public debt to GDP threshold level for homogeneous group of twelve FSU republics imply that the marginal impact of debt becomes negative at above 11-13 percent, while the overall impact of debt becomes negative at about 25 percent.

Finally, based on the findings of the research a set of suggestions were developed.

CHAPTER 1: INTRODUCTION

1.1 Background and problem statement

Tax is the main source of budget revenues and is not always sufficient to meet the needs. This is especially relevant to developing countries such as Tajikistan, which has few revenue options but large investment requirements for infrastructure, social sphere, and other development reforms. Therefore, governments broadly use debt instruments either domestically or externally to fill financial gap and meet investment requirements for the hope of economic development. However, the progressive impact of debt on economic development is an arguable issue and academicians with policymakers for long time been involved in the dispute concerning the assessment of the impact of public debt on economic growth.

Concerns on public debt started to rise especially after the second half of the twentieth century due to fiscal stresses and defaults at the beginning of the eighty's. This surged necessity in discovering the impact of public debt burden on growth for vulnerable to default HIPC¹ countries. One of the first papers that empirically analyzed this relation in HIPC was Cunningham (1993). His empirical findings was in line with extended debt overhang theory, according to which relation between debt and economic growth is defined as inverted U-shape type.

¹ “The heavily indebted poor countries (HIPC) are a group of developing countries with high levels of poverty and debt overhang, which are eligible for special assistance” (www.wikipedia.org).

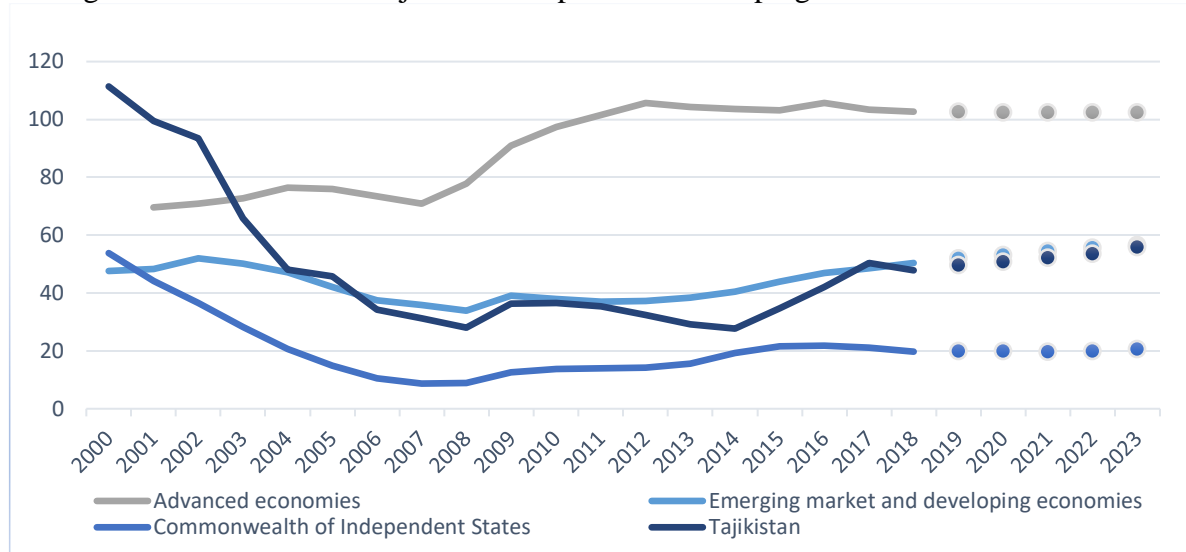
The second wave of researches evolved after huge fiscal imbalances followed by the Great Recession of 2008-09, which resulted in public debt crises in several countries. This time the debt and economic growth relationship was mostly concentrated to developed economies since the gross government debt for advanced countries had skyrocketed (see Figure 1). The most notable papers for the debt and growth nexus in advanced economies were introduced by Reinhart and Rogoff (2010a, 2010b, 2011) and Reinhart, Reinhart, Rogoff (2012). By analyzing large panel data of advanced countries authors discovered a threshold level for public debt at 90 percent level to GDP, beyond which debt hampers growth. This finding sparked an ample of new studies investigating the relationship of public debt and economic growth and the threshold level that jeopardize growth.

For developing countries general threshold level for public debt to GDP is estimated around 30-50 percent and are mainly revealed by technical works undertaken by IMF (2002, 2003). Although these benchmarks are not officially endorsed by IMF, another IMF paper (2010) suggest developing countries to reach suggested levels by 2030 and also Debt Sustainability Framework requires these thresholds to avoid risk. Therefore, a downturn trend can be seen for emerging and developing countries starting from 2002 in the Figure 1.

Excessive number of empirical studies with different dataset and methods of estimation resulted in several conclusions, specifically, public debt has positive (negative) effect on economic growth, public debt has positive (negative) effect on economic growth until certain level than the sign of effect changes and even public debt doesn't affect economic growth. Having several results on the same question brought a new cluster of studies that do not reject the existence of the relationship among these indicators but claim that a universal law for

debt to GDP threshold does not exist, hence suggest researchers to focus on the study of explicit condition and situations (Kray et al, 2006; Tomaselli et al., 2018).

Figure 1. Public debt in Tajikistan compared to developing and advanced economies



Source: IMF WEO, October 2018.

Note: Gross general government debt, dashed points indicate forecast.

In line with above and regardless of the number of empirical literature on the subject, the relation of public debt and economic growth in the case of Tajikistan has not been empirically investigated, whereas due to unfavorable international conditions the level of public debt is rising in recent years. For instance, the latest joint IMF and the WB Debt Sustainability Analysis² enlisted Tajikistan from group of low risk to high risk of debt distress countries. Likewise, Hurley et al. (2018) exploring future Belt and Road Initiative³ grouped Tajikistan as of particular concern for the occurrence of debt distress.

² “The Debt Sustainability Analysis is a tool that is used as part of a framework developed by the World Bank and the International Monetary Fund to help guide countries and donors in mobilizing critical financing for low-income countries, while reducing the chances of an excessive build-up of debt” (www.worldbank.org).

³ “The Belt and Road Initiative is a global development strategy adopted by the Chinese government involving infrastructure development and investments in 152 countries” www.wikipedia.org).

From other perspective, Tajikistan is the most disadvantaged state in the region and requires huge amount of investments for implementing development projects necessary to reduce poverty and create better opportunities for businesses. Implementation of the National Strategy of Development for Tajikistan for the period 2030 requires about 120 billion USD, where more than half of its financing is anticipated from public sector imposing GoT to increase borrowing amount to achieve intended objectives (GoT #392, 2016).

Moreover, in the last few years Tajikistan's economy is deteriorating due to decline in price of main export commodities and remittance inflow. The decline of prices for major exports and recession in Russian's economy, which is the main source of remittance inflow led to depreciation of national currency roughly twice during the last 3 years. Present economic environment had its negative effect on public debt as well, because almost 70 percent of debt are borrowed externally with foreign currencies.

Along with it, the banking sector became fragile. The level of non-performing loans in the banking sector reached almost 50 percent of total loans (NBT, 2017), which resulted in a crisis of several backbone banks of the country. GoT capitalized two major banks via issuance of government bonds (GoT #527, 2016). Capitalization of the banking sector triggered a worsening of the fiscal deficit and accordingly domestic debt rose from 5.3 percent in 2015 to 11.2 percent of the GDP in 2017.

However, the threshold for public debt adopted in medium-term PDMS⁴ for the years 2015-2017 (GoT #214, 2014) restricted the total amount to 47 percent, specifically 40 percent

⁴ "A debt management strategy sets out how the government intends to borrow and manage its debt to achieve a portfolio that reflect its cost and risk preferences, while meeting financing needs" (www.worldbank.org).

to GDP for external debt and 7 percent for domestic debt, where both have exceeded in 2017. Besides, to implement intended regionally strategic project “Rogun Hydropower”⁵ the second phase of borrowing in amount of half billion is expected (GoT #292, 2017). For these reasons, the new medium-term PDMS for the years 2018-2020 (GoT #486, 2017) set a new higher thresholds target of 60 percent to GDP. International institutions, for example IMF, have already proposed GoT to reduce the share of public debt to GDP (NBT, 2019). Such a macroeconomic condition makes policymakers, economists and scholars to ponder on how to overcome the problems of public debt with no harm on economic growth.

Therefore, conducting a research on defining the impact of domestic and external public debt on economic growth and discovering suitable threshold level, which maximizes economic performance and sustain long run fiscal and macroeconomic stability, would be a vital contribution.

In the light of above, this study employs country specific time-series analyses to investigate the impact of both domestic and external debt on growth in Tajikistan and also a panel data analyses with relatively homogenous group of 12 FSU⁶ republics to investigate non-linear relationship and identify a level of public debt that maximizes growth. The purpose of having panel data analyses in above to time-series is mainly data limitation including the number of observation and the range of public debt to output of Tajikistan that

⁵ The Rogun Hydrower project is a hydroelectric power station under construction in Tajikistan situated 110 km from Dushanbe.

⁶ “Former Soviet Union Republics are the sovereign states that emerged and re-emerged from the Union of Soviet Socialist Republics in its breakup in 1991” (www.unionpedia.org.)

doesn't allow to estimate non-linear relationship. In above, paper also intends to cover literature gap of public debt threshold estimation for selected group of countries.

1.2 Research objective, questions and hypotheses

The main objective of this study is to shed some light on issues rising around public debt in Tajikistan by discovering how public external debt and domestic debt is effecting growth in Tajikistan and whether a new adopted threshold level of public debt to GDP is valid.

General objective of the paper is to expand existing studies on the relationship between public debt and growth through empirically analyzing the dataset of Tajikistan with modified model and also search for an optimal level.

In order to achieve objectives of the research paper, the following questions are set to be answered:

- i. How domestic and external debt effects economic growth in the short and long run in Tajikistan?
- ii. Is investment a main channel that public debt impact growth in Tajikistan?
- iii. If a nonlinear relation of public debt and growth is true for homogenous group of 12 FSU republics, at what level the marginal impact of public debt become negative and whether it is adaptive in terms of fiscal balance?

The paper formulates analysis in such way to test enlisted below hypotheses, which are derived from popular theories on which recent papers of public debt and growth relationship are based. For instance, our first hypothesis is a conventional theory of public debt

(Elmendorf & Mankiw, 1999) and second hypothesis is explained by extended debt overhang theory (Sachs, 1989; Krugman, 1991) and capital flight theory (Calvo, 1998). The third hypothesis is a general level of public debt to GDP that IMF and WB advise and also globally admitted as a safe level for developing countries.

H1: Existence of the short-run positive and long-run negative effect of both domestic and external public debt on economic growth of Tajikistan.

H2: Non-linear relationship between public debt and growth.

H3: The general threshold of 40 percent for the level of public debt to GDP above which growth is hampered.

1.3 Research significance

The present study is the first research paper that empirically determines the relationship between public debt and economic growth in the unique economy of Tajikistan. It is also a reflection to newly adopted higher threshold level in Tajikistan. Paper intends to investigate the point, where economic growth is maximized with the use of broader data of homogenous 12 FSU republics that is in line with the latest vein of literature suggestion.

Different to most studies that mainly explore the effect of one element of public debt on economic growth, this study intends to focus on total debt both on internal and external public debt and how it effects economic growth in the short and in the long run. Moreover, the paper assesses the impact of public external debt disbursement along with other external

debt indicators that is different from previous studies. Inclusion of new variable will show how an economic growth is stimulated by external debt flow and also makes the result of stock public external debt more conclusive.

Furthermore, this paper assesses non-linearity between public debt and growth with intention to determine an optimal public debt level that will have positive marginal impact on economic growth. In addition to available studies this paper explores threshold point for public debt as the reflection of positive and negative fiscal balance.

The outcome of study can be widely used by policymakers on development of new PDMS and also considered by academicians who are interested in the relevant subject as reference for relationship of public debt and growth in unique economy of Tajikistan.

Various threshold estimation with panel data can be an asset for further researches of the public debt and growth relationship in the region that will help governments to make optimal decision on setting target level for the public debt.

CHAPTER 2: LITERATURE REVIEW

2.1 A glance at disparities in the theories of public debt

At various historical intervals, scholars and economists had different assumption towards impact of public debt on economy and even today they do not share a single point of view on the subject.

One of the earliest assumptions relevant to the public debt was proposed by French mercantilists at the beginning of the XVI century, which still can be seen in recent papers declaring “the more a nation owes, the more it also owns” (Salsman, 2017). This doctrine was active supporter of state intervention in the economy and considered money as an absolute form of wealth, therefore, naturally, the flow of money into the national economy was encouraged by them.

In contrast, representatives of the early classical school (A. Smith, D. Ricardo, J.B. Say) accused government debt because they believed that government expenditure is unproductive, hence public borrowing distorts private capital and negatively affect the accumulation of capital and growth (Tsoulfidis, 2007).

However, classics like Thomas Malthus and his successor John Stuart Mill come up with a different approach claiming that public debt doesn't necessarily act detrimental to the accumulation of productive capital, if they are directed either to balance overproduction of goods or in more advantageous uses (Bilan, 2016). After Mill, the classical theory of debt

was broadly acknowledged and the interest of authors on this issue was clogged until the Great Depression.

A fundamental change of perspective comes with the outstanding book of J.M. Keynes – “General Theory of Employment, Interest and Money” (2018). Although author does not trace public debt particularly, it provides concepts that disproves classical views on public debt. Most importantly it gives birth once again to the role of government interventions for stabilizing economy by countercyclical deficit spending.

While Keynes himself was worried about increasing amount of public debt, a latter generation of Keynesians tried to prove the contrary. For instance, Abba P. Lerner in his proposed theory of “Functional Finance and The Federal Debt” in 1943, stated that since government typically has the right to define level of taxes and print money, the size of the public debt in absolute or relative numbers is unimportant (because of transfer back to nation from taxpayers to bondholders). Therefore, government should do whatever to maintain the level of the national income to the level of full capacity and full employment exclusive of inflation and without worrying about the presence of budget deficits or the size of the national debt.

Another optimistic representative of Keynesian’s - Evsey D. Domar formed a mathematical proof in his paper “The Burden of the Debt and National Income” (1944) showing that under certain conditions public debt can be continuously growing but the proportion of taxes required to make it sustainable can remain constant. Thus, author advocates that as long as there is a sustainable growth of the economy deficit financing need not be considered.

James M. Buchanan the first to criticize overemphasized optimism of Keynesians toward government debt in 1958 published “Public Principles of Public Debt: Defense and Restatement” book. Buchanan referred to Keynesian’s ideas as “new orthodoxy” and opposed them in respect to three fundamental proposition (Table 1), showing that existing at that day perceptive, inferences and public policy repercussions of debt theory are fallacious.

Table 1. Disparities on fundamental proposition of public debt

Issue	Classicals	Keynesians	Buchanan
Does public debt burden transfer to future generation?	Yes, the burden of debt is transferred to future generations at the time of debt occurrence.	No, future generations is not involved in transfer of the primary real burden of public debt.	The fundamental real burden of a public debt is transferred to future generations.
Is there any difference among domestic and external debt?	No, both are reducing national wealth.	Yes, external debt and domestic debt differ significantly.	The domestic debt and external debt are fundamentally alike.

Source: Alekhina (2007) and Buchanan (1958).

Also monetarist economists, opposed Keynesians on encouraging budget deficits with objective to relaunch the stagnating economy because of the crowding-out effect. This concept was broadly used in literature of public debt and growth. The concept primarily means that when there is excess borrowing in the market to finance government budget deficit, the demand on loans increases, while the supply for loans does not change. Thus, in order to balance loan shortage, interest rate rises, which consequently reduces private investments and growth. However, from the Keynesian perspective, considering the conditions of an economy, where a significant amount of resources remains and the economy is not functioning on full aptitude, financing with deficits will attract these unused resources into the economic circuit. By this supply for loanable funds rises correspondingly to the demand and does not affect the interest rate (Bilan, 2016).

In line with Keynesian some other economist propose an opposite situation called crowding-in effect. For instance, Abdullatif (2006) explained crowding-in effect by the reduction of producing cost for the private sector, due to public investment in infrastructure, electricity generation, education, health care services and etc.

Ludvigson (1996) also explored how deficit financing could stimulate investment rather than crowding it out. By studying a forward-looking general equilibrium model he identified that deficit financing and income tax cut positively effect output, even if for repayment distortionary taxation is utilized. This is due to, firstly, when labor supply is elastic, tax cut today motivates workers to consume and work more and secondly government expenditure financed from borrowing increases consumption and output, lastly distortionary taxes only reduces consumption and output.

Ricardian equivalence theory proposed by Barro (1979) representative of rational expectation school disapproved both the Keynesian and Neoclassical's view on public debt and denoted neutrality of public debt. The theory claims that population admit that the increase in government expenditure today is retrieved through high taxes in the future. Therefore, they will be more willing to save or invest for the future rather than consume today. Accordingly, there is no change in interest rates or consumption, thus excess public expenditure through borrowing doesn't produce desired outcome. However, Bernheim (1987) comparing the Keynesian, Neoclassical and Ricardian school of thoughts regarding to deficit financing argues that the Ricardian paradigm holds on implausible assumptions and should be rejected on theoretic grounds.

Generally, from macro prospective view there is no commonly accepted formulation of impact of public debt on growth, or differently there are many possible ways that public debt can affect economic growth. Today most economist and policymakers combine Classical arguments and Keynesian arguments to explain the relationship between public debt and economic growth. For instance, the conventional theory advocates that in the short period, Keynesian approach is considered to lead, i.e. public debt positively effects economic growth. During the recession or stagnation governments tend to increase budget expenditure through deficit financing or borrowing externally. In contrary, in the medium to long term period markets return to equilibrium, therefore interest rates rise and crowd out investment, i.e. classical or liberal approach is expected (Elmandorf & Mankiw, 1999).

Another theory that combines both positive and negative effect, suggests that the relation of public debt and growth is non-linear by nature. This type of theories are very popular in threshold based empirical analyses and known as “extended debt overhang”, initially proposed by Sachs (1989), Krugman (1991) and further investigated by Deshpande (1997), Cordella et al (2010), Kobayashi (2013) and others. A “debt overhang” is a situation where investments are in decline or postponed due to the private sector expectation that the incomes from their investment will be used to service public debt. Accordingly, an extended accumulation of public debt stock generates insecurity among investors on how government will contest its debt service obligations. Eventually this will effect private investments and in turn will have negative impact on economic growth. Thus, the relation of public debt and growth according to this concept is shown as inverted U-shape type. More details on theories behind non-linearities between public debt and growth is provided in chapter 4.

Summing-up the theoretical part of the impact of public debt on economic growth it can be said that a single explanation of effect of public debt on growth does not exist. Therefore, it is important to explore the empirical literature to see what data says about this relationship and whether above hypotheses are realistic.

2.2 General review of time series and panel data empirical analysis

Until the Great Recession of 2008 most studies were merely dedicated to a group of poor and developing countries, which had large external debts. In general, it was in response to the defaults after Oil Shock in 1980. Traditional creditors as Paris Club, international financial institutions as IMF and WB, and a number of economists were eventful for resolving the debt burden issue for the group of HIPC.

Although, Tajikistan and some other FSU countries have accumulated huge amount of debt, especially from external sources soon after reaching independence, the author did not find any empirical studies on the subject at the country level. But some panel data analyses are available that consider these countries as a group.

There are, however, overall review and descriptive analysis on the relationship of public debt components and economic growth for FSU republics in separate. For instance, Ahmedov and Safarov (2016) have descriptively studied the impact of government debt on economic growth of Tajikistan for the period 2001-2014 and indicated that when government expenditures are raised by 1 percent, GDP will increase only by 0.29 percent, while increasing GDP by 1 percent budget incomes increase by 3.12 percent. Increasing external financing including external debt by 1 percent increases GDP by 0.24 percent and when

external investments are effectively implemented, its impact grows to 0.56 percent. Although, the methodology of estimating this regression is unclear authors present another table of the rate of external debt growth and nominal GDP growth and conclude with the Domar's (1944) suggestion that as long as rate of growth is higher than growth rate of public debt, there is less concern on stability and default.

Country level empirical analysis is quite plentiful for developing countries. Most of this studies resort to cointegration technics of Engle and Granger (1987) two-step method, Johansen and Juselius (1990) VECM or Pesaran and Shin (1998) and Pesaran et al. (2001) Autoregressive Distributed Lag Model (ARDL) approach of bound testing, because of non-stationarity of macroeconomic data at their level.

For instance, VECM was implemented by Ali et al. (2012) to investigate public external debt and economic growth relationship in Pakistan using annual data covering 1970 to 2010. The growth model was derived from Cunningham (1993) and Karagol (2002), where production function initially augmented by debt service than in line with Romer (1989) extended with human capital. Authors found a negative relationship between public debt and economic growth and direct the reason to debt overhang theories. The domestic debt and growth of Pakistan was analyzed by Sheikh et al. (2010) covering period 1971-2008. For some unknown reasons variables were in absolute form and investment variable was not included in the model. ARMA obtained positive coefficient for domestic debt, but negative for the service of these debts that overweighed the positive and hence the authors suggest that a government should not rely on domestic debt but reform tax code.

Akram (2011) used ARDL cointegration technic to test the production function augmenting with public debt variables for Pakistan and derived negative relationship for the variable of interest both in the short and long term. He also found negative relation of public debt with the main channel that debt can impact growth – investment in the long-run while insignificant results in the short-run and suggested not relying on public debt for financing government budget deficit. A reassessment for the relationship of public debt and indicators such as GDP and GNP was explored by Jibran et al., (2016). They used same method of ARDL and found similar result except for insignificant effect of domestic debt.

To cope with endogeneity, Islam (1992) used a two stage least square method which differs from other studies. The author investigated the link between loans, aids and growth in Bangladesh for the years 1972-1988 and found weak positive relation for aid but strong for government loans. Though, Farhana and Chowdhury (2014) using ARDL model studied external debt and growth in Bangladesh for the years 1972-2010 and found significant negative coefficient. Both studies seem to have some limitations, for instance former used the growth rates as dependent variable so the result can be interpreted as short run effect and later model suffer from autocorrelation that make the result of ARDL ambiguous.

Nonlinear relationship for the country level was conducted by Daud (2016) studying quarterly data for Malaysia for the period 1996-2011. The author employed Hansen (1999)⁷ method of identifying threshold for nonlinear relationship. The threshold point was estimated at level 12.8 percent of GDP, where above economy growth was hampered. Still, for the

⁷ Hansen method is a threshold regression method for non-dynamic panels with individual fixed effects based on spline function.

robust model debt coefficient above 12.8 percent was not significant. The nonlinear relationship of government debt and growth was also affirmed by Kumara and Coorey (2013) by studying Shri Lanka case. The study employed quadratic specification and find a threshold for the government debt at level of 60 percent, above which debt negatively affects growth. Almost the same result was reported by Purankumbura et al. (2015), but their study also on empirical bases found channels through which debt impacts growth including, national saving, trade openness, investment and budget deficit.

The empirical study on the panel data analyses is much broader than country level empirical studies. One of the important empirical papers on the subject was introduced by Pattillo et al. (2004). They conducted analyses by employing data of 61 developing countries to understand if debt impacts growth within total factor productivity or factor accumulation. As a results, a nonlinear relationship between debt and growth was found, supporting the argument that until certain level public debt has a significant positive effect, but further amount of debt reduces economic growth and also the impact is found to be through both total factor productivity and capital accumulation. Authors used external debt to GDP ratio and external debt to export ratio in their analyses and found 35-40 percent and 160 -170 percent threshold level accordingly. Lastly, they suggested to study the subject more deeply taking into account the quality of the policies in the countries of the sample.

The suggestion of Pattillo et.al. (2004) was applied in Cordella et al. (2005) paper. They examined the impact of debt on economic development in 79 developing countries. A new dependent indicator was formed with indices to measure the policy effect. Unlike most studies this paper used net present value of external debt above to nominal. The results of OLS regression and GMM system estimator implied that the debt threshold level for the

countries with better policies and institutions is at 15 – 30 percent of GDP and in countries with worse policies and institutions threshold level is between 0 - 20 percent of GDP. The negative marginal effect was significant until 70-80 percent of GDP and after that it became statistically insignificant.

Furthermore, analyzes of Patillo et. al. (2004) was developed by A. Schclarek (2004) by including in analyses private external debt and increased the sample set to 83 countries. Regression analysis was implemented by using GMM dynamic panel data estimator. He investigated linear and nonlinear type of relationship between public debt and economic growth. Author concluded that low amount of total country external debt has positive impact on growth rates in developing countries but found negative relation in the case of the public external debt. In addition, the study showed that mainly the debt is affected within the capital accumulation growth.

Kumar and Woo (2010) investigated the relationship between public debt and long run economic growth both in developing and developed countries. They used a different type of models and techniques including system GMM, pooled OLS, between estimator and fixed effect model. They found a negative relationship between these variables, pointing out that each percentage increase in public debt decreases growth by 0.02 percentage. The results were statistically significant only when the public debt to GDP ratio exceeds 90 percent.

Later in 2012 Panizza and Presbitero investigated the causality between public debt and economic growth by using instrumental variable regression. They selected OECD countries for analyses. Authors instrumented public debt to capture valuation effect. They did not find statistically significant results that could support an inverse U-shape effect.

Hence, they claimed that there is no causality between public debt and economic growth, nonetheless suggested to continue analyses through different techniques, variables and approaches.

For the countries of interest Oleksandr (2003) has studied non-linear impact of external debt on growth. The study analyzed data of 21 transitional economies for the period 1994-1999 by applying quadratic and spline function specification and estimating with common longitudinal techniques. The results show that the threshold level for the sample of transitional economies ranges at level 11 percent to 18 percent. The spline function method did not give any significant results with fixed effect model.

The transitional economies were also studied by Uzun et al. (2012) for the longer period of 1991-2009. The authors employed panel ARDL analysis and revealed positive effect of external debt on growth for the long run and negative in the short run. Author concluded that transitional economies are now in the right side of “debt Laffer curve”.

The study of empirical literature suggests that any kind of relation is possible between public debt and growth and it is merely depends on the study case. There are number of reasons, why results are different when employing different techniques or most importantly a sample group or an individual country. Firstly, it's because of different macroeconomic policy, institutions and production technology across countries (Temple, 1999) and secondly it is the composition and structure of public debt that differs significantly across countries. Therefore, these two main attributes have to be accounted while exploring the public debt and growth relationship.

CHAPTER 3: PUBLIC DEBT AND ECONOMIC GROWTH IN TAJIKISTAN: TIME SERIES ANALYSIS

3.1 Introduction

The relation between public debt and economic growth has long been under debate among academia and policy makers. Even today there is no commonly accepted opinion on the impact of public debt on growth. The conventional theory proposed by Mankiw et al. (1998) combines both possible effect and concludes that in the short run public debt has positive impact on growth emphasizing aggregate demand and negative impact in the long run due to crowding-out effect. Most of the time series empirical studies analyzing the public debt and growth nexus for the short and long term that were cited in literature either found negative or insignificant results. Taking into consideration only the stock variable of public debt as explanatory variable is assumed to be the reason of insignificant results.

This paper applies different approach and tries to discover effect of debt disbursement and debt service separate from the aggregate debt both in the short and long-run and test the first hypothesis of the research.

However, I acknowledge that the quarterly data spanning from 2005 to 2018 is not significant to assess long-run effect. Moreover having difficulties with availability of data for the domestic debt a second annual dataset is created that has only 21 observations and put some ambiguity on estimations.

Nevertheless, in order to achieve the objective of the study, namely to investigate the impact of both domestic and external debt on economic growth and test the defined hypothesis empirical analyses is employed according to mentioned limitations.

3.2 Economic growth and development of public debt in Tajikistan

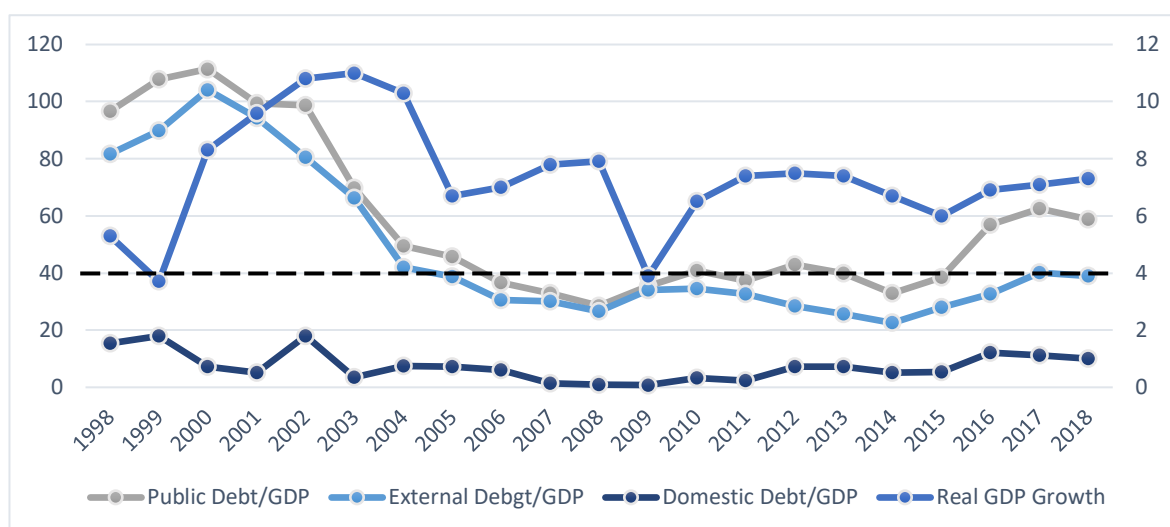
Tajikistan - a small landlocked country (142.6 thousand sq.km) with population of 9 million (as of 2019) gained independence after the Soviet Union collapse in the late 1991. Right after gaining independence Tajikistan implemented a series of nationwide economic reforms toward transferring from a planned economy to a market based economy in cooperation with international institutions (Iwasaki, 2002). Although reforms in economic and social spheres have noticeably increased living standards of population, Tajikistan remains as the poorest country in the region. It should be noted that even as Tajik Soviet Socialist Republic (TSSR) internal sources were insufficient, for instance Rubin (1994) reports that to cover social sector deficit TSSR received almost 50 percent of the budget from the center - Moscow as subsidy and in addition country had a huge trade deficit with other Soviet Republics for imports of energy and raw materials.

Furthermore, since its early independence, Tajikistan's economy has been devastated by political crises – civil war that caused to a colossal human and material loss. The civil war (1992-1997) made Tajikistan the worst economic performer among new independent countries and caused the country's GDP to drop by almost three times in 1997 from its initial level in 1991.

The first positive sign of growth was seen right after the peace treaty in 1997 amounting 1.7 percent and further between 2000-2004 average growth rate in Tajikistan experienced two-digit growth that confirmed the appropriate direction of reforms. However, according to WB (2005) Tajikistan was accounted as a country vulnerable to shocks because the main driver of economic growth at that time was favorable price of main export commodities, aluminum with cotton and remittance inflow, which generated more than 50 percent of GDP. The average rate of growth in the years 2005 to 2008 decelerated to 7.1 percent and due to the financial crisis, in 2009 growth dropped to the point of 3.9 percent. For the years 2010-2017 average growth was amounted around 6.9 percent. Nevertheless, beginning from the late 2014 due to the decline of major export product combined with the recession in Russian's economy, which is the main source of remittance inflow led to depreciation of national currency roughly by 65 percent for the years 2015-2016 and at the same time deteriorating business climate and macroeconomic indicators including debt sustainability.

The history of public debt evolution in independent Tajikistan begins with the time of the collapse of the USSR in 1991. The total amount of external debt of the USSR was roughly 81 billion USD (48.5 billion rubles) and due to the collapse of the USSR, in 1992 all this debt was planned to be divided between the newly formed independent states. The share of Tajikistan, according to the calculation, which was based on four indicators, namely the share of republics in exports, imports, national income and the population for the years 1986-1990 was accounted to be 0.0082 percent of total USSR debt (Shebanova, 2013).

Figure 2. Economic growth and Public debt in Tajikistan



Source: MFRT, ASUPRT, IMF

Note: Dashed line indicates threshold level. Domestic debt observations for the years before 2007 is calculated from data of IMF and MFRT. Left vertical axis is Debt to GDP ratio in percentage and right vertical axis is real GDP growth rate in percentage

However, an indisputable solution for the calculation of public debt share for each newly independent country was not achieved. Therefore, in 1993, FSU republics signed an agreement with the Russian Federation, according to which all public debts were accepted by Russian Federation, with the exception of the unsettled balance of correspondent accounts (Shebanova, 2013).

The necessity of public borrowing in Tajikistan rose again in the period of the civil war, for the military expenses and basic need for living, which were significantly imported on credit terms. Most of the debts had short-term condition and largely fell into arrears. The largest creditors were Russia, Kazakhstan, IMF and WB. Several debt rescheduling negotiations with main bilateral creditors, which were successfully conducted by GoT helped to improve debt profile (IMF, 2005). Nevertheless, the lack of domestic resources to make necessary reforms made public debt soon unsustainable, demanding for the service of debt

huge budgetary resources. Consequently by the end of 2000 the public debt of Tajikistan reached its peak of 111 percent to GDP as shown in Figure 2 (Jabborov, 2011).

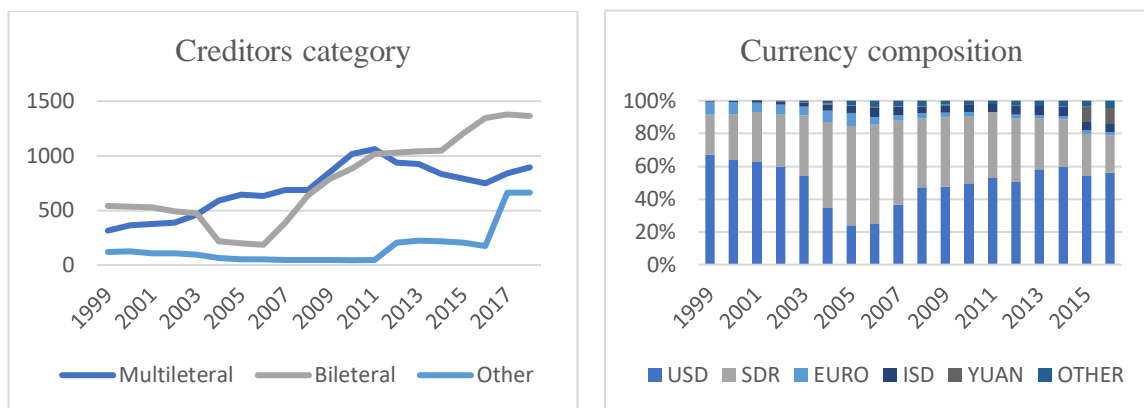
The double digit growth, borrowing only high concessional loans and debt cancelation agreements with Russia, India, China and Pakistan decreased the share of public debt to GDP, from the initial level of 111 percent in 2000 to 66.3 percent in 2003, and further to 49.4 percent in 2004. By the end of 2006, the debt level was reduced to 36 percent due to repayments and the cancellation of debt obligations by the IMF Executive Board, as part of the Multilateral Debt Relief Initiative for countries with excessive debt and low per capita income (IMF, 2007).

The structure of debt has also changed in this period with decline of bilateral debt from almost 90 percent in 1997 toward multilateral borrowing 73 percent in 2006. The currency structure of external debt on other hand has increased toward SDR amounting 61 percent in 2006, while USD amounted only 24 percent of total external debt (MoF, 2008). However, the increase in the share of bilateral loans again occurred with the start of the development of concessional loans from the Export-Import Bank of China. Thus, since 2007, the share of bilateral debt began to grow and by the end of 2018 amounted to 47 percent of total external debt. For the same reason the USD composition of debt has increased, since borrowed loans from Export-Import Bank of China were mainly in USD.

In contrary, a significant reduction in the share of multilateral flows towards bilateral flows can be seen since 2009. This is primarily due to the fact that from 2008, the investment policy of the WB and ADB for Tajikistan has been mainly focused on the provision of grant

aid, rather than loan funds (MOF, 2016). As a result, the share of multilateral loans in the total loan portfolio decreased from 73 percent of 2006 to 30 percent at the end of 2018.

Figure 3. External debt by credit category and currency composition



Source: MFRT (2008, 2016)

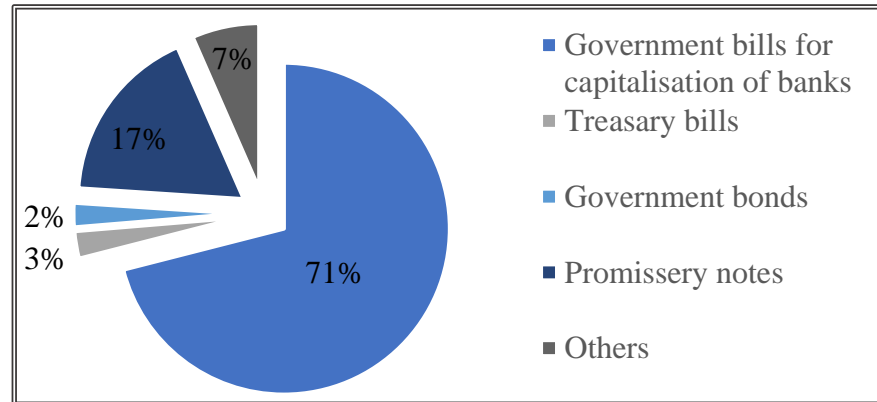
Note: In credit category other includes debt with government guarantee, NBT debt and Eurobond. SDR and ISD stands for Special Drawing Rights and Islamic Dinar accordingly.

The sharp increase in other category of creditors is due to the issuance of Eurobond in an amount of 500 million US dollars for the construction of hydropower project “Rogun Hydropower” with 10-year of maturity and a fixed rate of 7.125 percent by GoT. This is the first time when Tajikistan issued Eurobond (Allen, 2017). GoT (#292, 2017) decided to issue government bonds (Eurobonds) in the amount of up to one billion US dollars in international financial markets and as for the first stage half a billion was issued. The remaining amount will be issued in subsequent necessary cases. With prior assessment the potential costs and risks from attracting additional 500 million US dollars from Eurobonds in the medium term and also their impact on the future structure of the public debt of the country shows that the level of external debt in relation to the gross domestic product may increase to 44.5 percent and the weighted average interest rate on the total debt portfolio may rise to 3.7 percent from 2.3 percent per year in 2016 (GoT #486, 2017).

The public domestic debt unlike external debt is less developed in the sense of security market. The public debt reports prepared by MoF does not have data for domestic debt for the early years of 2000's and it varies around one percent to GDP from 2007 to 2010. Only in 2010 MoF reports (the previous reports include only external debt) that due to favorable development of the budget balance in 2002 to 2009 the dynamics of the development of the parameters of domestic debt remained unchanged and in 2010 it has increased by 3.1 percent in nominal terms owing to issuance of government bills, short and long term government treasury bills and government bonds. The report also states that the development of the state securities market is one of the priorities of the fiscal and monetary policy, not because of the coverage of the state budget deficit, but as the creation of additional leverage in the implementation of fiscal and monetary policy, an additional tool for regulating liquidity in the market, diversifying the domestic debt portfolio and developing the secondary securities market. Yet, security market still has not been developed to the necessary level and lacks systemic reforms.

As of 2018 domestic debt increased to 10.1 percent of GDP, which is in nominal terms equals to 6.95 billion Tajik somoni. Major share of domestic debt is government bills for capitalization, which account for around 70 percent of the total amount of debt. Because the interest rates of government securities are very low there is not much demand, therefore GoT doesn't borrow domestically for implementation of national projects or other type of real expenditure.

Figure 4. Domestic debt composition



Source: MoF operational data.

It is noteworthy to mention that the low weighted average interest rate on the entire debt portfolio is 1.7 percent, despite a rather high weighted average interest rate on domestic debt of 4.2 percent. This is due to the large number of low-interest loans in the total debt portfolio varying in range between 0.75 percent to 3 percent. Since the possibility of financing the state budget through bilateral and multilateral donors remains stable in the medium term, the risk of refinancing is estimated to be moderate (GoT #486, 2017).

3.3 Theoretical framework and model specification

Until recently endogenous growth-theories generally were anticipated to be more powerful, since their principal optimization models are constructed on microeconomic bases (Rao, 2010). However, recent theoretical criticisms toward endogenous growth-models (Jones, 1995 and Parente, 2001) once again increased importance of exogenous growth model, especially for time-series analyses (Rao, 2010).

Due to this criticism one cannot claim that endogenous growth-models are superior than exogenous growth-models to estimate vector of growth. Therefore, this study employ the extended exogenous model for growth estimation, which is derived heavily from Rao (2010) and Balassone et.al (2011). In these models Cobb-Douglas production function is augmented with endogenous variables for country specific growth policies, since exogenous Solow (1956) model of growth alone explain growth in range up to 70 percent for some cases as noted by Rao (2007) and the remaining part is explained by technological improvements (TFP) also known as Solow residual.

Considering the following production function:

$$Y_t = Ae^{f[t,X_{it}]}K_t^\alpha L_t^{1-a} \quad (1)$$

where the $f[t,X_{it}]$ is assumed as a function of growth inducing variable X_{it} and plus some unknown trended variable proxied by time and ceteris paribus Y is output at time t , A is constant representing initial level of stock of knowledge, K is capital at time t and L is labor at time t , and a and $(1-a)$ are elasticities of capital and labor.

For simplicity Balassone et al. (2011) assumed next linear relation:

$$f(t,X_{it}) = g_1t + g_2X_{i,t} + \dots + g_nX_{j,t} \quad (2)$$

By expressing equation (1) in per effective labor, next equation is derived:

$$y_t = Ae^{f[t,X_{it}]}k^a \quad (3)$$

Rewriting equation (1) and (2) in log transformed form result to:

$$\ln Y_t = \ln A + g_1 t + g_{2..n} X_{i..j,t} + \alpha \ln K_t + (1 - \alpha) \ln L_t \quad (4)$$

and in per effective labor:

$$\ln y_t = \ln A + g_1 t + g_{2..n} X_{i..j,t} + \alpha \ln k_t^{(8)} \quad (5)$$

Since most of macroeconomic data are not stationary in their level taking first difference of equation (5) will yield to:

$$\Delta \ln y_t = g_1 + g_{2..n} \Delta X_{i..j,t} + \alpha \Delta \ln k_t \quad (6)$$

According to theory in the long term, when per effective labor stock converges to its long run equilibrium value, where $\Delta \ln k_t^* \rightarrow 0$ output growth converges to:

$$\Delta \ln y_t^* = g_1 + g_{2..n} \Delta X_{i..j,t} \quad (7)$$

However, Tajikistan is relatively poor in regard to capital stock and has not converged to the steady state. Therefore, only studying the steady state equation (7) instead of equation (6) is not appropriate and above to that omitting the key variable could result in misspecification bias and yield unreliable effect for shift variable on output (Rao, 2006). Another reason for studying both equation is to understand the impact of public debt on output within capital accumulation channel.

Rewriting equation (6) and (7) with combining equation (5) ARDL (p, q) error correction form is specified and by augmenting shift variables of interest study's empirical model is constructed as follow:

⁸ Small letters of y and k indicate output and capital per labor.

$$\begin{aligned}
\Delta \ln y_t &= g_1 + \alpha \Delta \ln k_t + g_2 \Delta ED_t + g_3 \Delta EDS_t + \\
&\sum_{i=1}^p \beta_{yi} \Delta \ln y_{t-1} + \sum_{i=1}^{q_n} \beta_{edi} \Delta ED_{t-1} + \sum_{i=1}^{q_n} \beta_{edsi} \Delta EDS_{t-1} + \sum_{i=1}^{q_n} \beta_{ki} \Delta \ln k_{t-1} \\
&- \lambda (\ln y_{t-1} - \ln A - g_1^* t - g_2^* ED_{t-1} - g_3^* EDS_{t-1} - \alpha^* \ln k_{t-1}) + \mu_t \quad (8)
\end{aligned}$$

where $\ln y_t$ is natural logarithm of output level per labor, $\ln k_t$ is capital proxied with investment per labor, ED_t is external debt stock to nominal GDP and EDS_t is external debt service as ratio to export. First row of the equation is short run effects, second row is ARDL terms (short run dynamics) and third row is ECM or long-run effect including $(-\lambda)$ error correction term or adjustment speed and μ_t is a white noise error term. Rewriting equation (8) in the steady state form gives:

$$\begin{aligned}
\Delta \ln y_t &= g_1 + g_2 \Delta ED_t + g_3 \Delta EDS_t + \sum_{i=1}^p \beta_{yi} \Delta \ln y_{t-1} + \sum_{i=1}^{q_n} \beta_{edi} \Delta ED_{t-1} + \\
&\sum_{i=1}^{q_n} \beta_{edsi} \Delta EDS_{t-1} - \lambda (\ln y_{t-1} - g_1^* t - g_2^* ED_{t-1} - g_3^* EDS_{t-1}) + \mu^* \quad (9)
\end{aligned}$$

To capture the external effects, including financial crisis of 2008-2009 and economic recession with banking crisis of 2015 a dummy variable is generated, where it takes one for the years 2009 and 2015 otherwise it takes 0.

Transforming equation (8) to linear econometric equation and adding exogenous dummy variable will result to:

$$\begin{aligned}
\Delta \ln y_t &= \beta_0 + \beta_1 t + \beta_2 \ln y_{t-1} + \beta_3 \ln k_{t-1} + \beta_4 ED_{t-1} + \beta_5 EDS_{t-1} + \beta_6 \Delta \ln k_t \\
&+ \beta_7 \Delta ED_t + \beta_8 \Delta EDS_t + \beta_{11} DUM + \sum_{i=1}^p \beta_{yi} \Delta \ln y_{t-1} + \sum_{i=1}^{q_n} \beta_{ki} \Delta \ln k_{t-1} + \\
&\sum_{i=1}^{q_n} \beta_{edi} \Delta ED_{t-1} + \sum_{i=1}^{q_n} \beta_{edsi} \Delta EDS_{t-1} + u_t \quad (10)
\end{aligned}$$

From calculation of the coefficients in equation (10) it is feasible to recover the parameters of the equation (8) :

$$\begin{array}{lll}
\beta_0 = \lambda \ln A + g_1 & \beta_5 = \lambda g_{3*} & A = e^{-\frac{1}{\beta_2}(\beta_0 + \frac{\beta_1}{\beta_2})} \\
\beta_1 = \lambda g_{1*} & \beta_6 = \alpha > 0 & g_{1*} = -\frac{\beta_1}{\beta_2} \\
\beta_2 = -\lambda < 0 & \beta_7 = g_2 & a^* = -\frac{\beta_3}{\beta_2} \\
\beta_3 = \lambda \alpha^* > 0 & \beta_8 = g_3 & g_{2*} = -\frac{\beta_4}{\beta_2} \\
\beta_4 = \lambda g_{2*} & & g_{3*} = -\frac{\beta_5}{\beta_2}
\end{array} \tag{10a}$$

and similar approach is applied for equation (11) and (12).

For the consistency and logically easy interpretation of coefficient restrictions in future same beta indicators in all other equation is used, for instance in equation (9):

$$\begin{aligned}
\Delta \ln y_t = & \beta_0 + \beta_1 t + \beta_2 \ln y_{t-1} + \beta_4 ED_{t-1} + \beta_5 EDS_{t-1} + \beta_7 \Delta ED_t + \beta_8 \Delta EDS_t + \\
& \beta_{11} DUM + \sum_{i=1}^p \beta_{yi} \Delta \ln y_{t-1} + \sum_{i=1}^{q_n} \beta_{edi} \Delta ED_{t-1} + \sum_{i=1}^{q_n} \beta_{edsi} \Delta EDS_{t-1} + u_t^* \tag{11}
\end{aligned}$$

where u_t and u_t^* are white noise error term.

In addition to measure the impact of the flow variable of borrowed government financing proxied by external debt disbursement to show the effect of loan base government financing as discussed already, equation (9) is supplemented to:

$$\begin{aligned}
\Delta \ln y_t = & \beta_0 + \beta_1 t + \beta_2 \ln y_{t-1} + \beta_4 ED_{t-1} + \beta_5 EDS_{t-1} + \beta_6 EDD_{t-1} + \\
& \beta_7 \Delta ED_t + \beta_8 \Delta EDS_t + \beta_9 \Delta EDD_t + \beta_{11} DUM + \sum_{i=1}^p \beta_{yi} \Delta \ln y_{t-1} + \\
& \sum_{i=1}^{q_n} \beta_{edi} \Delta ED_{t-1} + \sum_{i=1}^{q_n} \beta_{edsi} \Delta EDS_{t-1} + \sum_{i=1}^{q_n} \beta_{eddi} \Delta EDD_{t-1} + u_t^* \tag{12}
\end{aligned}$$

The coefficient of lagged GDP per effective labor have to be negative ($\lambda < 0$) for the convergency of the equation. Coefficients of capital per labor is expected to be positive ($\alpha > 0$) in all equations. Stock debt variables are expected to be positive in short term and negative in long term according to our hypothesis, while debt service is predicted to be negative. However, there are no preliminary expectations regarding the coefficients of the ARDL terms (β_{yi} , β_{ki} , β_{EDi} , β_{EDSi} and β_{EDDi}), the intercept and the time trend.

This theoretical model is also base for the estimation of domestic debt. Because only data for the accumulated stock of domestic debt is available, the econometric model is formulated as next:

$$\Delta \ln y_t = \beta_0 + \beta_1 t + \beta_2 \ln y_{t-1} + \beta_3 \ln k_{t-1} + \beta_4 DD_{t-1} + \beta_5 \Delta \ln k_t + \beta_6 \Delta DD_t + \sum_{i=1}^p \beta_{yi} \Delta \ln y_{t-1} + \sum_{i=1}^{qn} \beta_{ki} \Delta \ln k_{t-1} + \sum_{i=1}^{qn} \beta_{DDi} \Delta DD_{t-1} + \varepsilon_t \quad (13)$$

and rewriting it without capital or in the steady state takes form of:

$$\Delta \ln y_t = \beta_0 + \beta_1 t + \beta_1 \ln y_{t-1} + \beta_2 DD_{t-1} + \beta_3 \Delta DD_t + \sum_{i=1}^p \beta_{yi} \Delta \ln y_{t-1} + \sum_{i=1}^{qn} \beta_{DDi} \Delta DD_{t-1} + \varepsilon * t \quad (14)$$

3.4 Data and determination of variables

The construction of data was mainly based on data availability. Therefore, in order to have fairly balanced data and due to shortage of figures two datasets were constructed. First dataset is in quarter for exploring impact of external debt that covers period 2005 to 2018

and in total consist of 56 observations. The second dataset is annual because for the domestic debt the quarterly data was available only for few last years. The data covers the period from 1998 to 2018 and in total has 21 observations. Also, since official data for domestic debt was after 2007 the data for the previous years were calculated by author through simply extracting public external debt from the gross public debt collected from IMF.

Data for time series analyses is collected mainly from the MoF including official and operational data, NBT, ASPRT and WEO of IMF.

Data for national accounts including GDP (Y), capital formation proxied by investment (K) and labor force (L) is derived from NBT and updated for the year 2018 from ASPRT. Quarterly data of accumulated external public debt (denoted as ED), external debt service (EDS) and external debt disbursement (EDD) is operational data that is kindly provided by Public Debt Management Department of MoF. Annual data for domestic debt (DD) is also collected from the MoF. Y, K, EDS, EDD are flow variables and L, ED and DD are stock variables.

Table 2. Summary statistics of time-series datasets

DATASET 1 (Q12015-Q42018)				DATASET 2 (1998-2018)			
Variable	N	Mean	Std. Dev.	Variable	N	Mean	Std. Dev.
ln(Y/L)	56	-0.458	0.435	ln(Y/L)	21	0.443	0.734
ln(K/L)	56	-2.336	0.680	ln(K/L)	21	1.724	1.247
ED/Y	56	30.640	5.274	DD/Y	21	7.383	5.135
EDS/EXP	56	11.159	6.984				
EDD/Y	56	4.138	4.192				

Note: Dataset 1 is external debt and dataset 2 is domestic debt.

Adding variables of EDS and EDD in analyses is mainly due to capture the separate effect of aggregate demand and the crowding out effect. Hence, the ED variable solely will explain the effect of aggregate external debt.

Collected data is analyzed with the use of the statistical package software – STATA.

3.5 Econometric procedures

The first objective of this study is to investigate the impact of external debt and domestic debt on growth both in the short and long term and also to test whether investment is a main channel through which debt impacts growth. To analyze long run relationship stationary data is required, however, it is obvious that most of macroeconomic data are non-stationary in their level and give spurious or nonsense results.

Common way to make variables stationary is taking difference, however by taking difference of variables the long run information that they had in their level would be lost, and in order to recover this information ECM is involved. But before deriving ECM, variables must be cointegrated. To tackle that in econometrics many cointegration techniques is applied, namely Granger et al. (1987), Johansen et al. (1990) or bound test of cointegration Pesaran et al. (1999). Each approach is developed with a certain constraints and advantages. By pre-analyzing our datasets and learning the requirement of each cointegration method the ARDL and bound testing of cointegration presented by Pesaran et al. (further ARDL model) is evaluated as most appropriate for our analyses. There are three main reasons, firstly the ARDL bound test approach gives consistent result irrespective of stationarity level, can have

finite sample size and include exogenous regressors. Other cointegration approaches and methods mentioned above in contrary require variables to be strictly integrated of order $I(1)$ and consist of large dataset and have to be exactly endogenous.

Since ARDL model can handle a mixture or same order of stochastic integration $I(0)$ with $I(1)$ or $I(1)$ with $I(1)$ testing stationarity of variables is not prerequisite, however model crashes if integrated stochastic trend of $I(2)$ and above present in equation (Nkoro et al., 2016). Therefore, ADF and DF-GLS unit root tests that said to have greater power is executed to see if variables are not integrated of order $I(2)$ or above.

Another important application of the ARDL is that it allows a maximum of one cointegrating vector or long run relationship between variables is possible. Hence, a Johansen test for cointegration is estimated to define number of cointegrating vectors. To test for the quarterly data a maximum lag of 4, while for annual data only 2 lags is applied. If the test reveal results in favor of ARDL cointegration technique than bound test of cointegration is examined. If cointegration is found than ARDL is reparametrized into error correction form and both short run and long run coefficients are estimated, otherwise if cointegration is rejected only short run ARDL would be appropriate.

The critical values for bound test cointegration proposed by Pesaran et al. (1999) were extended by Narayan(2005) to be robust for small number of observation and Kripfganz and Schneider (2018) further extended critical values using response surface regressions, which overtake the near-asymptotic critical values produced by Pesaran et al. and for finite-sample by Narayan. Therefore, in the analyses of bound test cointegration Kripfganz and Schneider critical values is used.

Finally, diagnostic test to check reliability of results are proceeded, which include residual test for serial correlation, heteroscedasticity and normality test. The study also employs specification test to evaluate omitted variable bias and chooses efficient model among them and lastly CUSUM results to assess the overall stability of each model is reported.

3.6 Estimation results and diagnostics

The analyses of descriptive statistics and correlation indicated that selected variables have enough variance from the mean and there is no unpredicted high correlation between variables (see Appendix I for Pearson's correlation matrix). An important thing to note is that the range of external debt to GDP, which lies between 22.8 to 41.521 is appropriate for estimating linear relationship, while not suitable for non-linear assessment. As already stated, this is one of the reasons why separately panel data regression for determining the level of threshold is employed.

Another pre-estimation test as discussed is a unit root test for stationarity. Widely used test for stationarity Dickey-Fuller test for unit root (DF) and also to be assured the modified Dickey-Fuller test DF-GLS, which is analogously to DF but estimated with GLS after detrending variables is employed. DF and DF-GLS test revealed that all variables are stationary at least after the first difference. Also ADF test, which includes trend and two lags , but is not shown in Table 3 for space reason, rejects presence of unit root after first difference.

Table 3. Unit-root test (external debt)

Dickey-Fuller test for unit root				DF-GLS			
Variable	Test statistic	Variable	Test statistic	Variable	Test statistic	Variable	Test statistic
lny	-3.438**	Δ lny	-8.236***	lny	-3.748***	Δ lny	-12.306***
lnk	-3.934***	Δ lnk	-11.996***	lnk	-2.612	Δ lnk	-7.974***
ED	-2.295	Δ ED	-7.756***	ED	-1.666	Δ ED	-7.013***
EDS	-5.210***	Δ EDS	-14.157***	EDS	-5.017***	Δ EDS	-7.774***
EDD	-7.079***	Δ EDD	-12.787***	EDD	-4.600***	Δ EDD	-8.492***

Note: ** and *** denote 5 percent and 1 percent significance level

The result of Johansen test for cointegration is shown in Table 4. It confirms with 1 percent of significance level that in the model at least and at most one cointegrating equation exist. However, when testing with 3 lags the significance decrease to 5 percent level. Nevertheless, results imply that Pesaran and Shin approach of ARDL bound testing is appropriate for investigating short and long run effects in our analyses.

Table 4. Johansen test for cointegration (external debt)

Trend: constant			Trend: Constant	
Number of observation 54 Lags 2			Number of observation 52 Lags 4	
maximum rank	eigenvalue	trace statistic	eigenvalue	trace statistic
0	.	56.021		82.770
1	0.438	24.900***	0.621	32.319***
2	0.254	9.047	0.332	11.356**
3	0.123	1.948	0.163	2.092
4	0.035		0.039	

Note: ** and *** denote 5 percent and 1 percent significance level

As a reference the baseline model 10 is estimated using standard OLS method, where ARDL terms are dropped. The results are shown in Table 5 column A. Coefficient signs are as expected and in overall statistically significant. The investment per labor as expected is

main growth driver of Tajikistan's economy. In the short period the impact is estimated to be almost as in the long run. External debt and external debt service ratios show almost similar negative effect on output level, while in the short-run the former show positive effect, which is in line with conventional theory of public debt. The positive trend coefficient implies that there are some unknown growth inducing factors that are captured by trend. The error correction term also known as the adjustment speed in response to long run deviation is also highly significant with expected negative sign. The results suggest that following a shock, approximately 68 percent of adjustments toward long run equilibrium is corrected after approximately two period.

The ARDL bound test result of F-statistics and t-statistics is scripted in Table 6 for the baseline equation 10 in column B, equation 11 in column C and equation 12 in column D. The bound test confirmed that all equations have long run relationship. For the optimal lag selection Bayesian information criteria were utilized.

The results of equation 10 with ARDL terms of (5, 0, 2, 5) vary considerably for some variables from baseline OLS result. For example, the adjustment speed for correction of equilibrium distortions has declined almost by half. The investment level effect has increased in the long run, but has decreased for the short run. The impact of external debt hasn't much been effected in the long run, but became negative in the short run, which now reject our first hypothesis. In contrary, the negative effect of external debt service has been tripled in the long run, while slightly decreased in the short run and became significant at 10 percent level.

Table 5. Regression estimation results (external debt)

VARIABLES	BASIC OLS	ARDL (5 0 2 5)	ARDL (5 0 5)	ARDL (4 4 5 5)
MODEL	A	B	C	D
EQUATION	10	10	11	12
ECT	-0.684***	-0.360***	-0.299***	-0.322***
LNK _{T-1}	0.162**	0.250***		
ED _{T-1}	-0.013***	-0.014***	-0.018***	-0.048***
EDS _{T-1}	-0.014***	-0.050***	-0.057***	-0.074***
EDD _{T-1}				0.090***
a*	0.237	0.694		
g ₁ *	-0.019	-0.039	-0.060	-0.149
g ₂ *	-0.020	-0.139	-0.191	-0.230
g ₃ *				0.280
ΔLNK _T	0.280***	0.090***		
ΔED _T	0.016**	-0.007**	-0.006**	-0.015***
ΔEDS _T	-0.004	-0.003*	-0.001	-0.005***
ΔEDD _T				0.003
CONSTANT	-1.725***	-0.864***	-1.046**	-1.685***
TREND	0.012***	0.017***	0.021***	0.033***
DUMMY	-0.154***	-0.118***	-0.142***	-0.141***
N	55	51	51	51
adj. R ²	0.80	0.98	0.97	0.98

Notes: *, ** and *** denote significance at 1, 5 and 10 percent levels.
(a*) and (g*) are long run parameter recovery (see equation 10a).

The result of equation 11 is shown in column C of Table 5. There is a slight difference between results of equation 10 and 11. However, the model 11 suffers from serial correlation in second lag, but not with 5 percent significance level.

Estimation of equation 12 can determine whether the flow of external debt had a positive or negative impact on output level and also if the borrowed money were effectively utilized. Moreover, it allows to calculate the difference of the other shift variables from equation 10 and resolve the second objective of the paper whether external debt and external

debt service impact output through investment channel. The result of ARDL estimation of equation 12 is summarized in column D of the Table 5. Results are quite impressive and the model in overall is stable. Important part of the finding is the variance of both external debt ratio in amount of 0.03 percent and external debt service ratio in amount of 0.024 percent in the long run and in the short run 0.008 percent and 0.002 percent accordingly. These variances are actually the effect of external debt and external debt service that impact output level, when investment variable is dropped.

In general results constitute that a 10 percent increase in the external debt ratio to GDP holding other factors constant declines level of output by 0.15 percent in the short term, and in the long term output is declined by 1.5 percent. The findings are in line with major empirical literature. External debt service on other hand along crowding out effect seems to have also some other indirect negative effect on output level, but only in the long term. The direct impact of external debt service keeping all other variables constant accounts for 0.23 percent in the long run and 0.005 percent in the short run.

Another worth noting coefficient result is external debt disbursement or the flow variable of external debt. The coefficient has positive sign for both short-run and long-run, however the short-run coefficient t-statistic is (1.58), which is close to 10 percent significance level. It indicates that each percent increase in external debt disbursement significantly increases output level by 0.28 percent in the long run, which overweight the negative effect of external debt service. Insignificant short term coefficient, is probably because of long-run economic return of public investments as infrastructure, education, healthcare and etc. Nevertheless, positive sign of disbursements confirm that the implemented projects through loan base are crowding in capital and hence supporting output level.

The diagnostic tests results are brought in Table 6 and includes ARDL bound test, with null hypothesis of no cointegration in the models. As can be seen all models reject null hypothesis with 5 percent and 1 percent significance level. The tests of J-B (Jarque-Bera) and S-W (Sharpo-Wilk) are employed to check the residual normality test. As shown in table 6 these tests cannot reject null hypothesis of that residuals are normally distributed.

The Durbin's alternative test and Breush-Godfrey test for serial correlation was employed to check if residuals are serially correlated. Both test null hypothesis is presence of residual serial correlation in the model. Only former is shown, since both of them give pretty similar results. As shown only model in column C suffers from serial correlation with significance level of 10 percent, yet it is rejected by 5 percent and 1 percent significance levels.

Another test is Cameron and Trivedi decomposition of IM-test that is heteroscedasticity test including higher order moments of residuals (skewness and kurtosis). The null hypothesis is homoscedasticity. None of null hypothesis in any of models were rejected. And last test is Ramsey regression equation specification error test (RESET) to check if non-linear patterns of the fitted values explain the independent variable. Only first model-Basic OLS can reject the null hypothesis with 1 percent significance level, which states that the functional form is misspecified. In the (Appendix II) the cumulative sum (CUSUM) stability test for each model is illustrated, which indicate that all models are stable within 95 percent significance level.

Table 6. Diagnostic test (external debt)

TEST NAMES	OLS	ARDL (5 0 2 5)	ARDL (5 0 5)	ARDL (4 4 5 5)
	A	B	C	D
	10	10	11	12
EQUATION				
ARDL bound test F		10.612***	8.086***	39.303***
and t-statistics		-5.303***	-4.017**	-5.092***
J-B and	0.662	0.705	0.564	0.945
S-W normality test	0.714	0.833	0.381	0.689
Durbin's alternative test for				
autocorrelation: lags 2	0.496	0.173	0.070	0.829
lags 3	0.712	0.327	0.135	0.934
Cameron & Trivedi's	0.410	0.496	0.322	0.515
decomposition of IM-test				
Ramsey reset test for	0.002	0.141	0.289	0.037
omitted variable				

Notes: *, ** and *** denote significance at 1, 5 and 10 percent levels. Second and third columns are p-values.

The next step is testing the impact of domestic debt on economic growth. Same approach for the dataset 2 is followed. The descriptive statistics is shown in table 2 and determine that variance from mean is large enough to have explanatory power. Correlation between domestic public debt and GDP per labor is weak and negative, as well as predicted a high positive correlation between capital and output can be seen (see Appendix I for correlation matrix).

DF unit-root test revealed that all variables become stationary after first difference, however DF-GLS, which applies similar method only with detrended form cannot reject presence of unit root of output variable. Therefore, ADF test including trend and lags is

employed and the results reject presence of unit root. Next Johansen cointegration test is employed.

Table 7. Unit root test (domestic debt)

Dickey Fuller (DF)				DF - GLS			
Variable	Test statistic	Variable	Test statistic	Variable	Test statistic	Variable	Test statistic
lny	-1.034	Δ lny	-3.243**	lny	-0.942	Δ lny	-2.238
lnk	-0.859	Δ lnk	-4.053***	lnk	-1.174	Δ lnk	-3.357*
DD	-3.181**	Δ DD	-6.773***	DD	-0.988	Δ DD	-3.464**

Notes: *, ** and *** denote significance at 1, 5 and 10 percent levels.

Since observations are small annual evaluation of up to two lags is appropriate for Johansen test for cointegration. Both results shows no cointegration. Moreover, ARDL bound test to assure if cointegration exist is employed, but results were similar supporting no cointegration between variables.

Table 8. Johansen test for cointegration (domestic debt)

Trend: constant			Trend: Constant	
Number of observation 20			Number of observation 19	
Lags 1			Lags 2	
maximum rank	eigenvalue	trace statistic	eigenvalue	trace statistic
0		22.209***		20.798***
1	0.531	7.055	0.46599	8.878
2	0.239	1.571	0.29232	2.309
3	0.076		0.11443	

Notes: *, ** and *** denote significance at 1, 5 and 10 percent levels.

Due to that the bound test for cointegration with maximum lag of 2 in model (13) and (14) revealed that there is no long run relationship, it is appropriate to only estimate basic ARDL, meaning without deriving ECM. Therefore, equation (13) and (14) are reformed into next equation:

$$\begin{aligned}\Delta \ln y_t = & \beta_0 + \beta_1 \Delta \ln k_t + \beta_2 \Delta DD_t + \sum_{i=1}^p \beta_{yi} \Delta \ln y_{t-1} + \sum_{i=1}^{q_n} \beta_{ki} \Delta \ln k_{t-1} \\ & + \sum_{i=1}^{q_n} \beta_{DDi} \Delta DD_{t-1} + \varepsilon_t\end{aligned}\quad (13a)$$

and without capital or in the steady state form:

$$\Delta \ln y_t = \beta_0 + \beta_2 \Delta DD_t + \sum_{i=1}^p \beta_{yi} \Delta \ln y_{t-1} + \sum_{i=1}^{q_n} \beta_{DDi} \Delta DD_{t-1} + \varepsilon_{*t} \quad (14a)$$

where β_0 is constant derived from trend (see transformation of equation 5 to 6), $\beta_1 \beta_2$ are slopes of capital and domestic public debt and $\beta_{yi} \beta_{ki} \beta_{DDi}$ are ARDL terms or short term dynamics.

Since, no significant result were observed from estimations, I find it appropriate to not demonstrate the result. Insignificant result could be for the reason of the composition of domestic debt itself, where more than 70 percent is government bills for capitalization of banks, and less of them is devoted to investment or other activities that could reflect growth. Moreover, data for early years were generated using different sources, which debilitates reliability of observations. Therefore, simple bivariate OLS regression is reported.

$$\ln y_t = 0.874^{***} + (-0.587^{*} DD_t), R^2=16, N=21 \quad (15)$$

The results indicate that each percent increase in domestic debt significantly ($p < 0.10$) decrease output by 0.587 percent. I admit that the results are spurious, nevertheless the relation is negative, hence hypothesis (H1) is rejected also for domestic debt.

CHAPTER 4: OPTIMAL THRESHOLD FOR PUBLIC DEBT: PANEL DATA ANALYSES

4.1 Introduction

In this chapter alternative objectives of the study, namely existence of the non-linear relation of public debt and growth for the homogeneous group of 12 FSU countries and the threshold level where the sign of impact changes is investigated.

To analyze non-linear relationship between public debt and economic growth different empirical strategies are employed. Initially, as common practice in many empirical studies, which are conducted by inclusion of squared public debt stock, is employed. Next approach is spline function using Hansen (1999) method of threshold estimation that searches for a threshold levels that minimizes standard errors. Lastly, to understand general impact of public debt in different ranges or in other words a level that overall impact of debt become negative intercept debt dummies is included.

Reason behind selecting this group of countries and estimation with panel method approach is the data limitation for Tajikistan that makes analyses of threshold inappropriate because of small number of observation and the range of public debt that does not show the whole picture. Also as recent studies suggest observational fields should be restricted, rather than expanded. Hence, analysis of a group of 12 FSU countries is esteemed to be appropriate in line with recent findings, since these countries have many similarities, including but not limited to transitional economies, geography, history and much importantly cooperation in

the regional intergovernmental organization of CIS⁹ that interrelates these countries in social and economic spheres.

Nevertheless, total government debt at its face value is problematic, since it does not capture the difference in maturities, weighted interest rates and other contractual form (Dias et al., 2014), it consist of both domestic debt and external debt and doesn't show the proportion of foreign currency denominated debt, which is the source of financial fragility as indicated by the original sin concepts (Hausman et al., 2011). It's important to note that public debt threshold can't be specified in exact form, because 1 percent increase or decrease from a threshold point doesn't make any drastic changes in reality. Also, endogeneity that is a common phenomenon for debt and growth relation, was not considered, however according to Ebbes et al. (2016) endogeneity issues is eliminated with panel structure.

4.2 Theoretical framework

Many studies divide theories on relationship of economic growth and public debt into three groups. The first group is related to positive impact of reasonable debt on growth, which is explained by importance of investment and saving that are represented by Keynesian and neoclassical schools. In the overlapping generation model Diamond (1965) showed how rise of interest rate due to public debt brings investment to the social optimum level, when real

⁹ CIS is an intergovernmental organization established in 1991 for encouragement of cooperation between newly independent countries in economic, political and security affairs after Soviet Union collapse. Due to political issues Georgia in 2008 and Ukraine in 2018 resigned their membership from this regional intergovernmental organization. However, in IMF WEO 2018 CIS is separated as a group consisting of all 12 countries including Ukraine and Georgia.

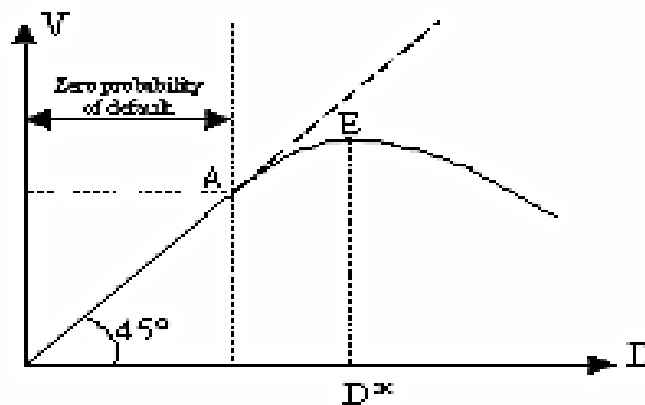
interest rates are lower than growth rates. Other positive effects can come from liquidity supply effect (Kobayashi, 2015) or fiscal multiplier effect (Batini et al., 2014), however if borrowed public debt is spent productively, for instance invested rather than consumed. In general since the interest rates in capital scarce countries are higher than world interest rates the marginal productivity of capital in this countries are assumed to be higher, which further induce transitional growth.

The second group of theories support the negative impact of large levels of public debt on growth. This can be crowding out effect (Saint-Paul, 1992) of high level of debt, where huge borrowings push interest rates to rise and decrease investment and growth. Another popular concept is debt overhang, which declare that higher level of debt discourage investment, because investors know that when debt service is higher than government ability to repay it, distortionary taxes are imposed. Another inference might be that government is going to have less motivation to execute tough reforms such as privatization or fiscal adjustments (Pattillo et al. 2011) . This mean debt does not only impact through investment channel but also through poor macroeconomic policies that decreases investment efficiency (Koboyashi, 2015).

This chapter is relevant to the third group of public debt and growth nexus interpretation. This group combine two other groups and state that debt and growth relationship is non-linear by nature. These are extended models of debt overhang theories that are transmitting Laffer curve to Laffer curve type of effect of debt on growth (Figure 4). It is said that increase of face value of debt service until point D^* increases expectation on resource transfer and market value increases at same rate, while above level D^* lowers

expectation on repayment, meaning market value of debt diminishes. Therefore point E is a threshold point above what debt starts to negatively impact growth.

Figure 5. Debt Laffer Curve

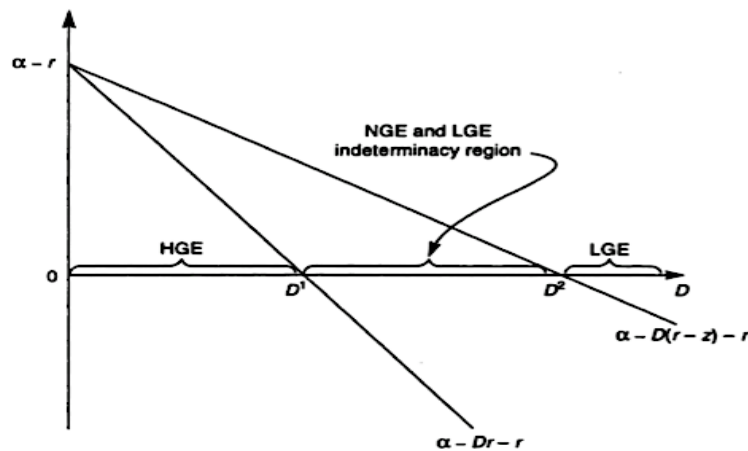


Source: Sachs (1989)

Another recent studies that explain non-linearity in the public debt and growth relation is advocated by Calvo (1998). The model undertakes three distinct debt areas. First where growth is an increasing function of debt, in the second area the effect on growth is indeterminate, and lastly growth is decreasing function of debt.

The model is quite naive and explain negative relation of debt with higher distortionary tax burden on capital that lowers return rate of capital and leads to lower investment and growth. The positive impact is explained for opposite reason. In the intermediate region economy can exhibit either high or low growth path. Mathematical formulation of the model is shown in Appendix III.

Figure 6. Capital mobility equilibrium



Source: Calvo, (1989)

In the above figure, the area between D^1 and D^2 is indeterminacy region and economy from this region can either settle to high growth by debt reduction or opposite if otherwise. This is explained by intuition that high level of initial debt is associated with higher level of tax necessary for the repayment so the core point is that the positive impact on growth induced by borrowed debt will decrease until it changes the sign. From another perspective growth reduces tax rate so tax burden is decreased and the return on capital is increased, while low growth increase tax rate and burden of tax resulting in lower return on capital hence growth. In the author's own words, "This inverse causation (from grow to tax burden) lies at the heart of the indeterminacy result" (Calvo, 1998, p.255).

Another important point from this model, as author indicates, is that slight changes in debt can have a big impact on growth. For instance, if initial debt is slightly higher than point of D^2 slight reduction of debt could posit the economy in the indeterminacy region, where high growth is possible. However, as author states there is no guarantee that high

growth path will be chosen, therefore some additional measures is required that are not costly, like making private sector to be more optimistic on the prospect of economy.

4.3 Data and determination of variables

Applied data for the analyses of non-linear relationship between public debt and growth as discussed earlier is data for all 12 FSU countries. Data covers period 1998-2017 and mainly were collected from WEO database of the IMF and WDI database of WB. The complete dataset consist of 240 observation, but because Turkmenistan's investment information were not available it was dropped at empirical analyses. The summary statistics and list of countries are shown in Table 9.

Table 9. Descriptive statistics and list of countries (panel data)

VARIABLES	Source	Obs.	Mean	Std. Dev.	Min	Max
GDP per capita growth rate (Δy)	WDI	240	5.218	5.233	-14.420	33.030
Initial level of GDP (Δy_0 log form, 2004)	WEO	240	2.534	1.608	0.728	6.453
Secondary school enrolment rate (H)	WDI	220	2.049	2.870	0.194	14.187
Investment over GDP (K)	WEO	220	24.466	7.080	4.386	57.99
Population growth (P)	WEO	240	0.487	1.061	-1.726	2.822
Fiscal Balance (F)	WEO	231	-1.037	4.863	-13.528	21.764
Public debt over GDP (D)	WEO	225	35.700	25.715	2.414	136.021
Squared Public Debt over GDP (D^2)	WEO	225	1932.855	2923.907	5.831	18501.7
Armenia (arm), Azerbaijan (aze), Belarus (bel), Georgia (geo), Kazakhstan (kaz), Kyrgyz (kyr), Moldova (mol), Russia (rus), Tajikistan (taj), Turkmenistan (tur), Ukraine (ukr), Uzbekistan (uzb)						

Note: Descriptive statistics for "H" is after linear prediction.

The per capita growth rate of GDP (Δy) is dependent variable for all threshold estimation models and public debt as the share of GDP is regressor of interest and objective of the study. Selection of other independent variables is in line with literature on panel threshold estimation of public debt and also on an availability of data.

2004 is selected as the base year for initial level of GDP (Δy_0), because from 2004 above data is strongly balanced. Inclusion of initial level of GDP is important for capturing convergence of economy and is expected to have negative sign according to theory indicating that countries with higher initial GDP grow slower in future years.

Secondary school enrollment (H) rate is proxy for human capital and expected to have positive impact since it measures the accumulation of human capital. It has 16 missing values, but to estimate threshold effects proposed by Hansen (1999) strongly balanced data is required, therefore linear prediction is applied to fill missing values.

The physical capital (K) is measured by investment over GDP and also expected to have positive impact. Population growth (P) is expected to be negative in line with neoclassical theories.

Fiscal balance (F) is included to measure the impact of budgetary policies and it is expected to be positive. Also some other variables were included, for instance terms of trade and inflation, but since their coefficient were insignificant and didn't improve overall model they were excluded from further analyses.

Figure 7. Public debt and growth in FSU republics



Note: Right y-axis is growth rate, left y-axis is public debt to GDP rate.

The dynamics of public debt and real economic growth for the year 1998 – 2017 for each country is shown in Figure 7. A sharp decrease of public debt is observed in the early years but slight increase in recent years almost for all countries. The growth rate on other hand has rising trend in early years, while sharp drop for 2009 and also a downturn is seen in last years because of fall of oil price and Russian's recession that had indirect impact to nearly all FSU countries.

4.4 Model specification and econometric procedures

To investigate non-linear relationship between public debt and growth the study refers to seminal papers of Pattillo et al. (2002, 2011), Kumar et al. (2010) and more recent paper

of Egert (2012). Most papers use the standard growth specification based on conditional convergence and augmenting variables of interest. This type of growth models add initial income as an explanatory variable, explaining this as the convergence speed and/or as the impact of the previous amount of income on future growth.

Different model specifications are applied for analyzing non-linearity in the debt and growth relationship. For instance, in order to capture the level of debt at which marginal impact of debt on growth becomes negative and the level of debt at which overall impact of debt becomes negative.

For the first objective, quadratic specification of debt stock popular in empirical literature and spline function applying Hansen(1999) method is employed. The quadratic specification is in the following form:

$$\Delta y_{it} = a_i + \beta D_{it} + \gamma D_{it}^2 + \delta X_{it} + \varepsilon_{it} \quad (16)$$

where Δy_{it} is per capita growth rate, a_i is a constant or an individual specific effects (intercepts), D_{it} is public debt as ratio of trended GDP, D_{it}^2 is squared of public debt ratio and X_{it} is vector of other control variables, ε_{it} is unobserved error term and i, t is representation of specific country and time. To find the turning point simple maximization problem is solved by taking first derivative of significant coefficient of D_{it}^2 and D_{it} holding all other variables constant.

$$\frac{\partial \Delta y_{it}}{\partial D_{it}} = 2\gamma D_{it} + \beta = 0 \quad (17)$$

and solving for zero it gives:

$$D_{it} = \frac{-\beta}{2\gamma} \quad (18)$$

If the value for coefficient γ is negative we solve for maximum point and do the opposite if the value is positive. Therefore, if regression gives coefficient for γ other than negative the hypothesis of inverted U-relationship is rejected, but not the non-linear relationship of debt and growth.

Another objective of this paper is to estimate the reflection of public debt at different levels of fiscal balance, because fiscal stability is an important indicator that relates to public debt. It is expected that countries with higher threshold levels for public debt have higher internal tax opportunities, that leads to balance budget or even surplus. To measure this interaction of public debt variable and squared public debt with dummy variable that takes 1 if fiscal balance is positive and 0 otherwise is executed.

The second method to estimate the level of debt where the marginal impact on growth become negative is presentation of spline function. Most papers use different threshold levels for specifying dummy variable in spline function, and manually take arbitrary threshold levels until the sum of error is minimized. However, as Egert (2012) emphasized this approach has many shortcomings since selection of the number of the regimes and the level of the thresholds are subjective and whether any of the nonlinear models deliver a better fit is unknown. To address this issue Hansen (1999) procedure is applied. Primarily because it reveals endogenously the threshold values by a grid search, and furthermore it tests using bootstrapping the significance of models between different regimes (Egert, 2012). For one threshold two regime and for two threshold three regimes are used. These two and three regimes are in the next form:

$$\Delta y_{it} = \begin{cases} a_i + \beta_1 D_{it} + \delta X_{it} + \varepsilon_{it} & \text{if } D_{it} < T \\ a_i + \beta_2 D_{it} + \delta X_{it} + \varepsilon_{it} & \text{if } D_{it} \geq T \end{cases} \quad (19)$$

$$\Delta y_{it} = \begin{cases} a_i + \beta_1 D_{it} + \delta X_{it} + \varepsilon_{it} & \text{if } D_{it} < T_1 \\ a_i + \beta_2 D_{it} + \delta X_{it} + \varepsilon_{it} & \text{if } T_2 > D_{it} \geq T_1 \\ a_i + \beta_3 D_{it} + \delta X_{it} + \varepsilon_{it} & \text{if } D_{it} \geq T_2 \end{cases} \quad (20)$$

The econometric equation therefore is in form:

$$\Delta y_{it} = a_i + (T < \gamma)\beta_1 D_{it} + (T \geq \gamma)\beta_2 D_{it} + \delta X_{it} + \varepsilon_{it} \quad (21)$$

where Δy_{it} is per capita growth rate, a_i is individual specific effects (intercepts), D is public debt, X is other control variables, T is threshold variable and γ is a threshold parameter that divides the equation into regimes. It should be noted that threshold estimation proposed by Hansen(1999) is for non-dynamic panels estimated by fixed effect model and requires strongly balanced data.

Lastly, to locate level of debt where overall impact of debt becomes negative a set of quantile debt dummies is added in regression (Pattillo et al. 2011) in such a way that number of observation for each quantile is higher than forty. Therefore observation are divided into 5 quantiles with ranges described later.

$$\Delta y_{it} = a_i + \gamma \sum_{i=2}^5 DUM + \delta X_{it} + \varepsilon_{it} \quad (22)$$

where Δy_{it} is per capita growth rate, a_i is individual specific effects (intercepts), $\sum_{i=2}^5 DUM_{it}$ is public debt dummies starting from quantile two to five and X_{it} is vector of other control variables.

The reason starting from quantile 2 ($i = 2$) is the presence of constant term. This imply that the coefficient of each dummy specifies the impact of given quantile range of debt stock with regard to the low debt (first quantile) or high debt (upper quantile).

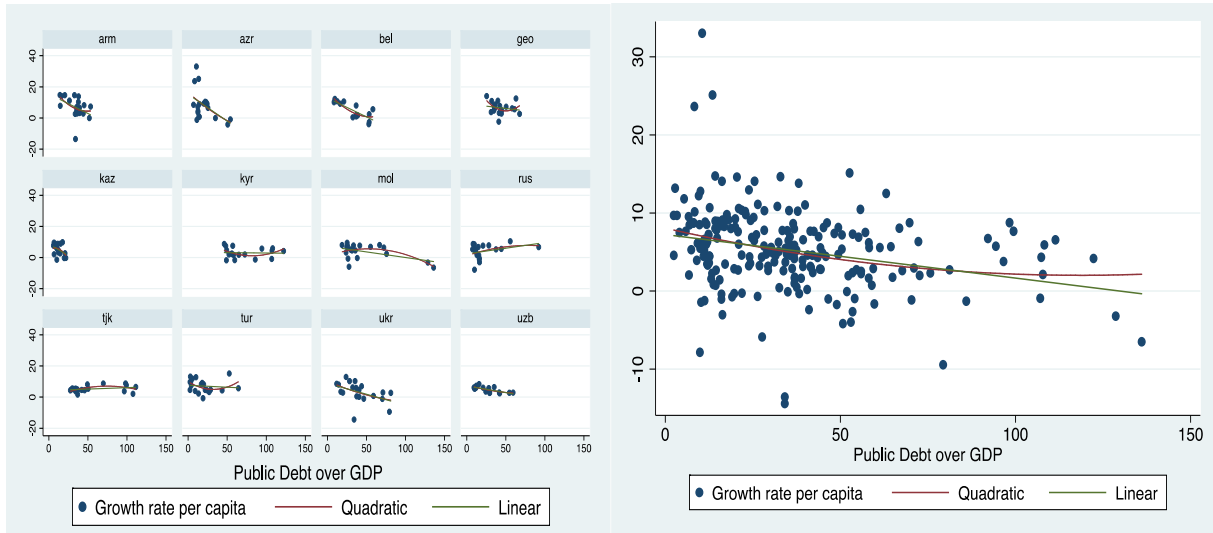
Study employs different assessment methods of longitudinal estimations, namely pooled OLS as arbitrary and random with fixed effect method for the presence of country specific effects.

4.5 Estimation results

Before the threshold estimation, a bivariate relationship between per capita growth rate and public debt of overall 12 FSU countries is explored. The right graph in Figure 8 illustrates an overall image for both linear and non-linear fitting lines, while the left graph illustrates linear and quadratic regression line for each country separately. It is very interesting that both positive and negative linear relationships and both U-shape and inverted U-shape relationships is seen for selected countries in separate, while only linear negative with U-shape relation can be seen for the pooled data.

For Tajikistan case one can observe a nonlinear relationship according to the papers hypothesis, however in overall of 12 FSU graph it is more linear or U-shape type, maybe because of outliers in the beginning years of our dataset, where the growth rate is reached above 30 percent and in the middle, where growth rates drops quite sharply because of 2008 Great Recession.

Figure 8. Linear and quadratic fit between debt and growth



Note: y-axis is per capita growth rate, x-axis public debt to GDP

The results for the first method of estimation, namely with quadratic specification equation (23) is shown in Table 11. All estimation is reported with robust standard errors, to address heteroscedasticity and autocorrelation. Observation for Turkmenistan was automatically dropped, because data for investments wasn't available. As discussed, pooled OLS estimation of the model as arbitrary and also common longitudinal methods of random and fixed effect models are employed. Because, non-linear specification estimation gave non-significant result also linear relationship just by excluding public debt in squared term from equation (23) is estimated.

Pooled OLS estimates revealed significant result for most of coefficients, so Breusch and Pagan LM test for random effects is tested, which rejects null hypothesis, concluding random effect estimation is efficient by 10 percent significance level. However, Hausman test result, which is shown under column D and E and both are significant with 1 percent and 10 percent level, indicate random effect model to be less efficient than fixed effect model.

Table 10. Quadratic specification result

	OLS (linear)	OLS (non- linear)	Random effect (linear)	Random effect (non- linear)	Random effect interaction	Fixed effect (linear)	Fixed effect (non-linear)
	A	B	D	E	G	H	I
log(Y ₂₀₀₄)	-2.067***	-2.433***	-2.249***	-2.686***	-2.227***		
H	0.867***	0.977***	0.979***	1.124***	0.819***	1.336***	1.691***
K	0.112**	0.112**	0.112**	0.112*	0.082	0.096**	0.090***
P	-0.973***	-1.281***	-1.189***	-1.513***	-1.335***	-3.963***	-3.595***
D	-0.076***	-0.208***	-0.075***	-0.216**	-0.167*	-0.072**	-0.220***
D ₁					0.052		
D ²		0.001**		0.001	0.001		0.001
D ² ₁					-0.002*		
const.	8.953***	12.357***	9.223***	12.969***	11.149***	4.456**	6.721**
N	205	205	205	205	205	205	205
R ²	19	23	19	24	25	27	24
Hausman			22.24***	20.55***	3.42		
LM test			1.9*	0.21			

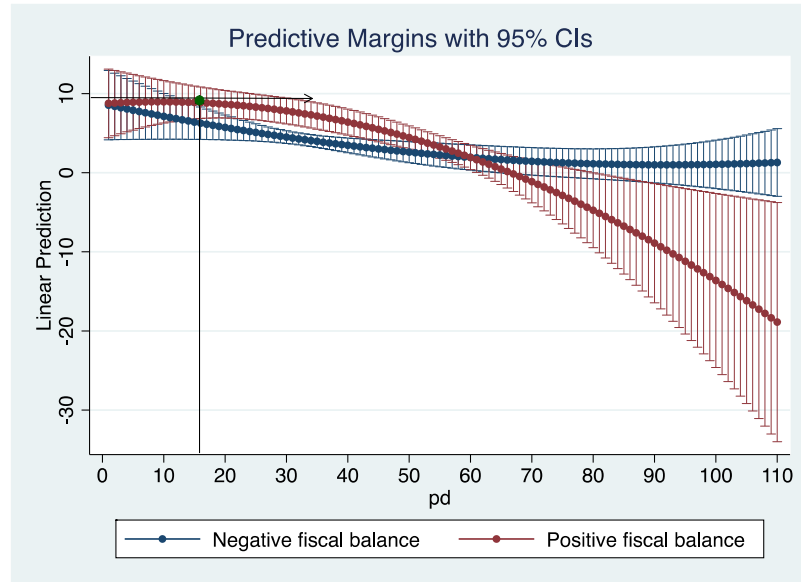
Notes: *, ** and *** denote significance at 1, 5 and 10 percent levels. D₁ is interacted debt variable with fiscal balance.

In general all coefficient results match expected sign, namely positive impact of human capital (H) and physical capital (K) and negative for the initial level of GDP log(Y₀), and population growths (P). Public debt on the other hand has significant and almost similar result across all estimation, while nonlinear relationship although increase the fitting power is not significant for the squared term on fixed effect estimations. Moreover, the coefficient for the squared debt result is positive that mean the equation has minimum value and the parabola opens up.

Hence, quadratic method estimation results indicate that public debt and growth relationship for the total observations of our sample is linear and negative, rejecting hypothesis of non-linear relationship between these variables. Negative effect of debt is quite similar among linear estimations and range around -0.07 percent.

Next, to understand the impact of public debt conditioning on fiscal imbalances, public debt and public debt in squared term is interacted with fiscal balance dummy. The interacted terms are significant only in 10 percent level. The results are shown in Table 11 column E. For public debt when fiscal balance was positive result is positive, but insignificant, while negative and significant for squared public debt and vice versa. Although, results are partially significant the signs imply that equation has inverted U-type relation when fiscal balance is kept positive.

Figure 9. Predictive margins of public debt in response to fiscal balance



Note: Green dot is calculated threshold level.

Further, margins of public debt for both positive and negative fiscal balance is predicted and graphically illustrated in Figure 9. As one can see, when fiscal balance is positive reasonable amount of public debt increases growth, while when fiscal balance is negative even small amount of debt has negative impact on growth. Lastly, by solving equation (25)

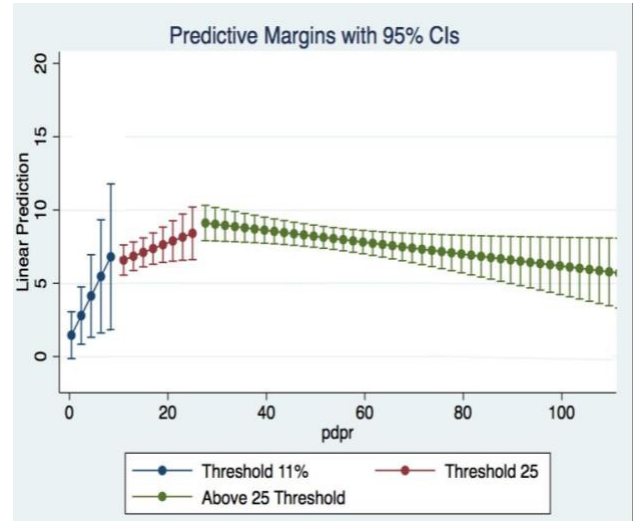
using the coefficient of regression, the threshold for public debt when fiscal balance is positive is estimated, which is equal to 13 percent (highlighted with green dot).

The result for the second method was also partially significant when robust errors were applied. Bootstrap analyses showed that three regime model was more significant than two regime. The estimated coefficients are shown in table 12. Results imply that public debt level until 11 percent to GDP has high positive impact (0.7 percent) on growth. From 11 percent to 25 percent the impact is still positive and significant, however effect diminishes to 0.16 percent. The marginal impact after this level becomes negative and insignificant. The results are in line with capital flight theory, where HGE region is up to 11 percent level, indeterminacy region is between 11 percent to 25 percent and LGE region is above 25 percent level.

Table 11. Spline function specification estimation result

Regressors	Fixed effect Threshold estimation	
	Two regime	Three regime
K	0.193*	0.174*
H	1.881**	1.598*
P	-3.497***	-3.331***
D<11	0.372	0.728*
D>11	-0.086**	
D<25		0.160**
D>25		-0.035
const.	-0.413	-1.630
N	154	154
R ²	34	38
B-test	10.25	8.39*

Figure 10. Slope of public debt coefficients at different threshold levels



Notes: *, ** and *** denote significance at 1, 5 and 10 percent levels. Horizontal axis is public debt over GDP in percentage.

Finally, Table 12 shows result for intercept dummy variable technique for threshold estimation. First two quantile are set at 13 percent and 25 percent level, since previous two methods show positive impact at this levels. The third quantile is general level of threshold for public debt-40 percent. The forth quantile is todays threshold level of public debt level in Tajikistan and last quantile is level above 60 percent.

Results imply same story in all models, although there are some differences in coefficient. The specification test revealed that fixed effect model is most appropriate for estimation. The implication is that the higher the level of public debt the lower is growth, however as one can see the difference between ranges of 40 percent to 25 percent is much higher than the rest, meaning above 40 percent level the negative impact is not significantly different.

Table 12. Intercept dummy specification estimation result

Regressors	Pooled OLS	Random effect	Fixed effect
	A	B	C
log(Y₂₀₀₄)	-2.228***	-3.044***	
H	0.786***	1.235***	1.641***
K	0.123**	0.128*	0.128
P	-1.567***	-2.335***	-3.646***
d2	-2.241**	-2.650***	-3.064**
d3	-5.986***	-6.616***	-7.039***
d4	-6.706***	-7.081***	-7.385***
d5	-5.844***	-6.373***	-7.150***
const.	11.073***	12.797***	5.201**
N	220	220	220
R-squared	22	27	28
Hausman		15.72**	
LM		4.01**	

Notes: *, ** and *** denote significance at 1, 5 and 10 percent levels.

Specification test define fixed effect model appropriate and results indicate that the first range has most positive impact on growth. Also, one can see that ranges above 25 percent level make overall impact negative. According to spline, dummy and quadratic method when interacted with fiscal balance results, hypothesis of non-linear relationship between public debt and growth is accepted. However, considering threshold levels of 11 percent, where marginal impact become negative and 25 percent above which overall impact become negative hypothesis of general safe level of 40 percent public debt to GDP is rejected for the case of 12 FSU countries.

CHAPTER 5: CONCLUSION

5.1 Summary of findings

Public debt is an important source for governments to implement necessary development projects, with intention of maintaining higher growth. It is an old tool that has been used for centuries. However, today the productiveness of public debt on stimulating economic growth is under question. Although it has been studied for a long time a singular conclusion has not been achieved until today. The current literature suggests that the impact of public debt on growth cannot be generalized and hence new studies have to investigate this relationship for unique cases and conditions.

In line with the above, and the recent hikes of public debt in Tajikistan that lead to distortion of threshold level motivated us to be the first paper to shed light on questions that matters both policymakers and academics around public debt in Tajikistan.

The study addressed the relationship between public debt and growth with two popular contemporary hypothesis of conventional theory and non-linear theories. The study implemented appropriate practices and proposed some insights to evaluate stock public debt more precisely. To overcome the data limitation 3 different datasets were created and time-series with panel data estimation approach were employed.

To answer the first research question the study carried out extended exogenous growth model. ARDL model incorporated with bound testing cointegration approach of Pesaran et.

al. (1999) was applied to estimate impact of public debt for the short and long run. The results from time-series approach rejected the hypothesis that public external debt has positive impact in the short-run, while has negative impact in the long-run, supporting negative impact for both short and long term. The inclusion of external debt disbursement implication is that loan sourced public expenditure is productive and overweight the debt service's negative impact, however the overall negative impact including the debt stock makes the impact of public external debt financing in Tajikistan negative. Another important finding is that investment is not a main channel for negative effect of external debt. This indicates that there are other factors through which external debt is negatively affecting growth. Public domestic debt on the other side had insignificant results, therefore only negative correlation with economic growth was reported.

For investigating optimal level for public debt, the study conducted standard growth specification based on conditional convergence by augmenting variables of interest. Because of data limitation longitudinal methods with data of homogeneous group of 12 FSU countries were employed.

To define turning points popular quadratic, spline function and intercept dummy methods was applied. Quadratic specification method rejected non-linear relationship between public debt and growth, however, when interacted debt with fiscal balance, 13 percent threshold level to GDP was found, but only if positive fiscal balance is kept. Spline function with Hansen (1999) method of threshold effect revealed 11 percent threshold level and 25 percent, where marginal and overall impact of public debt become negative accordingly. The intercept dummy once again confirmed that the lower ranges of public debt has higher positive impact and, when debt level is over defined points the overall impact

becomes negative. Considering above results, the nonlinearity hypothesis of public debt and growth is accepted.

However, since lower threshold levels were found the third hypothesis of this research is rejected, meaning the threshold load of public debt in 12 FSU republics are lower than common safe level that are found in many other studies. This implies that 12 FSU republics require further studies to define the reasons and channels, which make the public debt impact negative in such low levels and undertake necessary reforms.

5.2 Policy implications

Tajikistan in its short history of transition has faced numerous challenges. In above most of its infrastructure were built during the Soviet Union and requires restoration. However, today GoT is not in a position to finance all its development projects with internal sources, as most other developing countries. Therefore, public debt is an essential tool for government to implement necessary projects.

On the other side, as this study reveals although positive impact of external disbursement overweight debt service, overall impact of external debt is negative, due to debt overhang effects. Domestic debt also has negative correlation with growth. Optimum level of public debt for homogeneous group of 12 FSU republics is estimated to be as low as 11 percent and 25 percent to GDP. Even keeping fiscal balance positive only 13 percent threshold level is revealed.

Nevertheless, Tajikistan's latest PDMS set threshold level for public debt to GDP to 60 percent, which is far above the optimum level revealed in this study. Obviously, this paper suggests to reduce the amount of public borrowings and/or find and reduce the factors that are making the impact of public debt negative in such low levels.

One way to go forward with the first suggestion can be a new limitation indicator restraining amount of growth of debt in terms of economic growth, which will gradually reduce ratio of debt to GDP. This means the higher the economic growth the more country can borrow without effecting overall increase of debt as a share of GDP. However, as Calvo (1998) suggest, only by decreasing debt level from the LGE to indeterminacy region or even HGE will not guarantee high growth, hence additional measures as convincing private sector to be more optimistic in regard to future prospect of economy is required.

Secondly, as results of the time-series estimation indicate, investment is not a main channel of negative effect in Tajikistan, i.e. there are some other factors that have not been examined in this paper. Commonly, it is an institutional factor, as governance including fiscal and monetary policies also the overall social, geographical and economic situation of a country. Hence, it is suggested to oblige special attention on implementation of borrowed funds starting from selection of favorable projects to meticulous control of expenditure, which can be done by development of the human capacity factor and other necessary reforms in management of public debt.

Another important point is to encourage private sector and assist them to attract concessional loans from international financial markets, cooperate with them through public-private partnership and provide public guarantees, since private sector is often more

productive than government institutions and moreover it will allow to reduce the service load of public debt. Therefore, the paper encourages government to prepare strategy for transferring its unproductive activities to more incentivized private sector rather implementing it with public borrowings. This also could lead to more favorable climate for attraction of foreign investments, because of governments direct involvement.

Finally, in order to support more researches necessary for providing policy guidance GoT has to advance available database for domestic debt and enrich external debt database including net present value that would give much efficient results, allow studying merely Tajikistan case and also be a valuable asset in future studies.

5.3 Limitation and recommendation for future studies

The main limitation for the study was shortage of data that forced us to create different three datasets. For instance the quarterly data spanning from 2005 to 2018 collected for time-series analysis is not sufficient to assess long-run effects and moreover for the domestic debt a second annual dataset was created that has only 21 observations and put some ambiguity on estimations.

For the panel data the face value was used for public debt variable, which is problematic, since it does not capture the difference in conditionality and doesn't show the proportion of foreign currency denominated debt. Additionally, outliers were not considered solely, which could be the reason of discrepancy from theoretical hypothesis. Moreover, public debt

threshold cannot be specified in exact form, because 1 percent increase or decrease from a threshold point doesn't make any drastic changes in reality.

Hence, new research in this direction should be conducted using bigger data including both external and domestic debt incorporated in one dataset with using the present value of debts rather than its face value. It is also recommended to study instrumenting techniques to cope with endogeneity between growth and debt. In overall, further researches have to focus on analyzing the factors or channels that debt is impacting growth negatively and find ways to reduce them so that Tajikistan could handle higher threshold levels for public debt.

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APPENDICES

Appendix I. Pearson's correlation Matrix

Correlation table (external debt dataset).

Variable	lny	lnk	ed_gdp	eds_export	edis_gdp
log of GDP per labor	1				
log of investment per labor	0.909	1			
external government debt to GDP ratio	-0.135	-0.093	1		
external government debt service to Export ratio	0.188	0.175	0.116	1	
external government debt disbursement to GDP ratio	-0.063	0.070	0.281	-0.135	1

Correlation table (domestic debt dataset).

Variable	lny	lnk	dd_gdp
log of GDP per labor	1		
log of investment per labor	0.909	1	
domestic government debt to GDP ratio	-0.135	-0.093	1

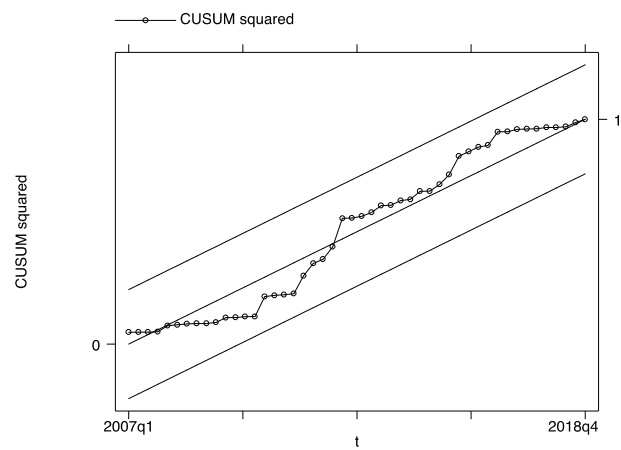
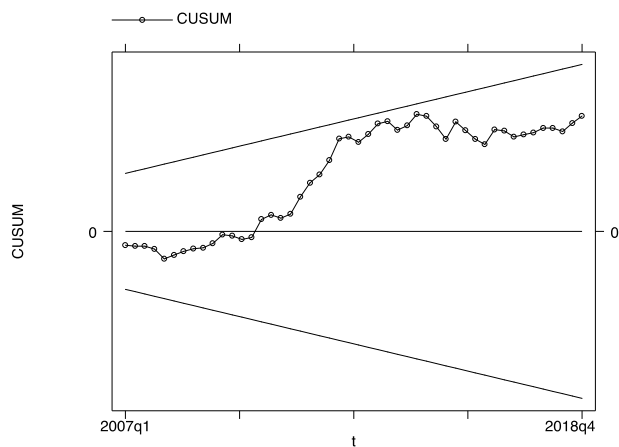
Correlation table (panel dataset).

	Δy	Y_0	H	K	P	F	D	D^2
Δy	1							
Y_0	-0.0699	1						
H	-0.0144	0.8358	1					
K	0.2334	-0.0179	-0.2079	1				
P	-0.0728	-0.2819	-0.1396	-0.0949	1			
F	0.2481	0.1964	0.167	0.1224	0.128	1		
D	-0.2659	-0.3761	-0.1848	-0.3779	-0.0052	-0.3754	1	
D^2	-0.224	-0.2986	-0.1387	-0.3713	0.0514	-0.2855	0.9468	1

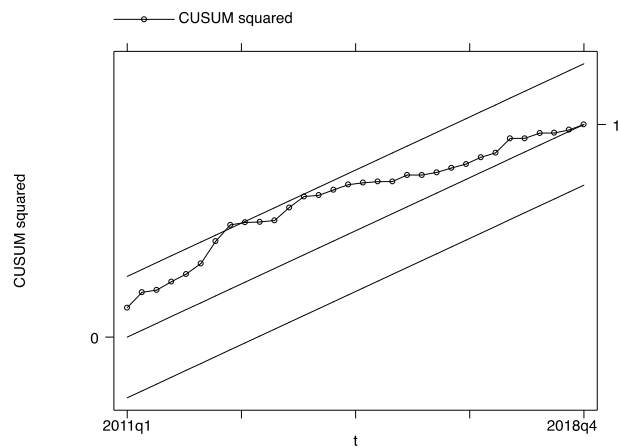
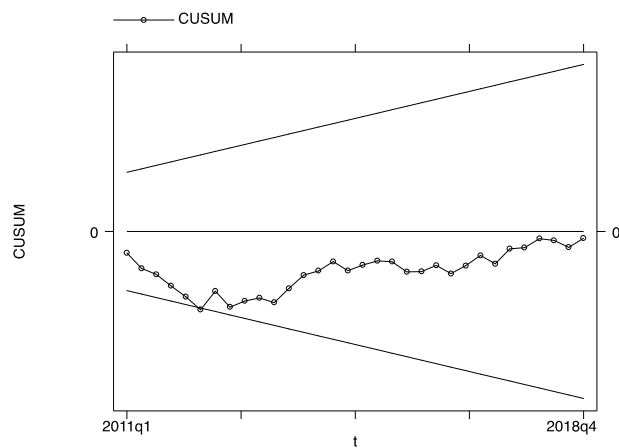
Appendix II. Stability diagnostic test for external debt regressions.

- CUSUM Results (please refer to table 5 in page 39).

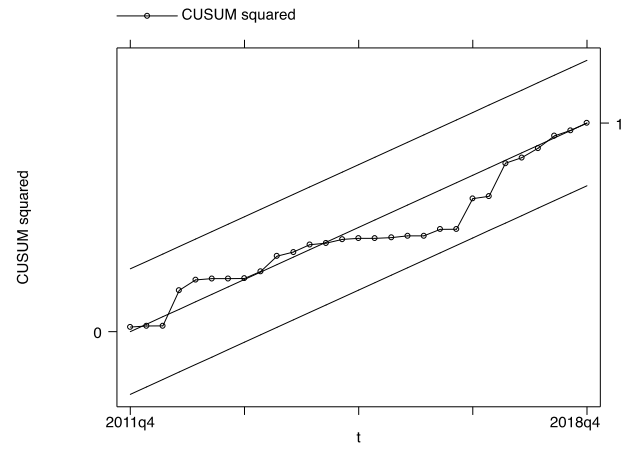
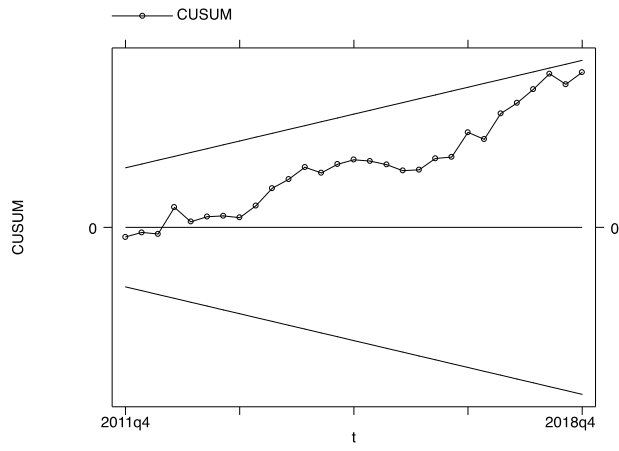
Model A



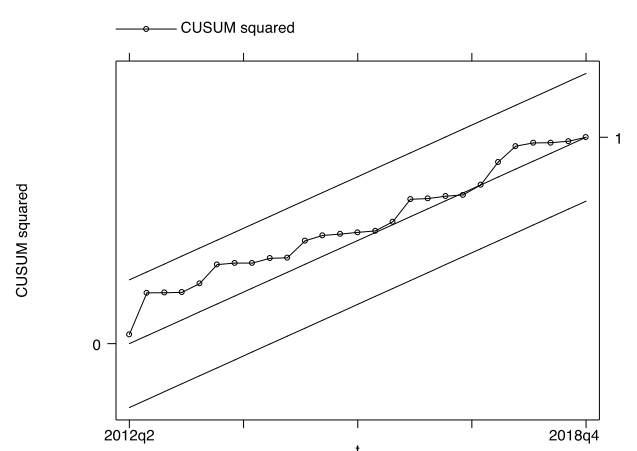
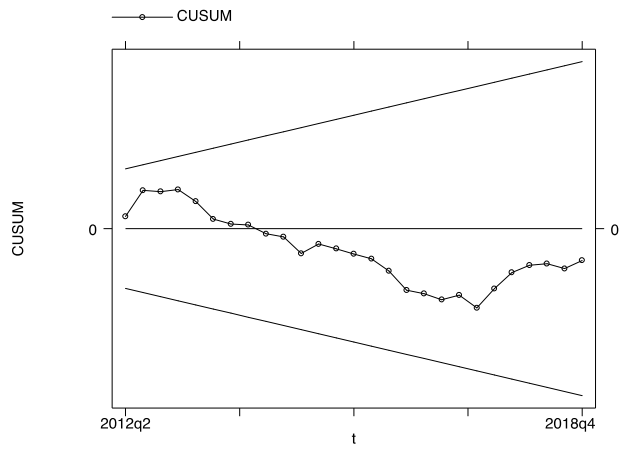
Model B



Model C



Model D



Appendix III. Mathematical formulation of Capital Flight theory.

The model asserts output in economy is produced only by means of physical capital K , where 1 unit of output can be produced by utilizing $1/a$ unit of capital K .

$$Y_t = aK_t \quad (1)$$

Capital is perfectly internationally mobile *ex-ante* but not *ex-post* and also no depreciation is accounted. K_0 is assumed to be equal to 1. The net cashflow S for a firm that accumulates capital at rate \check{K} is expressed as:

$$S_t = a(1 - \tau)K_t - \check{K}_t \quad (2)$$

where τ is constant output tax rate lying between 0 to 1. Net present value of the firm at time 0 is in form:

$$V = \int_0^\infty S_t e^{-rt} dt \quad (3)$$

where r is international interest rate equal to the own rate of return on output. Since according to equation (1) growth of capital is same as growth of output ($\check{Y}/Y = \check{K}/K = z$) expression $z \equiv \check{K}/K$ is given by:

$$V = \int_0^\infty [a(1 - \tau) - z_t] e^{-rt} e^{-\int_0^t (r_s - z_s) ds} dt \quad (4)$$

The firm V , maximizes its value by choosing positive growth path $z(\bullet)$. Hence, to keep model simple further assumed z is constant over time and is lower than international interest rate. Denoting $e^{-\int_0^t (r_s - z_s) ds}$ and differentiating it then plugin it to equation (4) we get:

$$V = \frac{a(1-\tau)-z}{(r-z)} \quad (5)$$

Differentiating equation (5) with respect to z as the firm maximizes value and with assumption of positive growth path $z(\bullet)$ takes following form:

$$sgn \frac{\partial V}{\partial z} = sgn[a - (1 - \tau) - r] \quad (6)$$

Meaning when marginal productivity is higher than the real interest rates firms are better off to grow fast and vice versa in opposite. Further to prevent unbounded growth upper bound of growth rate is assumed to be \hat{z} . The lower bound for the reason of putty-clay assumption is 0. Now assuming that economy inherits initial debt equal to D and government tax is set in rate only for servicing debt and that government has full access to international credit markets, the solvency condition yields:

$$D = a\tau \int_0^\infty K_t e^{-rt} dt = \frac{a\tau}{r-z} \quad (7)$$

Than expressing τ from equation (7) and plugging it to equation (6) result in:

$$sgn \frac{\partial V}{\partial z} = sgn[a - D(r - z) - r] \quad (8)$$

By the previous remarks, except in the borderline case when equation (8) is equal to zero, economy depending on z either settle in low-growth equilibrium (LGE) if $z=0$ or high-growth equilibrium (HGE) if $z=\hat{z}$. Therefore when: $D > (a - r)/r \equiv D^1$ economy is settled in HGE and when $D < (a - r)/(r - \hat{z}) \equiv D^2$ economy is settled in LGE.