

Debt sustainability: Case study for Armenia

No one writes to the Debtor

Master Thesis

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Introduction

“What can be added to the happiness of a man who is in health, out of debt, and has a clear conscience?”

Adam Smith

Generally, debt is an amount of money (or other type of obligation) that is borrowed from another person. Although during many centuries taking a debt was immoral and prohibited in different regions of the world, the recent living standards and current economic progress would not be achieved without the properties of debt. The debt, in a macro level, is taken to increase the wealth of the economy, to stimulate the economy and to have higher growth rates. As the theory of debt overhang suggests the relationship between debt and economic growth is estimated to be positive at first. At some point when the efficiency of one more unit of debt starts to decline the impact on growth becomes negative. The question is what that level is. Theory and estimations suggest different levels for debt overhang. For developing countries the threshold was estimated to be 60% of debt over GDP ratio (Reinhart and Rogoff 2010)¹. However, the recent news about the uncertain dataset and omitted countries doubts the economic theory of public debt as well as external debt. The topic of indebtedness is becoming more and more essential, as a lot of economic policies has been constructing according to the threshold levels estimated by Reinhart and Rogoff; many politicians were citing them in their speeches; many studies have been done taking their results as given. Although Herndon et al have found a lot of mistakes in the data which Reinhart and Rogoff (R&R) were using in their estimations, the final estimations do not vary from the R&R's results and there exists debt overhang level, but not at 90%. Moreover, the Greek economy collapse showed that with regards to other aspects the default happened at a

¹ <http://www.heritage.org/research/reports/2013/05/does-debt-hurt-growth-growth-in-a-time-of-debt>

higher level (170%). But the case of Greece has its specification as Greece is a member of European Union (EU). Before reaching an unsustainable level of indebtedness Greece was getting the support of other countries and was willing to carry a higher level of external debts compared to any other developing country which is not a EU member. Perhaps the recent controversy of the public debt may serve as a lesson that the economic profession/policy makers not to be bounded to just one influential paper's results.

The aim of the thesis work is to estimate threshold for Armenian economy where debt starts to have a negative impact on growth. Armenia is not a big country located in the South Caucasus with a population of 3.3million. It is a former Soviet Union country and its economy is considered to be transitional until it will have sustainable economy with sustainable growth. The main share of Armenian GDP comes from services and agricultural products. Although in Soviet Union times it used to have fairly large share of industry, after Soviet Union collapse Armenia stopped investing in the industry and started developing structurally new economy.

After soviet union collapse there was a huge uncertainty about the external debt to GDP ratio. There was no clear theory answering this question and no experience of running debts. There was a huge decline in output levels, which was also distorting. However, in the first years of development for Armenia and other transitional countries the control of external debt was one of the highly important questions as there were requirements for CIS (Commonwealth of Independent States) membership. Now after the recent, "scandal" in public debt economics, a lot of literature and policies must be reviewed.² The father of economics Adam Smith claims, somebody who is in debt cannot be happy until he will return his debt.

² <http://www.guardian.co.uk/commentisfree/2013/apr/16/unemployment-reinhart-rogooff-arithmetic-cause>

Literature Review

Djankov et al (2006) state that: “Debt is one of the most useful contracts in every economy, since it enables firms to finance investment and individuals to smooth consumption”. (Djankov et al, 2006)

Reinhart et al. (2003) studies the tolerance of public as well as external debts. It uses data collected from over 100 countries from 1820's till 2000's. The main finding is that there is a huge standard deviation in the threshold levels of defaulted countries defaulted. In most cases the emerging countries defaulted with a very low debt to GDP ratio. The observed threshold was 20%. After 1970 the trend went up and all the studied cases had a default of less than 60%. Already for the 2000's the estimated threshold is at around 150% Reinhart et al suggest the idea of serial defaults.

“A country’s record at meeting its debt obligations and managing its macroeconomy in the past is relevant to forecasting its ability to sustain moderate to high levels of indebtedness, both domestic and external, for many years into the future.” (Reinhart et al 2003)

Thus, if the statement is true a country which once had a debt crisis will face it again. The interest rates at which countries borrow differ according to the history of the country. Therefore, defaults are counted in the interest rates and the “bad history” will make it more likely to have a default. The case of Greece is extremely relevant for this topic as Greek debt crisis is one of the

recent defaults. In 2012 the debt-GDP ratio was 160%. Could the default be expected? According to Reinhart et al. (2003) it could. Only in 19th century Greek economy had four debt defaults (1826, 1843, 1860 and 1893). The history accumulates its “negative and positive memory” and causes a collapse sooner or later. Consequently, the chances of independent country which has 20 years of economic history decrease. (Reinhart et al 2003)

Lachler and Nunnenkamp (1987) try to show that growth can be explained by three main factors: foreign direct investments as a share of GDP, foreign aids as a share of GDP; external debt as a share of GDP. The final dataset used for the estimations was a panel data consisting of 36 countries and 32 years of observations. The main equation of the Lachler and Nunnenkamp (1987) is:

$$X_i = a_0 + a_1 \cdot (FDI / GDP)_i + a_2 \cdot (AID / GDP)_i + a_3 \cdot (DEBT / GDP)_i$$

Where X_i is the growth indicator (GDP growth), FDI is foreign direct investments, AID is foreign aids, DEBT is external debt. The main obtained conclusions were that during the period that Lachler and Nunnenkamp (1987) analyzed most developing countries did not have cooperative relationship with “foreign suppliers of capital”. The non-cooperative equilibrium, as the authors state, was that those countries who receive foreign capital will have to compromise between less income variation and faster growth (when receiving the equity or debt-financed inflows). The intuition of the authors is that the less uncertain foreign inflows are, the less risky they are for the economy and the higher is the growth. However, Lachler and Nunnenkamp (1987) discuss only linear impact of the external debt, so other foreign inflows and there results might be ambiguous. (Nunnenkamp and Lachler 1987)

Pattillo et al (2002) studied the non-linear impact of the external debt on the economic growth. The data used for the estimations is a panel data of annual reports for 93 developing countries starting from 1969 till 1998. Pattillo et al (2002) ran different types of regressions trying to find the best method of capturing relationship between growth and external debt. First linear relationship is defines as follows:

$$y_{it} = \alpha_{i,t} + \beta \cdot X_{i,t} + \gamma \cdot D_{i,t} + \varepsilon_{i,t} \quad (1)$$

Where y is the per capita GDP growth, X 's are the control variables (openness, schooling, population, foreign direct investment, import, export and their logarithmic interpretation, as well as the same variables as share of GDP), D is the debt indicator variable. In order to indicate the level of debt at which the impact of debt becomes negative, dummy variables representing the quintiles of the debt are introduced in the model;

$$y_{it} = \alpha_{i,t} + \beta \cdot X_{i,t} + \gamma_2 \cdot d_2 + \gamma_3 \cdot d_3 + \gamma_4 \cdot d_4 + \gamma_5 \cdot d_5 + \varepsilon_{i,t} \quad (2)$$

Where d_2 to d_5 are dummy variables for the second to fifth quintiles of the debt. The economic theory says that the relationship of debt and growth must represent inverted U-shape graph. The intuition is that at some level high indebtedness start to have negative impact on the economic growth Therefore, the square of the debt variable must be included in the following equation;

$$y_{it} = \alpha_{i,t} + \beta \cdot X_{i,t} + \gamma \cdot D_{i,t} + \delta \cdot D_{i,t}^2 + \varepsilon_{i,t} \quad (3)$$

The intuition behind this type of equation is that the relationship between growth rate and debt is quadratic, which means that at some point the impact of debt on the growth starts to decline, and here the question is “What is that level?”

In order to check the results of obtained in the previous regressions, IV estimations have been done.

$$y_{it} = \alpha_{i,t} + \beta \cdot X_{i,t} + \gamma \cdot D_{i,t} + \chi(D_{i,t} - D_{i,t}^*)Z + \varepsilon_{i,t}$$

Where D^* is the threshold for the debt variable and Z is a dummy variable, which is 1 if the debt is above the threshold and 0 if it is below the threshold. The last regression shows that if the theory suggests a threshold level for debt/GDP ratio, we can take a constant variable and discuss the impact of the debt/GDP ratio if it is above the threshold.

Pattillo et al. (2002) also uses the ratio of external debt over exports as a debt indicator, as well as net present values of both the variables. However, the findings of the paper suggest that the impact of debt becomes negative when external debt over exports is 160-170% and external debt over GDP is 35-40%. They claim that doubling the debt at this levels of indebtedness will decrease the growth by 1-1.5%. (Pattillo et al, 2002)

Irons and Bivens (2010) take as given the results obtained by the Reinhart and Rogoff (2009), who discovered that external debt-GDP ratio starts to have a negative impact on the growth at 60%. The paper discusses the case of the United States using 216 observations. To avoid the problem of simultaneous equations Granger-causality tests are done. Two hypotheses are under consideration: debt does not Granger-cause growth; growth does not Granger-cause debt. For both of the tests the following lags are taken: 2, 4, 6, 8 and 10 years. The first hypothesis was rejected in all cases and the second hypothesis was accepted in all cases with 99% confidence interval. (Irons and Bivens 2010)

Irons and Bivens (2010) take the results of Reinhart and Rogoff (2008) as given and considering the recent “scandal” in economic theory concerning the topic of finding the threshold for indebtedness, their paper is also under suspicion. The criticism of the paper is that it does causality assumptions with referring to the results obtained by Reinhart and Rogoff (2008)

Reinhart and Rogoff (2010) used more recent data to “search for a systematic relationship between debt levels, growth and inflation”. Generally, in emerging countries with high level of public debt the inflation rate is also significantly high. The intuition behind it is as follows. The government takes more debt, and in order to reach “debt sustainability” the taxes should be increased; the more the taxes are the more is the dead-weight lose of the economy. Of course government can decrease its spendings, but What for? why taking a debt then? “...as for inflation, an obvious connection stems from the fact that unanticipated high inflation can reduce the real cost of servicing the debt”. But it will decrease only short-term debt and will indirectly increase the interest rates which the country is paying for its debts. The sources for data which Reinhart and Rogoff (2010) are using are International Monetary Fund, World Economic Outlook, World Bank and Global Development Finance. There are 252 observations below 30% of debt/GDP ratio; 309 observations for the ratio between 30% and 60%; 120 observations for the debt /GDP ratio between 60% and 90%; and 74 observations above 90%. Overall it is 755 annual observations for 20 emerging countries³. The results that the paper obtains is that for the average country at the 90% level of external debt/GDP ratio the GDP growth is negative and the inflation is the highest recorded for that 20 countries (16.7%). The lowest inflation has the average country with the debt/GDP ratio of less than 30%. While the famous book by the authors is under attack of modern economic society, the other papers are still under the shadow

³ The list of the countries does not include any post-soviet Union country.

and until the hypothesis of their irrelevance is not proved, my thesis work is going to take the intuition of the economic (Reinhart and Rogoff, 2010)

One of the few papers which includes post-soviet union countries in the study is Geithner(2002). It also includes Armenia. Geithner(2002) analyzes general financial sustainability of different countries and also estimates the external debt threshold level where the growth and debt are negatively correlated. For the external debt sustainability studies a dataset of 15 post-soviet union countries⁴ was used starting from 1995 to 2001. The paper uses 508 observations, where the number of observed crises is 53. The estimated threshold of external debt over GDP ratio is 44.7% which is very low noting that most of the Former Soviet Union countries had a higher level of indebtedness. However, Geithner indicates that the estimated probability that a country, which has more than 40% debt to GDP ratio, will not have a crisis is 80% (Geithner, 2002)

Clements et al (2005) in their paper estimate the consequences of debt release by the International Monetary Fund (IMF). They are discussing the cases of 28 heavily indebted poor-countries⁵ (HIPC) and cases of their debt reliefs. According to this policy when a part of the debt is forgiven, the country will at least be able to function and return rest of the debt. The conclusions that the paper found was that indeed the relationship between external debt and per capita GDP growth is non-linear, and there exists a threshold of 50% (on average) after which the relationship becomes negative. In their models, Clements et al (2005) use following control variables; population growth, lagged real income per capita, secondary school enrollment and total debt services(both private and public). One of the findings of the paper is that if a country which receives HIPC debt relief it should allocate some part of its released monetary assets to

⁴ The list of the countries for : Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyz Republic, Latvia, Lithuania, Moldova, Russia, Tajikistan, Ukraine, Uzbekistan.

public investment. Clements et al (2005) find that the non-linear impact of debt of growth is through public investments, and researchers should try to focus on searching indirect ways of affecting growth through debt paying much attention on public sector deficits. The interesting fact is that Clements et al include Armenia as heavily indebted poor country. Although in Ministry of Finance any debt relief is not recorded, there was a debt reconstruction. This means that Armenia applied to IMF in order to reconsider the schedule of payments, and the agreement was changed due to the request.

Data description

The dataset of main macroeconomic indicators used in the analysis is taken from the official website of National Statistical Service of the Republic of Armenia (www.armstat.am). The Republic of Armenia is relatively young and the detailed data from the first years of its existence is not available mainly because of the inexperienced system of the statistical agencies. For the analysis of the debt-growth relationship a quarterly data from 1999-2012 (56 observations) is used. All the variables under consideration are converted into USD (current).

The main variables of our interest are debt indicators. The detailed quarterly data about debts and loans are taken directly from the Public Debt Management Department of the Ministry of Finance of Republic of Armenia (www.minfin.am). The debt data is given by USD (current). It also includes the installments that Armenia has to pay for its debt. It is important to notice that if considering the situation at the end of 2012 Armenia will pay all its debts back only in 2050.

In order to convert all the nominal variables into real terms the time series of consumer price index was taken from the official website of Central Bank of Republic of Armenia (www.cba.am). As the available data was only monthly, a simple arithmetical average was calculated to formulate the quarterly data. The base year for calculations is 1994. The essential variables which have the money component in them were transformed to real values by dividing by the corresponding consumer price index for that quarter.

As already mentioned above, the time series of population is taken from official sources. However, there is an over-estimation of Armenian population in 1999 and 2000. In 1999 and 2000 the population size was around 3.8 million people. Already in the first quarter of 2001 the population size is 3.2 million people. The reason for such sharp decline is that Armenian Statistical Service made its in publications more precise starting from 1999. Before 1999 there were a lot of misspecifications in most of the available data. The population size of Armenia was being calculated by adding the number of people who are born or migrated to Armenia and subtracting the number of people who died or emigrated from Armenia. The misspecification in calculation was due to the fact that not all the emigration data was registered. In 2001 Population Census was held in Armenia and starting from 2001 the population size is much more trustful. In order this false decline not to affect our results; the population size is fixed to 3.215 million people during 1999 and 2000.

The main variable of our interest is the debt-GDP ratio (the share of external debt in the GDP). The GDP variable and the debt variable are available quarterly, but there is a misspecification, as GDP is a flow variable, meanwhile debt is a stock variable. Thus, the ratio of these variables gives exaggerated numbers. In order to have a more intuitive variable, which can be compared to

the yearly debt GDP ratios and interpreted as quarterly debt/GDP ratio, the following formula was used to calculate the variable of interest:

$$\frac{Debt}{GDP} = \frac{debt_{t,i}}{(5-i) \cdot GDP_{t,i} + \sum_{j=1}^{i-1} GDP_{t,j}}$$

where t represents years, i and j represent quarters corresponding quarters ($i=\{1,2,3,4\}$, $j=\{1,2,3\}$). Accordingly the 4th quarter debt/GDP value is the value for the yearly debt/GDP ratio. This interpretation of debt/GDP quarterly data fully describes the situation given any particular quarter.

As in the debt variable are also included guarantees and Central Bank (CB) borrowings, we exclude them from our estimations by generating two more variables. The first will be a debt variable without CB borrowings and guarantees and it will represent the governmental obligations. The second variable will not involve guarantees, as excluding guarantees will give more intuitive results for the economy as the new variable will give more clear information of Armenian obligations for the period of our interest. The necessary information is taken from Ministry of Finance (www.minfin.am). Again we are interested in the ratio variable and the ratio variable is constructed by the same rule as the debt/GDP ratio without excluding guarantees and CB borrowings.

Table1. Summary statistics of main variables

Quarterly Indicators(in 1000USD)	No.	Min	Average	Max	St. deviation
Nominal GDP	56	241.7000	1519.4530	4133.1000	1027.3330
Nominal debt	56	790.6300	1773.3260	3930.0400	1074.9540
Foreign Direct Investment (FDI)	55	319.4900	2005.9550	5145.8200	1609.1620
Export	55	59.8500	216.5218	439.4000	109.3179
Import	55	156.7000	507.2702	1110.1500	299.4243
Volume of trade (openness)	55	221.1200	723.7913	1455.7400	397.6651
Population	56	3209.2500	3229.2480	3282.0000	21.4135
GDP per capita growth	55	-54.9352	13.2453	84.1019	42.7337
Debt without guarantees	56	755.8090	1763.6790	3930.0400	1082.4660
Debt without guarantees and CB borrowings	56	570.1110	1444.5260	3247.5130	909.4653
Quarterly Indicators (%)					
Debt_GDP ratio	56	12.8284	40.0047	81.7766	15.6710
FDI as share of GDP	55	64.4356	132.3623	302.1483	55.9260
Export as share of GDP	55	7.4371	17.3821	33.8020	6.7987
Import as share of GDP	55	23.0341	37.5522	64.9524	9.5656
Volume of trade as share of GDP	55	33.1744	54.9342	91.4853	15.2410
Debt_GDP ratio(without guarantees)	56	38.5880	142.6899	312.7054	62.5505
Debt_GDP ratio(without guarantees and CB borrowings)	56	34.0069	114.5260	235.8755	48.3249

The data of loans was given in different currencies as they are taken from different international institutions or governments. The purpose of the borrowing the loans are also included in the supported dataset by the Public Debt Management Department. According to these reasons the loans are divided in five intuitive groups. The first category is the loans taken for social programs. The second category is represented by the loans for the infrastructural improvement (building or mending roads etc.). The third category of loans is those taken for economic

development (investments, subsidies etc.). The forth classification of the loans are the ones taken for reforms in some specific fields such as health and educational systems. The last group of loans is the loans the purposes of which are not indicated, thus just deposits.

Table2. The Summary statistics of loans

Loans in real terms (1000USD)			
Types of Loans	No.	Average	St. Deviation
1. Social Programs	56	30.88	34.61
2. Infrastructure	56	89.50	59.78
3. Economic Development	56	42.64	54.85
4. Reforms (health, education etc.)	56	22.64	30.07
5. Just deposits	56	147.52	379.43
Total	280	66.63531	179.64

The loan variable represents all the loans that Armenia borrowed from the first quarter of 1999 till the fourth quarter of 2012. The variable consists of 5 types of loans per each quarter. If there is no loan taken in that quarter the variable is assigned to be 0. Table2 shows more detailed information about the types of loans.

In order to analyze more detailed relationship between debt and growth the quintiles of the debt/GDP ratio were calculated. The quintiles of the ratios are shown in the Table2. The first quintile is distributed from 13% to 24% of the debt/GDP ratio; the second quintile is from 27% to 36%; the third is from 36% to 45%; the fourth is from 45% to 54%; and the fifth is from 55% to 82%. Using quintiles will be able to analyze the impact of each quintile separately.

Table3. The Summary statistics of quintiles of the debt/GDP ratio

QUINTILE	Debt/GDP(in shares)				
	No.	Min	Average	Max	St. deviation
Quintle1	12	0.13	0.19	0.24	0.04
Quintle2	11	0.27	0.32	0.36	0.03
Quintle3	11	0.36	0.41	0.45	0.03
Quintle4	11	0.45	0.49	0.54	0.03
Quintle5	11	0.55	0.62	0.82	0.08

Methodology

The thesis work is estimating the relationship of economic growth and external debt. All the analyses are done be for Armenian economy. The methodology of the thesis work includes the regressions of the Pattillo et al (2002). First, linear relationship is estimated, where the dependent variable is the per capita GDP growth. The independent variables are debt indicators and control variables. In debt indicators I use external debt/GDP ratio and real debt. As for control variables, the volume of trade (the sum of exports and imports), foreign direct investments and population size are taken. ⁶

Second, in order to investigate more precisely the pattern of the relationship of debt/GDP ratio and economic growth, dummy variables representing the quintiles of the debt were generated. The dummy variables are used as independent variable instead of ratio variable

⁶ As it is mentioned in the data description all the necessary variables are in real terms (1994 is the base year).

Third type of equations is quadratic equation where the square of the debt/GDP variable is included in the model. The purpose is to find inverted U-shape relationship between debt and growth.

The next groups of estimations use loans as a proxy to debt. As there are 5 groups of loans, it means that for each quarter there are 5 observations (overall the number of observations becomes 260⁷). First we test that loans affect the growth with similar pattern as debts. Then, we estimate the relationship between each type of the loan and the per capita growth of GDP. The estimations are going to be:

$$y_{it} = \alpha_{i,t} + \beta \cdot X_{i,t} + \gamma \cdot L_{i,t} + \varphi \cdot L_{i,t} \cdot l + \delta \cdot l + \varepsilon_{i,t} \quad (4)$$

Where y is per capita growth, X's are control variables, L is the amount of loan taken in that particular period, and l is the type of the loan.

In order to test stationarity of all the time valid variables Dickey-Fuller r tests were done. Table 8 shows the results of the tests. Some of the variables were differenced stationary, some of them trend stationary. GDP per capita growth and debt/GDP ratio are both stationary variables. That allows us to interpret results without complications.

⁷ It is calculated as follows 4 quarters, 5 observations per each quarter and 13 years. 4x5x13=260

Results

As the thesis work deals with quarter time series, the matter of stationarity must be the most important issue. The stationary tests of the variables are shown in Table 9. The Control variables openness (volume of the trade), foreign direct investments (FDI) and population fail to be stationary variables. The FDI and openness variables are difference stationary, while population is trend stationary (with exponential growth)⁸. The estimated results of the linear estimation, where the dependent variable is the GDP per capita growth and the independent variables are debt/GDP ratio, the volume of the trade, the foreign direct investments and the population size, are shown in the Table4. It can be seen that the main variable of our interest debt/GDP ratio variable affects GDP per capita growth significantly negatively. Table 4 shows that linear estimation of the debt variable impact is insignificant. Foreign direct investments also have insignificant impact on per capita growth. In the meantime, population size growth has negative impact on the per capita growth. That is fairly intuitive; as the larger is the population size the less must the share of each person in the GDP. The volume of the trade or the openness of Armenian economy also has significantly negative impact on growth. If we compare these results to Pattillo et al (2002), we see that in some estimations openness has significant positive impact, but in others insignificantly negative impact. Generally, the openness of the country must influence on the capital inflows and outflows and consequently, it must increase the GDP. However, for a small country such as Armenia the large deficit of net exports makes the relationship to be negative rather than positive. Moreover, when we do Ramsey RESET test⁹ it is obvious that when we estimate linear relationship between GDP per capita growth and external

⁸The variable of the predicted residuals of the following regression are stationary $pop = \alpha + \beta_1 \cdot t + \beta_2 \cdot t^2$

⁹ RESET (Regression Equation Specification Error Test) is generally specification test which tests the linearity of the regression. The details of the RESET tests are in the Appendix.

debt we are missing “powers of independent variables”. The test suggests us to use higher powers of our variables. As most of the theory suggests including the quadratic variable of the debt/GDP ratio, we suspect that it solves the problem.

Table4. Linear and Quadratic effects on Growth

	OLS	
	Linear	Quadratic
Debt/GDP ratio	-0.224 (0.47)	2.876** (1.25)
Squared Debt/GDP ratio	-	-0.042** (0.02)
FDI as share of GDP	-0.017 (0.13)	-0.061 (0.13)
Volume of trade as share of GDP	-1.768** (0.59)	-1.460** (0.62)
Log(Population growth)	-428.975*** (108.22)	-413.015*** (97.51)
Constant	135.606*** (17.18)	75.623** (34.57)
R-square	0.5062	0.5511
Number of observation	54	54

where * means significant at 10%, ** means significant at 5%, *** means significant at 1%

In order to find more accurate relationship between per capita GDP growth and debt, the analyses with quintiles is used. The obtained results are shown in Table 5. The second, third and fourth quintiles have positive impact on the growth, in the meantime the fourth and fifth have negative impact. Consequently at some point the relationship between the growth and the debt cannot be linear. Interesting fact to notice is that FDI does not significant impact, meanwhile the

two other control variables have similar impact as in the simple linear OLS case. These results of quintile impacts are similar the ones obtained by Pattillo et al (2002) and also support the idea of using powers of debt/GDP ratio.

Table5. Effects of each quintile on Growth

	Linear OLS
d2(RATIO)	11.331** (3.07)
d3(RATIO)	7.484 (4.75)
d4(RATIO)	2.976 (3.8)
d5(RATIO)	-4.620* (2.73)
FDI as share of GDP	0.004 (0.11)
Volume of trade as share of GDP	-0.899* (0.51)
Log(Population growth)	-530.591*** (106.70)
Constant(RATIO)	-1.245 (2.26)
R-square	0.725
Number of observation	54

where * means significant at 10%, ** means significant at 5%, *** means significant at 1%

In order to find the level of debt at which the GDP growth becomes negative, the quadratic relationship is tested and the significant results prove that there is an inverted U-shape relationship between the variables of our interest. For this purpose, a variable which is the square of debt/GDP ratio, is generated and the quadratic type of regressions are run. The output in Table 4 shows that the coefficient of the debt/GDP ratio is positive, and the coefficient of the square of

that ratio is negative. Accordingly, there is indeed inverted U-shape relationship between the debt/GDP ratio and the growth variable. In order to find the level where the debt overhangs, we need to calculate the first derivative of the quadratic equation and equalize it to 0. The threshold level therefore is:

$$\hat{D} = -\frac{\beta_1}{2 \cdot \beta_2}$$

where \hat{D} is the threshold level, β_1 and β_2 are the coefficients from table (4).

According to our estimations and table (5) the level of debt overhang is 34.5%. The goal of this thesis work to find the threshold of debt overhang and to aware Armenian policy makers to stop borrowing or borrow more wisely. As Armenia has already reached and overcome the level of the debt overhang, which means that Armenia is in the downward sloping part of the relationship, the reasonable implication for Armenia is to stop borrowing or to optimize time management over debt repayment years. It is important to point out that Armenian current level of indebtedness is 39% of its GDP. In order the result and conclusions not to be spurious, we ran regressions with a new variable which excludes CB borrowings and guarantees from the debt.

Table6. Linear and Quadratic effects on Growth (excluding guarantees and CB borrowings)

	OLS(excluding guarantees)		OLS(excluding CB borrowings and guarantees)	
	Linear	Quadratic	Linear	Quadratic
Debt/GDP ratio	-0.246 (0.48)	2.449* (1.37)	-0.218 (0.65)	3.304* (1.90)
Squared Debt/GDP ratio	-	-0.037* (0.02)	-	-0.061* (0.04)
FDI as share of GDP	-0.011 (0.14)	-0.041 (0.13)	-0.016 (0.14)	-0.025 (0.14)
Volume of trade as share of GDP	-1.778*** (0.57)	-1.497** (0.63)	-1.812*** (0.56)	-1.562** (0.62)
Log(Population growth)	-430.81*** (110.3)	-426.04*** (102.47)	-422.42*** (110.69)	-421.15*** (103.84)
Constant	136.34*** (17.60)	83.83** (36.00)	135.75*** (17.96)	79.74** (39.28)
Threshold level	-	32.8	-	27.2
R-square	0.5064	0.5352	0.5047	0.5314
Number of observation	54	54	54	54

where * means significant at 10%, ** means significant at 5%, *** means significant at 1%

Table 6 represents the impact of debt/GDP ratio without taking account guarantees and CB borrowings. The level of overhang for debt/GDP ratio excluding guarantees and the level of overhang for the debt/GDP ratio excluding both guarantees and CB borrowings we are calculating with the same formula as we did for the initial debt/GDP ratio variable. Table 6 also indicates the levels of debt overhang. As we supposed the level of threshold is much less when

we subtract guarantees and CB borrowings. However, it clear from that excluding only guarantees does not change the threshold level much (from 34.5% to 32.8%)

As at this level of indebtedness increasing the level of borrowings from the rest of the world will decrease the economic growth of Armenia, and sooner or later Armenia will face the problem of debt sustainability. If Armenia is not able to pay its debts back, IMF and other international monetary institutions will apply to their “HIPC debt relief policy”. HIPCs (heavily indebted poor countries) are those countries that have a high level of debt and cannot sustain them. IMF (or other international monetary agency that supplies money to the countries) forgives part of the debt in order to help the country to avoid the default and be able to pay back at least the rest part of the debt later. In the situation of high indebtedness this policy is beneficial for both of the sides. However, as indicated in Reinhart et al (2003) the record about the country will always stay in the history and will affect the interest rate the country is borrowing with. Armenian economy is significantly small, and still in a transition period as Armenia did not find its comparative advantageous in the international trade and is changing the structure of its economy constantly trying to find the optimal structure for its growth. In this context Armenia cannot stop borrowing, as borrowing means investment in those branches of the economy where they are needed.

All the loans taken by Armenia starting from 1999 are divided into five main groups. In order to understand which type of loans are more efficient for the economy the following type of estimations are done:

$$y_{it} = \alpha_{i,t} + \beta \cdot X_{i,t} + \gamma \cdot L_{i,t} + \varphi \cdot L_{i,t} \cdot l + \delta \cdot l + \varepsilon_{i,t}$$

Table 7 shows the linear OLS coefficients estimates of our independent variables. The independent variables are the types of loans as share of GDP, foreign direct investments as a share of GDP, the volume of the trade (openness of the economy) as a share of GDP and the population growth. From the obtained coefficients we can conclude that social programs have significantly negative impact on GDP per capita growth. If Armenia will increase the share of loans taken for social programs by 1% the GDP per capita growth will decrease by 5%. To interpret the impacts of other types of loans we need to subtract the effect of the social programs. Loans taken for infrastructural changes have less negative effect on GDP per capita growth than loans taken for social programs. The impact of the “development” type of loans is not significant. This may be due to the fact that not all the loans are working efficiently to increase the per capita GDP growth. The next group of loans is loans taken for reforms in educational or health systems. These are the only type of loans that have positive impact on the dependent variable of our interest. The last group is just deposits. If we compare its impact with other types but “reforms” it has the least negative effect. The development loans are directly taken in order to develop the economy or some part of it. Accordingly, it is intuitive to expect development to have significant and positive effect on per capita growth. However, our results do not accept that hypothesis. Meanwhile, only “reforms” increase per capita GDP growth. If we do not consider “development” loans (as their impact is insignificant), social programs have the most negative impact on per capita growth. The intuition behind this is that social programs affect economic activities less, as they are targeting more vulnerable groups to ensure better standards of living. Infrastructural changes like building roads and other ways of communication affect trade and correspondingly the growth of the economy.

Table7. The impact of different types of loans on GDP per capita growth

	OLS-linear
Social programs(cons)	-5.010*** (0.59)
Infrastructure	2.606*** (0.30)
Development	-0.066 (0.75)
Reforms	6.260*** (0.62)
Just deposits	4.189*** (0.67)
FDI as share of GDP	-0.050*** (0.03)
Volume of trade as share of GDP	-1.803*** (0.07)
Log(Population growth)	-357.952*** (57.01)
R-square	0.4977
Number of observation	268

Where * means significant at 10%, ** means significant at 5%, *** means significant at 1%

Overall, the estimations of the thesis work suggest increasing the share of reforms in the share of loans that Armenian government is taking. The next group of loans that have comparatively positive impact is “infrastructural” loans. Building roads and other infrastructure, generally, have negative impact on per capita GDP growth. However, in comparison to social programs and development loans, the third types of loans have less negative impact. The interpretation of the fifth types of loans indicated as “just deposits” is less intuitive, as the reason of why they have been taken is not pointed out.

Conclusion

Although public debt economics is an urgent topic and is under the consideration of global changing, the theory of having threshold for external debts still can be supported. In our estimations we tried to estimate both linear and quadratic type of relationship between debt and growth. My thesis work tests all the relationships suggested by Pattillo et al (2002). As the theory suggests linear and quadratic relationships should be tested to define the impact of debt on growth. The goal of the thesis work was to check whether there is find the threshold where the debt becomes non-sustainable. According to our estimations it is around 34.5%. The ratio of debt/GDP is more than the threshold level (currently it is 39%), which means we are in the declining part of the inverted U-shape graph. If Armenia continues borrowing it will mean that the debt will become more and more unsustainable, and the default will be fatal and it will affect the interest rate at which Armenia is borrowing. The case of Greece is very relevant for the topic as its economy is collapsing periodically, as it is indicated Reinhart and Rogoff (2010). This implication has been done before the recent Greek debt default. Although in the case of Greece the default happened at extremely large level of debt/GDP ratio, there are a lot of economic and non-economic factors that made Greek economy to sustain higher levels without crashing. For the Greece case there are a lot of reasons why EU was trying to sustain the high levels of indebtedness (the same currency zone, possible sequential defaults in other EU countries etc.) Although Armenia is a CIS country but the agreement of CIS member countries implies less responsibility with respect to each other. Thus, Armenia economy is more vulnerable to shocks compared to Greek economy. According to Clements et al (2005) countries with high indebtedness Armenian government should increase the share of public investments in the economy.

The thesis work finds that, the threshold of external debt GDP ratio exists and for Armenian economy it is estimated to be 34.5%. In 1999 Armenia had a very high level of indebtedness (82%) and succeeded continuing growing by managing the debt correctly. The reconstruction of debt payback schemes is a good way of managing the debt in “bad times”. Nevertheless, having the threshold at 34.45% it is not irreversible as the examples of many countries show us.

The estimation of the impact of different types of loans on growth show that social programs have negative impact on growth due to the fact that they do not affect economic activity much, but they are targeted to help more vulnerable groups of the society. Meanwhile, in comparison to the social program loans other types of loans seem to have positive effect on growth. Among the loan groups the only one which has positive impact are reforms. Thus, in the times of debt overhang Armenia should more focus on loans taken for reforms in the health and educational systems.

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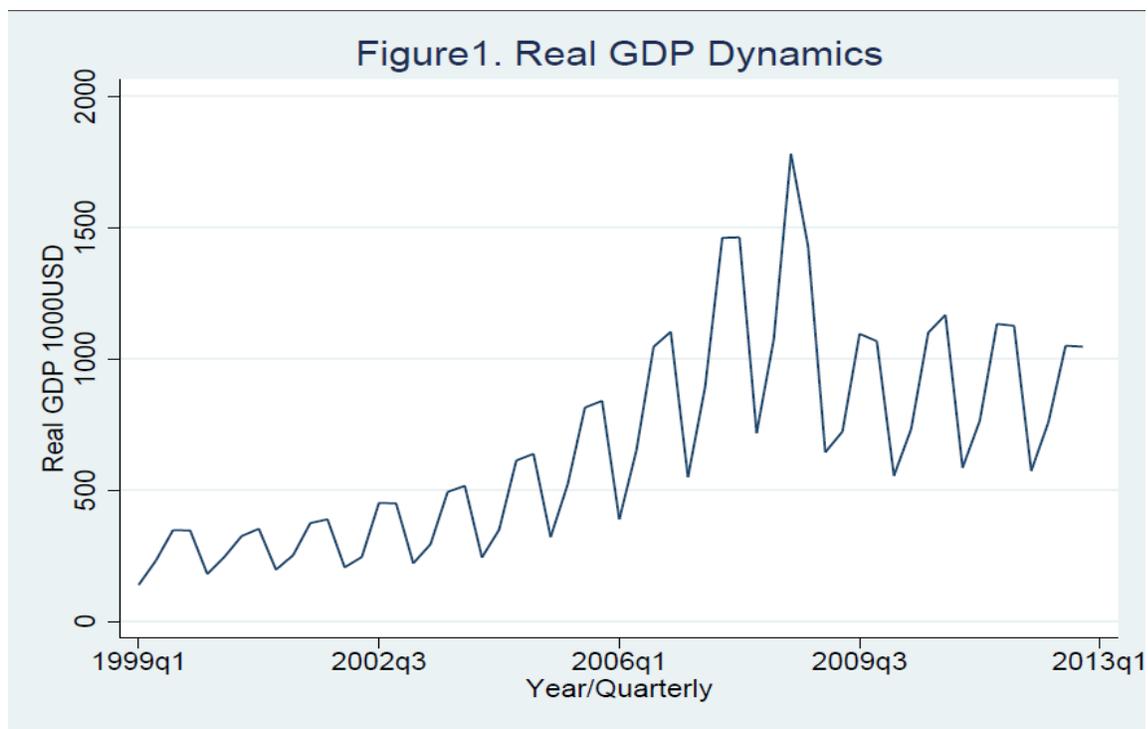
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Appendix



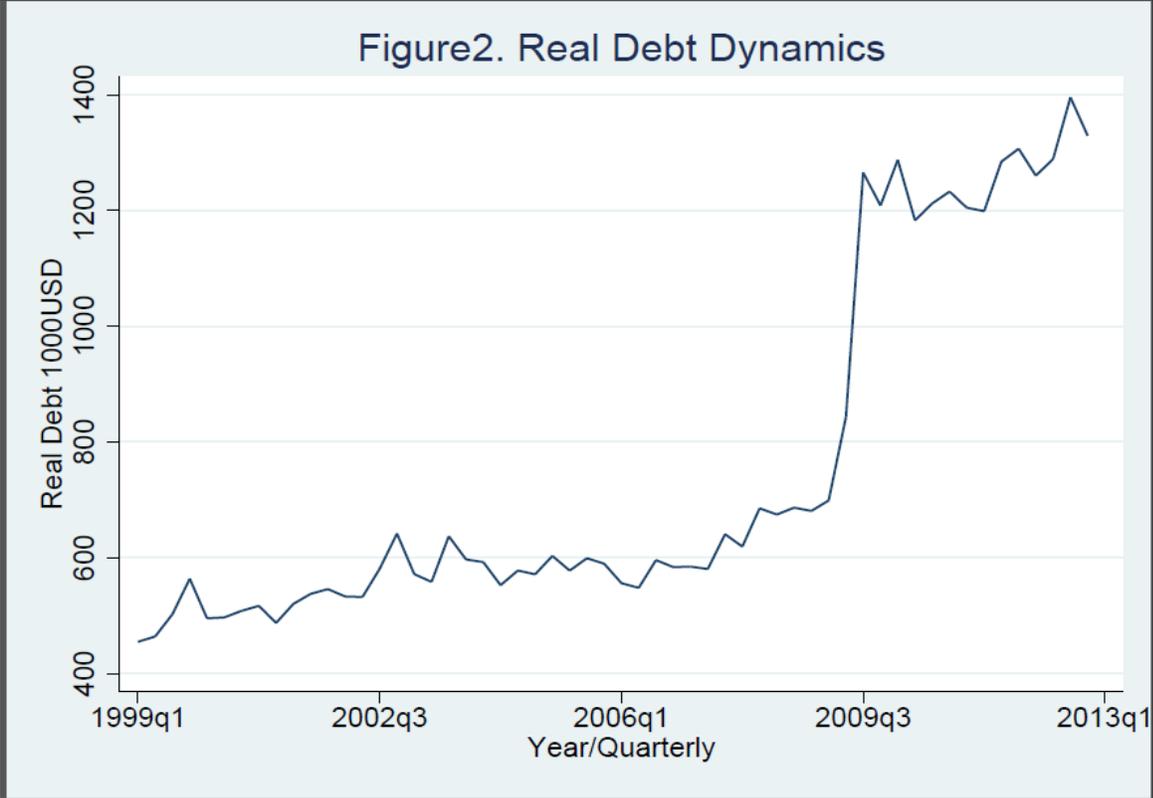


Figure3. Armenian Import, Export and Trade yearly dynamics

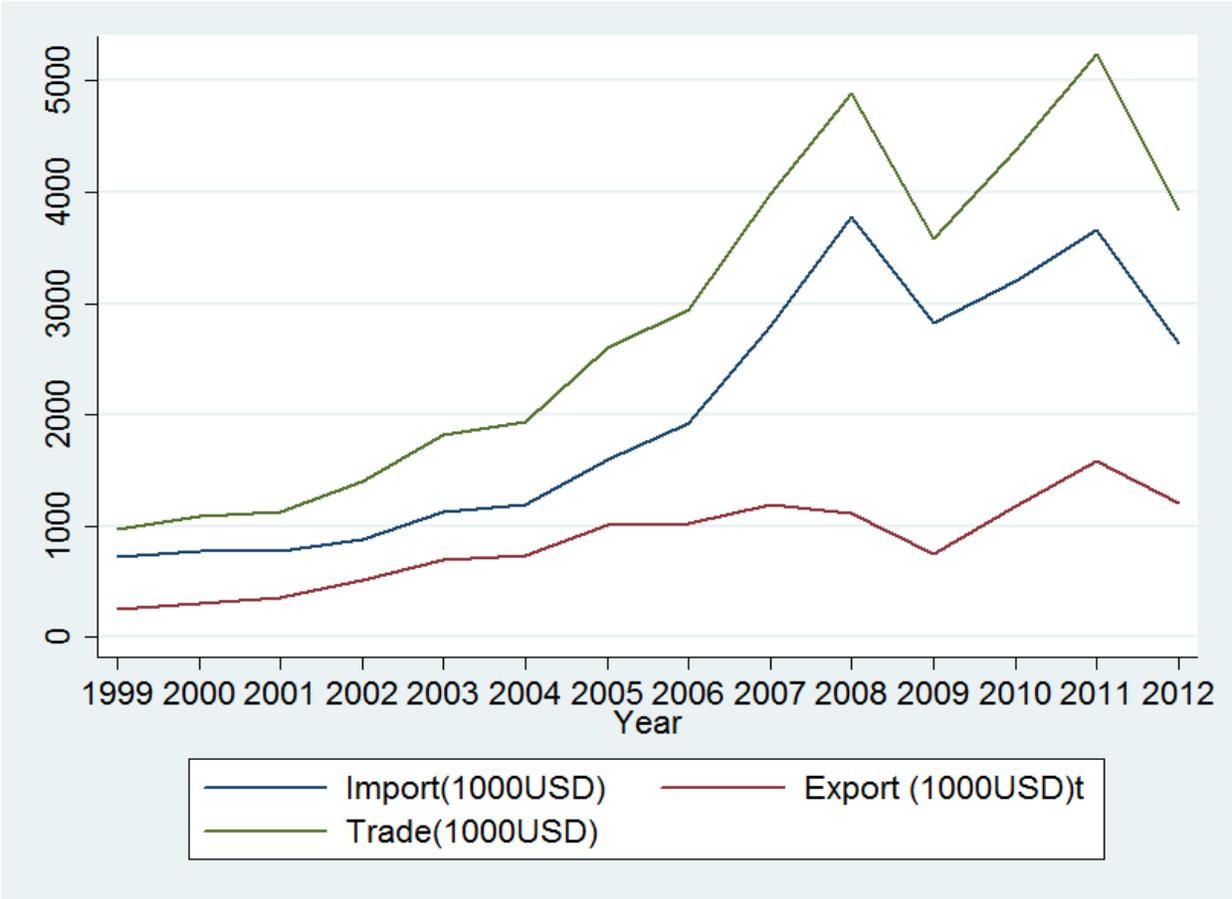


Figure4. Armenian Import/GDP, Export/GDP and Trade/GDP yearly dynamics

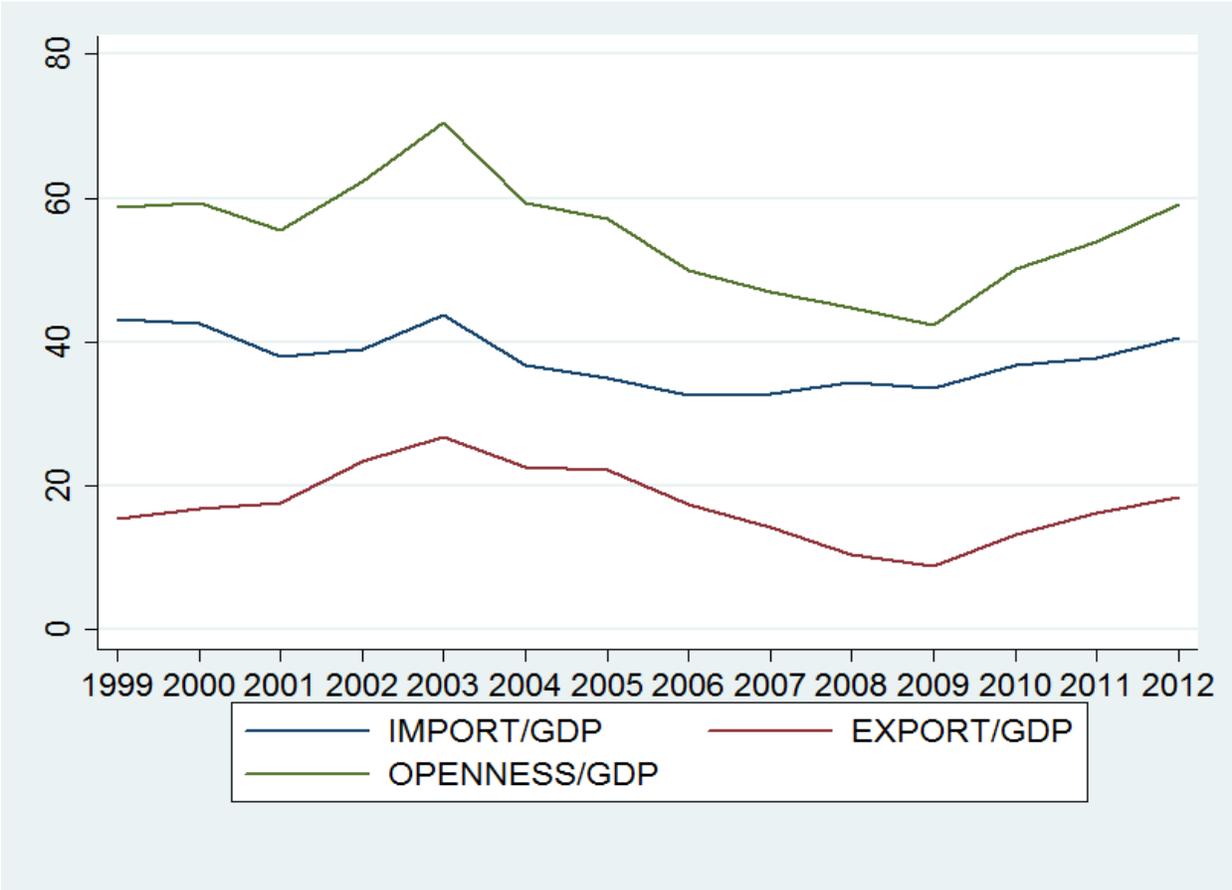


Table8. Stationarity tests

Dickey Fuller Test	Test Statistic	P-Value	1% Critical Value	5% Critical Value	10% Critical Value
Real GDP	-3.244**	0.0180	-3.573	-2.926	-2.598
GDP per capita growth	-7.455***	0.0000	-3.574	-2.927	-2.598
Export	-1.184	0.6800	-3.574	-2.927	-2.598
Import	-1.437	0.5645	-3.574	-2.927	-2.598
Trade	-2.048	0.2660	-3.574	-2.927	-2.598
Foreign Direct Investment	0.419	0.9820	-3.574	-2.927	-2.598
Debt/GDP	-3.667*	0.0050	-3.573	-2.926	-2.598
Population	16.863	1.0000	-3.573	-2.926	-2.598
Import as share of GDP	-6.831***	0.0000	-3.573	-2.926	-2.598
Export as share of GDP	-4.169***	0.0007	-3.576	-2.928	-2.599
Trade as share of GDP	-6.043***	0.0000	-3.576	-2.928	-2.599
FDI as share of GDP	-7.198***	0.0000	-3.576	-2.928	-2.599
Population growth	-2.587*	0.0958	-3.573	-2.926	-2.598

* means stationary at 10%, ** means stationary at 5%, *** means stationary at 1%

Table9. Ramsey RESET test (using powers of independent variables)

	F-test	P-value
Linear debt regression	1.92	0.0638
Quadratic debt regression	0.41	0.7451