

CHARLES UNIVERSITY IN PRAGUE

FACULTY OF SOCIAL SCIENCES

Institute of International Studies

Master thesis

2014

Ting Ting

CHARLES UNIVERSITY IN PRAGUE

FACULTY OF SOCIAL SCIENCES

Institute of International Studies

Ting Ting

Public debt and growth: the delicate relationship

Master thesis

Prague 2014

Author: Ting Ting

Supervisor: prof. Barbara Pertold-Gebicka, Ph.D.

Academic Year: 2013/2014

Bibliographic note

TING, Ting. (2014) *Public debt and growth: the delicate relationship*. Mater thesis.

Charles University, Faculty of Social Sciences, Institute of International Studies.

Supervisor: prof. Barbara Pertold-Gebicka, Ph.D.

Abstract

This paper analyses the long-term relationship between public debt and economic growth. Using Reinhart and Rogoff's data for 20 advanced countries in the post-war period, we find no evidence for common debt threshold within countries over time, above which GDP growth will sharply drop. Still, we confirm the negative correlation between government debt and economic growth within most of selected countries. Moreover, we argue that the causality between debt and growth is very important in understanding the precise impact of debt on economic growth. Countries in an economic boom are less vulnerable to high public debt. With regard to current debate, the results suggest two things: 1) Excessive public debt truly stifles GDP growth but debt-growth relationship differs across countries and time periods. 2) Cutting debt to return economic prosperity is a long-term plan. That is, less short-term fiscal austerity is appropriate in an economic recession in the countries with high debt.

Keywords: Growth, Public debt, Advanced countries, Capital accumulation.

Abstrakt

Tato práce analyzuje dlouhodobou souvislost mezi veřejným dluhem a ekonomickým růstem. Za použití Reinhartových a Rogoffových dat 20 ekonomicky rozvinutých zemí poválečného období, nenacházíme žádný důkaz pro tvrzení, že za určitou prahovou mezí veřejného dluhu začne růst HDP vykazovat strmý pád. Přesto potvrzujeme negativní korelaci mezi vládním dluhem a ekonomickým růstem ve většině zkoumaných zemí. Navíc tvrdíme, že kauzalita veřejného dluhu a ekonomického růstu je velmi důležitá pro pochopení přesného dopadu dluhu na ekonomický růst. Ekonomicky prosperující země jsou méně náchylné k vysokým úrovním veřejného dluhu. S ohledem na současnou debatu naše výsledky naznačují dvojí: 1) Přílišné veřejné zadlužení brání růstu HDP. 2) Cesta snižování dluhu za účelem zvýšení růstu HDP je dlouhodobým plánem, a proto je za předpokladu ekonomické recese vhodné provádět méně krátkodobých škrtů, a to i v případě vysoce zadlužených zemí.

Klíčová slova: Ekonomický růst, Veřejný dluh, Rozvinuté země, Akumulace kapitálu.

Range of thesis: 146231 symbols, 22512 words, 91 pages.

Declaration of Authorship

1. The author hereby declares that he compiled this thesis independently, using only the listed resources and literature.
2. The author hereby declares that all the sources and literature used have been properly cited.
3. The author hereby declares that the thesis has not been used to obtain a different or the same degree.

Prague _____

Institute of International Studies
Master Thesis Proposal

Key Research Questions:

Does public debt certainly restrain growth? Is there a threshold in debt-growth relationship? What are the mechanisms occur from high debt to growth?

Brief Description of Theory:

We use Classical and Keynesian economics theories and apply neoclassical model in regression analysis.

Brief Description of Methodology:

We mainly use qualitative method to analyze the relationship between debt and growth. We reproduce Reinhart and Rogoff's approach but with novel alternative method.

Conclusions:

Excessive public debt truly stifles GDP growth but it is not as serious as what previous papers argued. The debt-growth relationship would change across countries and over time. We suggest there is no common threshold can be applied for all selected countries.

Contents

Introduction.....	9
Part 1: Does high public debt certainly cause slow growth?.....	11
Chapter 1: Theory.....	12
1.1 The Classical and Neoclassical paradigm.....	12
1.2 The Keynesian and New Keynesian paradigm.....	15
1.3 The conflicts and compromises between Classical and Keynesian.....	17
Chapter 2: Debt-growth nexus.....	21
2.1 The Reinhart and Rogoff controversy.....	21
2.2 Methodology and Data.....	22
2.3 Debt-growth nexus on the whole.....	23
2.4 Debt-growth nexus across time periods.....	23
2.5 Debt-growth nexus across countries.....	26
Chapter 3: Regression analysis.....	32
3.1 Existing results.....	32
3.2 Methodology and data.....	33
3.3 Empirical result.....	35
Chapter 4: Causation.....	37
4.1 Correlation or causation.....	37
4.2 Simulation model of causation.....	39
4.3 Estimation Strategy.....	40
4.4 Case study- the United States.....	41
4.5 Result after considering causation.....	43
Part 2: The channels through which debt affects the economy.	48
Chapter 5: Private investment contraction.....	49
5.1 Debt-investment nexus.....	49
5.2 Importance of private investment.....	49
5.3 Methodology and data.....	50
5.4 The change of private investment in GDP compositions.....	50
5.5 Comparison between impacts of debt and economic growth.....	51
Chapter 6: Mechanisms in debt-growth relationship.....	53
6.1 Crowding-out effect.....	53
6.2 Reduced national saving..	55
6.3 Debt overhang theory.	57
6.4 Decline of government effectiveness.....	58

Concluding remarks.....	61
Reference.....	62
Appendix.....	66

Introduction:

The 2008 financial crisis raised the curtain of a series of debt crises. Low economic growth and rising government budget deficits result in the accumulation of substantial public debt in the advanced economies. It ignited Eurozone crisis that extinguished the hope of economic recovery and aroused an unprecedented market concern with respect to fiscal sustainability in vulnerable high-debt countries. In the course of recent economic recession, high-debt countries not only encounter a high risk of default in straitened circumstances but also sink into a deeper economic bust due to the credit crises. According to European Commission (2014), the general government gross debt-to-GDP ratio of the EU (EA17) stands at 92.7%, which has already reached the “dangerous” levels of debt.¹ Consequently, the increasing public debt is no longer an issue that countries can prolong but a thorny problem that is badly in need of solvency. Against this background, during the ongoing recession many high-debt countries have been forced to adopt the austerity policy toward recovery rather than embracing the conventional view that advocates expansionary fiscal policy.

The effect of large government deficit has been forcefully discussed in modern economics. According to classical economics, government budget deficit will depress the capital formation by inducing higher long-term interest rate. Moreover, permanent government deficit can also imply a higher inflation, greater uncertainty to crises and an additional taxation hike in the near future. Nevertheless, there are two opposing arguments with regard to economic impact of excessive public debt in the circles of academe and politics. Reinhart and Rogoff (2010) argue that when public debt exceeds 90 percent, average GDP growth will drop significantly according to their empirical research. This paper suggests that there is a threshold for debt that countries with high debt should take precaution against. With econometrics techniques, many follow-up papers confirm that the existence of debt threshold and further suggest that after a certain threshold (90-100 percent) the deleterious impact of debt becomes significant (Cecchetti, Mohanty and Zampolli, 2011; Checherita and Rother, 2010). However, the other contrasting argument concerns that the result is merely a representative of countries with particularly high debt. Furthermore, it doesn't

¹ The data are released by Eurostat, the statistical office of the European Union.

consider the causality running from growth to debt so that it may cause endogeneity problems. From a fiscal policy perspective, if the particular threshold truly exists at certain level of public debt, austerity policy such as debt reduction through fiscal consolidation would be inevitable and appropriate in the economic recession. But, if the high public debt is not associated with considerably adverse impact on growth, it is more appropriate to stimulate growth rather than cutting debt in economic downturn.

In light of this, this paper is placed on investigating the relationship between government debt and economic growth with a more detailed and precise analysis. We research on the long-term impact of debt on economic growth in advanced countries, which are related to current debate. Our result proves that negative correlation between public debt and GDP growth exists in most of selected countries. However, there is no evidence that allows us to claim the existence of a general debt threshold that policymaker should pay attention to. We further find that the causality between debt and growth is the key issue to determine the GDP growth of that time. Moreover, in view of some misinterpretation of debt effect in current discussion, we analyze debt theories in hope of giving a proper advice to policymakers.

There are two parts in this paper. In part 1, we focus on finding the empirical evidence that high levels of public debt reduce economic growth. We extend Reinhart and Rogoff's research (2010) to prove that there is no general threshold for debt across countries and across time by providing more evidences regarding the debt-growth relationship. After that, we apply econometric techniques to analyze the inverse relationship between government debt and GDP growth. Furthermore, we investigate the causality between debt and growth to see whether the impact of debt is misinterpreted in the opposite direction or not. In part 2, we turn to research on the mechanisms running from high debt to slow economic growth, providing the practical reasons to answer why economic growth would be hindered by the high public debt.

Part 1: Does high public debt certainly cause slow growth?

Whether government debt has an adverse impact on economic growth has been a very difficult question for a long time. Any matter viewed from different angles may result in different interpretations. Although most of theories regard government deficit as detrimental factor to productivity, there are still many evidences proving that government debt is usable and actually can be productive. As a consequence, the best way to evaluate the effect of debt is to examine the reasons behind the accumulation of government debt. For instance, is the debt being used to invest infrastructure that will in turn crowd in private investment? Or is debt is caused by long-run economic recession? However, it is impossible to analyze debt-growth relationship into this way because there is no data provided for these trivial changes. In view of this, our analysis will not only interpret the data result but also explain the background. For example, the debt-growth relationship is in the post-war economic expansion. We try to make a comprehensive understanding of government debt and its potential effect on economic growth through the theoretical discussion and empirical analysis.

In this section, we are going to answer these following questions. Does high public debt consistently depress economic growth? Is there any systematic impact of public debt on economic growth? Whether the threshold for debt that many papers argue is meaningful and suitable to every country or not? In particular, the causality between debt and growth is still obscure. How can we precisely estimate the impact of debt from the perplexing relationships?

Chapter 1: Theory

This research starts with theoretical probe on the impact of government budget deficit on economic growth in terms of the perspectives of classical and Keynesian arguments. It tries to shed light on the current debates concerning fiscal policies and further give a theoretical support in explaining the empirical results.

1.1 The Classical and Neoclassical paradigm

The effect of public debt on economy has been a very controversial issue existing in two opposing views of the capitalist economy for two centuries. Starting from David Ricardo in 1817, classical economists consider the accumulation of debt detrimental to society's capacity to accumulate wealth (Tsoulfidis, 2007). Applying a concept like "the right hand which pays the left" described by Adam Smith, we can notice that the effect of public debt on economic development tends to be pernicious and useless in classical economics. The original theories of classical economics toward public debt were built on hypothesis of consumers' psychological expectations. For example, when a nation has accumulated loads of debt, the concern to redeem the debt will lead to increased taxation in the near future, causing the retreat of capital and devaluation of the currency with negative influence on the producers (Tsoulfidis, 2007, Smith 1937).

According to Adam Smith, "when the public expense is defrayed by funding, it is defrayed by the annual destruction of some capital which had before existed in the country". He further suggested that government borrowing is a capital transfer from productive labor towards unproductive labor (Smith, 1937). The above passage delivers two ideas. Firstly, the amount of capital transferred to government is as same as the amount of private investment that could be contributed by private sectors, that is, government borrowing will crowd out private investment. Secondly, the contribution of government spending on economic growth is not as potent as the effect of private investment or consumption.

Moreover, Ricardian equivalence also conveys the idea that government's borrowing will be internalized in people's consuming behavior. Fiscal deficit would cause consumer spending decline to cope with the future tax increase. A decrease in the

government's saving leads to offsetting increase in desired private saving, and to no change in desired national saving (Ramazan, 1992). If the theory holds in the present world, we can expect government borrowing and tax cut have no essential impact on increasing aggregate demand. Deficits and taxes are equivalent in their effects on consumption. Consequently, Barro and the new classical economists argue that taxation or borrowing leads essentially to the same final results (Barro, 1974; Tsoufidis, 2007).

We can notice that in early period classical economists believed in the negative or neutral effect of deficit on economy resulting from capital competition or resources substitution between government and private sectors.

The neoclassical economists further extend their theories to crowding-out effect caused by interest rate. Diamond (1965) examines the both effects of internal and external debts on capital market. He finds that government deficit crowds out the private capital accumulation while the debt is permanent, because government deficit, which raises the interest rate, lowers utility in the efficient case.

Further studies investigate the effects of deficit changes in the short run. Auerbach and Kotlikoff (1987) prove that deficits arising from income tax cuts of short duration crowd in saving and investment in the short run, but capital formation and private saving are crowded out in the long run. In their simulation model, 1- and 5-year tax-cut policies exhibit crowding-in effect prior to the year tax rates are increased. However, crowding-out effect occurs after taxes have been raised. Their results suggest that, firstly, short tax-cut increases capital formation temporarily and crowds out the saving and investment in the end. Secondly, "crowding out is a slow and gradual process", which means crowding-out effect appears in the long run. Thirdly, in contrast to the two shorter-term tax cuts, the 20-year tax cut leads to immediate crowding-out effect.

Furthermore, they also test effect of government deficits by government consumption increases. Their simulation findings show that crowding-out effect is larger when government consumption is permanent, not temporary. Although in the final steady state short-run crowding out effect is zero in the temporary increase government consumption model, the crowding-out effect of short-run government consumption

increase is considerably larger than the permanent one within 60 years. They explain this result by avoidance of high tax brought by the additional government consumption. People choose to have more leisure and consumption to avoid the temporary tax rise. For example, when there is 5-year temporary government consumption increase, during the first few years crowding-out of investment is almost dollar for dollar. In year 10 the capital stock is 6.3 percent lower than its initial and ultimate value. In contrast, when the increase in government spending is permanent, the year 10 capital stock is only 3.7 percent lower than initially, though it is ultimately 7.8 percent lower.

However, these simulation findings still leave some questions unsolved. For example, why the 20-year tax cut exhibits immediate crowding-out effect? The authors explain the result that people will become austere because of reduction of their future welfare. As they assert, “The short-run differences in these simulations clearly reflect the predominance of substitution over income effects in the case of the short-period tax cuts and the converse for the 20-year tax cut”.² But in such a long period, 20 years, it is absurd to say that tax contributors can forecast the future tax increase. Suppose one 20-year-old worker decide to save more just for handling 20 years later increased tax. Also, suppose a current tax contributor who benefits from the tax cut policy, she will probably increase her consumption or investment without hesitation, because after 20 years she will be retired anyway, as always being a beneficial owner.

Furthermore, concerning the budget increase in government consumption, the simulation model is based on the hypothesis that a government consumption increase occurs along with a prompt tax increase, in other words, the budget is balanced each year in this simulation. Under this condition, the result shows that crowding-out effect in the temporary rise in government consumption is considerably larger than that in permanent. Hereto, Auerbach and Kotlikoff (1987) argue that workers prefer to have more leisure or consumption than investment in order to avoid the tax hike. However, we can imagine that politicians tend to accumulate the deficit rather than actively facing the debt problem in actual practice. Consequently, the crowding-out effect in the short run may be exaggerated under this hypothesis. In my opinion, the crowding-out effect in the simulation model of permanent increase in government

² According to Auerbach and Kotlikoff (1987), “Dynamic fiscal policy” (p.91)

spending is closer to the reality, in which people cannot forecast the government's taxation policy. Moreover, it is possible that government doesn't keep the deficit balanced every year, that is, government is not in a hurry to increase tax in the short time. Hence, the crowding-out effect should be milder in the real world than the results of simulation models.

To sum up, Neo-classical economists believe that a permanent increase in debt accumulation depresses capital accumulation. A continuing deficit accumulation causes crowding-out effect and harm economic prospect in the long run. They partly admit that temporary deficits might have positive impact on the whole economy by increasing consumption.

1.2 The Keynesian and New Keynesian paradigm

Compared with Classical economists, Keynesian economics supporters tend to keep neutral attitudes toward public debt. The sudden decline of aggregate demand in recession can be revived with the use of tax cut or overspend of budget. Hence, Keynesians adopt actively expansionary fiscal policies that permit the appearance of unbalanced government budgets. Moreover, the additional expense from the government is believed to drive the aggregate spending by a multiple of that increase, known as Keynesian multiplier. Due to myopic and liquidity constrained characteristic, short-run government budget would not influence private consumption. With regard to national saving, it was viewed as potentially disruptive to the economy and vain to social welfare development (Keynes; 1936). Basically, the philosophy of Keynesian delivers a concept that government deficit is exploitable and effective in response to economic bust.

Instead of crowding-out effect caused by the rise of interest rate, Eisner (1994; 1989) points out the government budget deficits may bring about increases in gross private domestic investment, because the consumption demand is stimulated by government borrowing. The budget deficit can be regarded as stimulator that is beneficial to increase in output, and then the greater financial wealth in turn induce an increase in demand for physical capital. The government can gain extra taxes in the future when the economy moves to a higher growth path. However, it is more suitable for describing rapidly growing countries that can endure an increased debt. Otherwise if

government spending lacks efficiency and effectiveness, the economy will soon face a new problem caused by the debt.

Thus it can be seen that allocation of public funding or the manipulation of taxation is the key point in whole story. As Eisner (1989) asserts, “budget deficit do matter and their effects, contrary to Barro’s Ricardian equivalence theorem, can be substantial.”³ If used rightly, deficit for enhancing aggregate demand leads to a higher level of private investment at any given rate of interest. The consumption is supplied from otherwise unutilized resources.

Despite the positive effect of debt on economic growth in the short run, Modigliani (2005) describes the national debt as a “gross burden” for next generation, though “the increase of debt is generally advantageous to those present at the time of the increase”.⁴ He argues that the gross burden could be offset on the condition that government expenditure could contribute to the real income of future generations such as productive public capital formation.

The earliest emphasis from Keynesians is that there is no need to balance the budget during the periods of recession. However, concerning the impact of debt in the long run, the whole story should be built in balance on average over the business cycle, in surplus during booms and in deficit during recessions. (Fischer and Easterly, 1990) Consequently, the most important intention on which the Keynesian economists insist is to mitigate the time of economic downturns and focus on short-term solution for recession rather than the impact of debt in the long run.

Consequently, New Keynesian economists’ attitudes towards deficit can be either positive or detrimental. They recognize that excessive budget deficits can lead to inflation, exchange crises, external debt crises, and high real interest rates. Hence, large public deficits pose real threats to macroeconomic stability and therefore to economic growth. (Fischer and Easterly, 1990) The useful financial stimulations are based on appropriate intensity of financial force and time.

³ According to Eisner (1989), “Budget Deficits: Rhetoric and Reality” (p.73)

⁴ According to Modigliani (2005), “Long-run implications of alternative fiscal policies and the burden of the national debt” (p.80)

1.3 The conflicts and compromises between Classical and Keynesian

Unquestionably, no single theory can correspond exactly to reality. We have found that the great difference between Keynesian and Classical is that Keynesian mainly focuses on the effects caused by temporary deficits, while the Classical concerns the effects of permanent deficits the most.

Keynesian gives priority to lightening the present economic recession, taking the initiative to solve the problem of the recession of aggregate demand. The budget deficit can exploit the “unutilized resources” and compel the economy into next growth path. Due to the high elasticity of demand for money and the perspective of open and small economy, Keynesian models predict that deficit would have little or no effect on interest rates especially in an economic recession. (Bernheim, 1989) Nevertheless, Classical economists think that the negative side effect brought by deficit is more harmful to the economy, especially in the long run. The side effects such as higher inflation and increase of interest rate lead to another burden in the economy.

As more and more studies have been developed, two opposing views toward public debt are reaching certain levels of consensus. Most of studies agree with the harm of crowding-out effect on economy in the long run and the need of financial stimulation in the desperate recession. (Fischer, 1989) Since Classical framework is short of strong predictions concerning the effects of temporary deficits, politicians have favored Keynesian solution for recession.

Through the understanding of classical economics, the most harmful ramification of high public debt is the crowding-out effect caused by higher long-term interest rates. Reduced domestic investment implies lower output and income. Less capital private sectors can be used will cause the marginal product of capital higher. Then it will reduce the average real wage and total labor income (Elmendorf and Mankiw, 1999). According to Bernheim (1989), “even the most steadfast Keynesian is willing to concede that at full employment real deficits crowd out private investment and raise the rate of inflation.”⁵ He further describes Keynesian type of policy as not being a

⁵ According to Bernheim (1989), “A neoclassical perspective on budget deficits” (p.61).

long-term solution but a stopgap measure. Also because Keynesian primarily centers on solutions of current economic downturn, its view of follow-up public debt's effect is comparatively neglectful, sometimes too optimistic and lacks systemic arguments for the debt in the long period. In particular, Keynesian economics do not have a permanent solution to the fiscal unbalance.

Although much of the discussion of budget deficit focuses on the decision of the government and the follow-up sequelae brought out by debt accumulation, the criticisms on Keynesian also neglect the importance of budget utilization. In fact, government investment can be the bellwether to promote the productivity. Many papers indicate that public capital stock actually complements private investment. If public debt is used to hold up productive public capital, an increase in debt would spur the private capital so that the aggregate influence is positive. Aschauer (1989) discovers that the non-military public capital stock has an explanatory power for productivity. Many follow-up researches reaffirm the correlation that capital for public infrastructure projects crowds in private capital (Serven, 1996; Hatano, 2010). It indirectly proves that Keynesian arguments are correct in enhancing public investment in infrastructure in recession.

Different from public consumption expenditure, public investment can stimulate private investment and then enhance the whole productivity in the long run. For instance, public investment on infrastructure such as roads, sewers, schools and water systems can spur the economic growth and also advance the life standard. The investment on health care system can raise the human capital. Consequently, it is undeniable that Keynesian view believes that government can effectively guide the economy into next growth path. In particular, public investment is expected to trigger substantial structural upgrades in industries, and its importance for future development is magnificent. For instance, government painstakingly increases investments on energy industry, deployment of Internet, and new technology for the future. It offers the legitimacy for public budget unbalance in the recession. It is believed that when the recession occurs, the economy has faced a bottleneck of development lacking of capital stimulus to drive industries. Therefore, public investment plays the role to lead the economy to the right track, even though the government has to bear the debt.

Besides, there is an essential conflict between Classical and Keynesian with regard to government spending. Inheriting the Adam Smith's thinking, the Classical model assumes that an economy has a certain fixed amount of resources by which it creates productive capacity. If government decides to intervene the market, let's say, to borrow more in particular time, a capital transfer from private sectors to public sectors will undoubtedly happen. Based on this idea, government borrowing is considered to have a negative effect on economy. The relationship between public expenditure and private capital stock is not complementary.

The last point is based on the "misuse of Keynesian economics". The implication of Keynesian economics that government debt is disposable gives a perfect excuse to shortsighted politician. Since policy makers or politician always put their first priority to GDP growth, they are likely to take pleasure in stimulating economy again and again, using the debt to nurture the temporary economic growth. At last, the short-term pleasure leads to permanent economic burden.

After the 2008 financial crisis, the sovereign default crisis seems to be a more serious problem than the initial financial crisis, making the global economy bogged down into another slump. The downturns in high-debt countries are more fearful than in others. Until now, it seems that the actual circumstances in most of countries tend to support the arguments as classical economics, that is, the impact of debt is deleterious on economy in the long run. Although it is undeniable that use of fiscal stimulus is conducive to the short-run GDP growth, we should also think if the tax cut or government borrowing have already become a habit, since actual defaults of countries seldom happen in the real world. As a consequence, policy makers might enjoy a short-term prosperity rather than pursuing long-term stability.

To sum up, the differences between Keynesian and Classical views toward deficits are not only the different horizon focuses such as short run or long run, but also different views toward government expenditure. A persistent and effective public investment can reverse the economic downturn, but long-standing ineffective government consumption can cause another conclusion.

Hence, we can conclude that there are two prerequisites for analyzing the effect of government expenditure. First, has the government overspent its budget to sustain the

country? If government has piled up the debt for a long time, it indirectly violates the Keynesian argument, which believes the economy can move to a higher growth path by exploiting “the unutilized resources”. Permanent unbalanced budget also represents no future extra taxes can be expected to cover the deficit. Secondly, whether the public expenditure is used in an effective and efficient way or not? Is it a meticulous public investment or just a stopgap public consumption? In other words, whether the amount of public fund is used successfully to improve the productivity or reform the structure of economy. If so, public investment can revive the economy as same as Keynesian economists believe.

Chapter 2: Debt-growth nexus

In view of the current debate of debt threshold, we essentially reproduce Reinhart and Rogoff's approach but with new alternative methods. We target at the debt-growth link at particular time and in individual country to test the existence of threshold.

2.1 The Reinhart and Rogoff controversy

The 2008 financial crisis was a prologue of a series of thorny problems such as the sovereign debt crises and the policy debate between austerity and anti-austerity. The impact of public debt on economic growth has come into notice by the public again. Many high-debt countries have to make a knotty decision, which comes to policy makers, "should the government adopt expansionary fiscal policy or austerity policy instead?" Is it about time to reduce budget deficits during adverse economic conditions? Reinhart and Rogoff (2010) have raised concern about increasing public debt that may retard countries' economic growth, strongly supporting the pro-austerity policies after aftermath of the financial crisis in 2008. Their empirical studies declare that economic growth is restrained while the debt levels are high. They found that when public debt approaches 90 percent of GDP, the average growth rates would drop remarkably, using data on 44 countries in the period of 200 years.

The question whether there is a threshold of debt-to-GDP ratio existed in the relationship between debt and GDP growth has attracted public attention. In particular, their finding highlights that high debt-to-GDP levels (90 percent and above) are associated with especially lower GDP growth across both advanced and emerging economies. They calculate the mean of economic growth in different levels of public debt and compare the results. However, this paper was found containing biased conclusion resulting from coding errors, selective exclusion of available data, and unconventional weighting of summary statistics in the critique paper released by Herndon, Ash and Pollin (2013). The new result shows that in advanced countries the average real GDP growth is 2.2 percent for countries reaching 90 percent of the public-debt-to-GDP ratio, not -0.1 percent as concluded by Reinhart and Rogoff. The properly analyzed data shows that the mean of growth is 4.2 percent in 0-30 percent of debt, 3.1 percent in 30-60 percent, 3.2 percent in 60-90 percent, 2.4 percent in 90-120 percent, and 1.6 percent when debt is above 120 percent. Therefore, this

finding suggests that the growth would drop relatively slow when public debt is above 90 percent of GDP, contrary to Reinhart and Rogoff's argument for the debt threshold. Apparently, Reinhart and Rogoff's result exaggerates the detrimental influence of high debt and creates a misleading policy suggestion.

Herndon, Ash and Pollin (2013) further find that the different time periods lead to different average GDP growth from examining the average GDP growth by public debt category for subsampled periods of the data. It means that the results do not have the characteristic of consistency. They indicate that the result is not robust across the full time period whereas non-linearity between the lowest debt country-years and higher-debt country-years is apparent, and that the relationship between GDP growth and public debt become weaker in more recent years relative to the earlier years of the sample.

However, there are still some questions regarding the relationship between public debt and economic growth, especially about the existence of threshold. Is the threshold really meaningful and suitable to all time periods? From the conclusion of Herndon, Ash and Pollin's paper (2013), we already know the results change by period, but the public debt category for subsampled periods of the data would omit the particularity of some particular period. For example, if we only examine the period before 1950, both public debt and GDP growth would probably show their particularities of patterns under the influence of the war.

Therefore, we are going to test the consistency of the relationship between debt and growth and to see if any exception happened. In addition, we will also find out whether the relationship is suitable for all selected countries.

2.2 Methodology and Data

We start by providing more empirical evidences to examine Reinhart and Rogoff's argument and further to suggest a more comprehensive interpretation. Consequently, we use the same data sample from Reinhart and Rogoff (2010). They provide their country historical data in spreadsheets on their website.⁶ After their paper was found

⁶ See <http://www.reinhartandrogoff.com/data/browse-by-topic/topics/9/>

with statistical mistakes, their working spreadsheet is available on the websites.⁷ The original dataset consists of 20 advanced countries in the period of 1946-2009 but is incomplete in some parts. There are some missing data in the whole dataset. The starting years of the data are different. Nine countries are observed since 1946, Belgium and Ireland from 1947, Austria from 1948, Denmark and France from 1950, Germany and Italy from 1951, Portugal from 1953, Japan from 1956, Netherland from 1957, and Greece joins the data set in 1970. In addition, there are some missing observations in period of 1959-1980 in Spain, 1973-1978 in France, and 1976-1979 in Denmark. A complete data description is provided in the **Table 1**. We principally accept the completeness of data from Reinhart and Rogoff.

In our methodology design, we adopt Reinhart and Rogoff's approach to arrange national debt into levels. The annual observations are divided into 5 groups, according to the ratio of debt to GDP during that particular year. The debt levels will be like this: years when debt/GDP ratios were below 30 percent; years when debt/GDP ratios were 30 to 60 percent; 60 to 90 percent; 90 to 120 percent; and above 120 percent. We use this approach to measure the impact of debt on economic growth.

2.3 Debt-growth nexus on the whole

Figure 1 provides a collective diagram for average debt (histogram, left axis) and average growth (line chart, right axis) of all countries in our data sample. We can roughly say the trend of average public debt decreases after World War II and starts to increase in 1974. As for average economic growth, 1974 seems also to be the turning point and 2008 is another changing point. Before 1974, average GDP growth is between 2 and 6 percent; after 1974 but before 2008, its range turns to be between 1 and 4. There seems to be a negative correlation between the trend of public debt and economic growth in terms of total average values.

2.4 Debt-growth nexus across time periods

In order to see whether there is consistency of relationship in every particular time, we arrange the data into fragments of time for 1940-1950, 1950-1959, 1960-1969,

⁷ See <http://blog.wolfram.com/2013/09/26/is-high-debt-bad-for-economic-growth/>

1970-1979, 1980-1989, 1990-1999, and 2000-2009. The data is divided into 10-years-long sub-periods, which offers a good balance between sufficient number of observation-years per sub-period and potential for detailed cross-period comparison. This allows us to examine if the relationship between debt and GDP growth changes over time and also to avoid the impact of overlapped period.

Compared with the common practice in the existing literature that analyzes data altogether, we set 10 years as a standard period of observation to avoid the disappearance of some significant results if the period is set too long and the impact of business cycle. This method is designed to examine if the relationship between debt and GDP growth changes over time and also the possible specialty of time period.

Table 2 presents the result for different time periods. The result highlights substantial heterogeneity across time periods. We can see that the result is in line with Herndon, Ash and Pollin's conclusion, which suggests that the negative correlation between debt and growth would become weaker in more recent time. But our result highlights the time difference that affects the debt-growth relationship. In general, before 1970 the debt-growth link presents a significantly negative correlation; after 1970, impact of debt on growth becomes not as clear as before. Before the turning point in 1970, the growth gaps between different levels of debt vary a lot, but the growth rates have become more dispersive after 1970. For example, it can be interpreted that the impact of debt is negligible or unobservable during 1980 to 1989, because the growth rates are very average across the levels of public debt. Still, we can assert, growth stays clearly low when public debt is higher than 120 debt-to-GDP percent.

As a consequence, we can notice that the result doesn't support the argument of debt threshold found in previous studies in terms of all time periods. Especially in recent time, countries with high debt over the "threshold" can have higher growth rates, as shown for period of 1980-1989 and 2000-2009. In all groups of time periods, countries exceeding the debt threshold of 90 percent appear only in 3 periods, which are "before 1950", "1950-1959", and "1990-1999". According to Reinhart and Rogoff's description, once the public debt is beyond the threshold, the growth rates would be "dramatically" slowdown. During 1960-1969 the threshold for debt doesn't clear exist, since the growth over 90 percent of debt-to-GDP is only slightly lower

than previous debt level. Strictly speaking, we can say debt threshold that cuts economic growth by half only exists before 1960. As for other periods, we cannot find a dramatically decrease in growth when debt is beyond 90 percent of debt-to-GDP ratio. The growth in the debt levels of 90 to 120 is even relatively high during 2000 to 2009. Hence, setting a general debt threshold for all time seems impractical.

With regard to the negative correlation, it also appears to be very erratic. The growth fluctuates across debt levels in period of 1950-1959 and 1980-1989. During 1980 - 1989, the highest average GDP growth appears at debt level 90 - 120 percent, though it is not significant. Besides, countries with higher debt have experienced a better economic performance than low-debt countries in the period of 1970 - 1979. Another observation worthy to mention is during the period of 2000 - 2009, the average GDP growth at debt levels from 30 percent to 90 percent are apparently lower than the growth at debt levels of below 30 percent and the one between 90 to 120 percent. Therefore, in addition to ineffectiveness of debt threshold, we can also conclude that the negative correlation between public debt and economic growth becomes trivial in more recent period in respect of comparison between growth and debt. The result seems to imply that the debt influence on economic growth becomes irregular and is heavily affected by other variables after 1970. [Figure 2](#) provides debt-growth relationship across time periods. The line charts represent the correlation between debt and growth and the histograms shows the occurrence of debt threshold. We can see debt thresholds shown in red color only exist in three charts and there are many exceptions in negative correlation between debt and growth.

We further provide fractional polynomial regression lines with 95 percent confidence interval for economic growth against levels of debt for different time periods. The plot, provided in [figure 3](#), can be noticed that the debt-growth relationship changes greatly over time. The inverted U-shape appears in period of before 1950, 1970-1979, and 1990-1999. However, the U-shape occurs in 1980-1989; that means contemporary economic growth slightly increases at higher debt levels. In 1950-1959, 1960-1969, and 2000-2009, the debt-growth relationship demonstrates a stable decreasing trend.

Apparently, the nexus between debt and growth differs greatly across different time

periods. Regarding this result, we think the impact of debt on economic growth is undermined by other variables at different time periods. The most likely factor is the economic circumstance, which represents the trend of economic growth. For instance, during 1950-1970 there is a so-called postwar economic boom. Global economic circumstance is relatively simple. However, 1970s is a special time that not only the total debt is lowest among all time periods but also the debt-growth nexus starts to become more erratic. It is likely when the oil crisis outbreaks in 1973, countries start to suffer from certain degree influences. Each country begins to adopt different fiscal policies to respond the economic problems and the global economic circumstance has become more complex. Hence, the link between debt and growth is dependent on not only debt levels, but also on contemporary economic circumstance.

To conclude, the result suggests that economic growth declines at very high debt level (120 percent) in the rough, but the pattern and potential threshold depend on the time period, if we choose 10 years as standard period of observation. The negative correlation in recent time is not as significant as early time, and it is very hard to conclude a fixed debt threshold for all periods. In fact, we cannot deny the possibilities of having good GDP growths in high-debt countries in special time. It suggests that the relationship between debt and GDP growth is dynamically changing in different period. The heterogeneity of time periods highlights the concern of specialty of contemporary, such as global economic shock and main economic trend.

2.5 Debt-growth nexus across countries

In Reinhart and Rogoff's study, they contend that the nonlinear response of growth to debt as debt grows towards historical boundaries is reminiscent of the debt tolerance phenomenon (Reinhart, Rogoff, and Savastano 2003). In upper part, we already know the threshold for debt and negative correlation are undependable and changeable over time. But when it comes to the link across countries, does the negative correlation still holds? Is there any meaningful debt threshold for every country?

Reinhart and Rogoff's result has suggested average GDP growth slides at 90 percent debt level, which may be an alarming threshold for all countries. However, the threshold is very likely an outcome of empirical misspecification, which clearly omits the patterns of low-debt countries. Accordingly, before we find out a general

threshold for all countries, we should focus on one thing that whether country-specific patterns influence the general relationship between debt and growth or not.

In order to see whether countries have their own specific patterns or not, we also explore the same dataset from Reinhart and Rogoff. Different from their approach used the perspective of levels of debt, the method we use is to see the relative amount of debt. This time we only focus on the pattern of individual country, not aggregate pattern of all countries. We provide descriptive analysis using a new classification method for debt and growth. We quarter each country's data by amount of debt from low to high. Therefore, every country should have 4 debt levels from the perspective of relative amount of debt. The classification divides data into 0-25 percent, 26-50 percent, 51-75 percent, and 76-100 percent according to amounts of debt. The method allows us to see if relative high debt in each country would stifle economic growth.

And we count the average GDP growth rate of each group to examine the impact of debt on GDP growth in individual country. Thus, each country has four proportional debt levels, in which there are four average GDP growth rates. For example, 64 country-year data in Australia from 1946 to 2009 will be divided into four groups according to its amount of debt. Each proportional group contains 16 country-year data. And we compare each average GDP growth to see if relatively high debt influences its GDP growth in each country.

<Australia>

Debt level	0-25%	26-50%	51-75%	76-100%	Average
Debt	8.8	18.4	35.3	95.3	39.5
Growth	2.8	3.6	4.6	3.9	3.7

Note. The debt level is according to the amount of public debt from low to high in Australia. There are 64 country-year data between 1946-2009 in Australia. Consequently, the 16 country-year data with lowest debt are assigned to 0-25 % section.

Table 3 shows debt-growth relationship of country's individual pattern. Concerning the country's form of debt-growth relationship, we can hardly argue that there is a significantly consistent trend, which can be observed in all countries. Comparison of within-country debt-growth relationships reveals nonlinearity in most of countries in

our sample. Still, we can roughly categorize the debt-growth relationships into four groups.

The first one is that growth-debt relationship follows completely negative correlation, that is, lower debt is correlated with higher growth. These countries are Austria, Germany, Belgium, Italy, and Japan. Their economic performances are negatively correlated with their amounts of debt. The second type is that countries mostly follow the negative growth-debt relationship but with few exceptions or fluctuations. Denmark, France, Netherlands, Portugal, Spain, Ireland, Sweden, and United States belong to the second type. Their patterns of debt-growth relationships still present a negative trend. The negative effect of debt on economy is evident in these countries, which belong to first and second types. Third, countries like Finland, Canada, Greece, New Zealand, and United Kingdom have a fluctuating growth-debt relationship so that there is no a fixed positive or negative correlation we can assert. The effect of debt on GDP growth seems irregular, or we can say other variables affecting the GDP growth are more powerful in these countries. As a result, we cannot argue that the effect of debt is detrimental or beneficial in these countries according to the empirical result. The last group includes only two countries, Australia and Norway, which have positive relationships between public debt and GDP growth. With only one exception in Australian debt-growth relationship, the debt-growth relationships in Norway and Australia are positive correlated. Moreover, the fourth growth rate, 3.9 percent, corresponded to 95.3 debt-to-GDP ratio is surprisingly high in Australia. However, we have to emphasize that the most of time debt in Norway and Australia are comparatively lower than other countries. Their public debt is largely observed below 40 percent of debt-to-GDP ratio. Hence, we can conjecture that the effect of debt is somehow encouraging GDP growth in low debt levels.

In contrast to the previous researches using aggregate data, this result proves that each country follows a different long-term relationship between debt and growth. We can surprisingly find some countries, which are Australia, Norway, Spain, Canada, and United Kingdom; their weakest GDP growth rates happen at their lowest levels of public debt among all debt groups. It can be explained that low public debt doesn't guarantee to have higher GDP growth in these countries.

Despite these special cases, we tend to confirm that higher public debt is harmful to

GDP growth. We conclude this argument by examining each country's debt-growth relationship rather than using the result of aggregate data. According to the result, the negative correlation between debt and growth occurs in most of countries. The negative debt-growth relationship can be clearly seen in 13 out of 20 countries, which belongs to first and second types. There are 9 countries having their lowest GDP growths in the highest debt level, and another 5 countries have their second lowest GDP growths in the highest debt level. This result again shows that data contain heterogeneity if we analyze all countries together, and also suggests the existence of negative correlation between debt and GDP growth in vast majority. As a consequence, we prove that relatively higher public debt burden is associated with lower GDP growth.

Again, we employ country-specific fractional polynomial regression lines shown in [figure 4](#) for selected countries. Inverted U-shape appears in most of countries, 11 out of 20. Finland, France, and Greece have U-shape in debt-growth relationship. For those which can not be seen U-shape or inverted U-shape, economic growth stably declines with rise of debt in Germany, Japan, and Portugal; the contrary situations happen in New Zealand and Norway. In Sweden, economic growth is not affected by relatively high debt. These differences across countries directly suggest there is no common debt-growth pattern for all countries. Each country has different tolerance toward debt due to many reasons, such as dissimilar economic structures, usages of debt and policy practices. For example, whereas debt-growth links in Belgium and Canada have much in commons such as inverted U-shapes and similar ranges of debt, the inversed U-shape is right-skewed in Belgium and left-skewed in Canada.

We further put all countries' patterns in the aggregate debt levels. [Table 4](#) shows the distribution of country's individual pattern in the debt-to-GDP levels. It implies that non-linearity of aggregate data is resulting from diverse country-specific patterns. In particular, some countries' highest public debt is only half of the highest of others. We can notice that countries vary greatly in the aggregate levels of debt. Countries that have ever achieved their national debt over 90 percent of GDP are Australia, Belgium, Canada, Greece, Ireland, Italy, Japan, New Zealand, United Kingdom, and United States in our sample. Public debts in another countries are below 90 percent of GDP. That can explain why lots of previous studies conclude the threshold for public debt would occur at 90-100 percent of GDP, because it only reflects the patterns of

high-debt countries and neglects the change of debt-growth relationship of low-debt countries. In fact, previous studies analyzed pooled data neglect the effect of debt in low-debt countries. As we can see, the negative correlation between debt and growth is still clear in low-debt countries like Austria, Germany, Portugal and Spain, which government debt are mainly lower than 60 percent of GDP. Increasing government deficit is still a ball and chain around the neck of economic growth in these low-debt countries, which have never achieved the 90 percent threshold. For instance, the GDP growth is very low in its highest debt group in Germany, but the average debt is just 34.3 percent of GDP ratio, which is not even over 40 percent. In addition, if only based on each debt-growth relationship in high-debt countries, we still cannot conclude 90 percent debt-to-GDP ratio is a meaningful threshold. The wave crests of inversed U-shape often appear before and after the 90 percent threshold. For instance, regarding the debt-growth relationships of Japan, Belgium and Italy, their wave crests occurs at very low debt levels, meaning that GDP would decline much earlier than the 90 percent threshold. Hence, how can we say 90 percent threshold is a constructive reference for these high-debt countries?

As a consequence, we can conclude that setting the debt threshold for all countries is too superficial. It overlooks the impact of debt on economic growth in low-debt countries and cannot prove its reference value effectively to high-debt countries. Apparently, the threshold derived from either econometric techniques or Reinhart and Rogoff's approach might be the outcome of empirical convergence of high-debt countries, not for all countries. Our finding provides an opinion. That is, the impact of debt can be seen through two ways: relative or absolute perspective. Current papers that try to find an overall threshold for every country are using the perspective of absolute amount of debt, attempting to find out if the absolute high debt level influences economic growth. In our approach, instead, we find higher debt is associated with lower GDP growth from the perspective of relative amount of debt. It shows the negative growth-debt relationship exists within countries and proves that low-debt countries are also negatively affected by high debt under the "threshold" that previous paper found.

Our descriptive analysis thus suggests that since the shape and form of the debt-growth relationship differs across countries, there is no meaningful common threshold for all countries. Although current papers suggest 90 percent is a threshold

beyond which economic growth would significantly decline, we argue that investigating each country's debt-growth pattern is more important than setting an overall threshold for debt in terms of policy advices. According to our empirical result, we can hardly notice any country follow the 90 percent threshold. Due to the complexities of countries' economic patterns, the impact of debt on economy in different country is supposed to be different. Moreover, the impact of debt on economy rests with many potential factors such as country's industrial competitiveness, debt composition, usage of government deficit, financial stability, and economic circumstance. For instance, countries follow strict austerity policies may cause their economic growths decline in very low debt level. In contrary, countries that embrace expansionary fiscal policies possibly postpone their credit crisis until they start to face the burden dragging down their future economic development.

To conclude, our findings suggest two important conclusions: (1) To set a debt threshold across countries is not meaningful. The 90 percent threshold for debt is likely to be the outcome of empirical misspecification. Countries' GDP growths shrink at different debt levels, since their public debt ratios vary greatly. Reinhart and Rogoff's method using average values across all countries and time periods leads to a vague conclusion that is insufficient to be a strong support for austerity. (2) Country's debt-growth relationship has its uniqueness. There is no common pattern that can explain each country's debt-growth nexus. But, the negative correlation between public debt and GDP growth holds in most countries, if we examine them from perspective of relative high debt. Positive correlation between debt and growth occurs in Norway and New Zealand. It proves that high debt is essentially negative correlated with low economic growth.

Chapter 3: Regression analysis

In chapter 2, we extend Reinhart and Rogoff's study (2010) and further prove that the debt-growth relationships are changing according to different time periods and different countries. Nevertheless, the result cannot suggest a precise effect of debt in growth entirely, since we don't consider other determinants of growth. In view of this, we turn to analyze the effect of debt in growth model.

3.1 Existing results

A strand of literature used neoclassical growth model of Solow to estimate the relationship between debt and economic growth. The basic estimation equation is as follows:

$$\text{GROWTH}_{i,t+k} = \alpha + \beta \ln(\text{GDP/cap})_{it} + \gamma \text{DEBT}_{it} + \delta X_{it} + \theta_i + \eta_t + \varepsilon_{i,t} \quad (1)$$

In equation (1), the growth rate of GDP per capita of country i over period $k = 1, 3$ or 5 is regressed on the ratio of public debt/GDP, the initial level of GDP per capita, a set of independent variables X , country-specific dummies θ , and time-specific dummies η . In most of literature, they adopt 3-year or 5-year average of GDP per capita growth rate to omit the potential effect of business cycle fluctuations.

However, debt-growth relationships are estimated differently in current papers.

Imbs and Rancier's results are mostly insignificant in the satisfactory models (Imbs, Rancier, 2005). For those that have significant results, there is a main difference that occurs at the question whether the debt-growth relationship is positive at low debt levels. Some studies find that there is a debt threshold, which differentiates two different debt-growth relationships. That is, there is a positive correlation between debt and growth until the debt is beyond the threshold. They find out the debt-growth relationship presents inverted-U in most models. (Caner, Grennes, Geib, 2010; Checherita, Rother, 2012; Baum, Checherita, Rother, 2013). Another strand of papers suggest that the negative correlation between debt and growth would become significant beyond the threshold. (Kumar, Woo, 2010; Cecchetti Monhanty, Zampolli, 2011) In general, most of literature confirms that excessive high debt is associated with slow GDP growth and the negative correlation would become more serious when debt is beyond the threshold.

With the use of equation (1), Ceccetti, Mohanty and Zampolli (2011) find that a 10 percent increase in the debt/GDP ratio is associated with 0.17 to 0.18 percent reductions in subsequent average annual growth. When concerning the threshold, which they find around 84 percent of GDP, their finding indicates that further 10-percentage point increase in the ratio of public debt to GDP depresses the growth around 0.1- 0.15 percent. Their data includes 18 OECD countries over the period 1980 - 2006. (Ceccetti, Mohanty and Zampolli, 2012)

Kumar and Woo also reaches a similar result, showing that a 10-percentage point increase in the initial debt-to-GDP ratio is associated with a slowdown in annual real per capita GDP growth of 0.2 percentage points per year. Their dataset contains a panel of 38 advanced and emerging economies from 1970 to 2007. (Kumar and Woo, 2010)

Another paper published by Checherita and Rother also estimates equation (1) across 12 European countries over a long period of time starting in 1970, confirming the non-linear impact of public debt on per-capita GDP growth rate. However, their finding suggests the relationship between public debt and economic growth is inverted U-shape with the debt turning point at about 90-100 percent of GDP. It means that public debt is associated with higher growth below the 90-100 percent turning point. (Checherita and Rother, 2012) They explain this result by assuming that the government deficits were used to support productive public investment, but they also admit that the debt increase of the past decades are related to higher public consumption and transfer expenditure. A study researching developing countries by Patilli et al. (2004), contends that doubling the debt ratio would diminish GDP growth by between 0.5 and 1 percent.

3.2 Methodology and data

From our extension of Reinhart and Rogoff's study (2010), we know that the debt-growth link changes across different time sections, and the negative correlation becomes very weak in more recent time. It is possible that the effect of debt on GDP growth is offset by other variables or has become trivial nowadays due to some unknown reasons. In light of this, in order to estimate the effect of debt more precise in recent years, our time section for the model is relatively short for the period

1995-2012. Using the relatively short time periods is to mitigating the issue of heterogeneity of different periods and focus on the debt-growth relationship in more recent time.

The empirical specification is derived from the neoclassical growth model of Solow. The GDP growth is dependent on the level of physical and human capital. Our analysis focuses on the effect of debt level on GDP growth. We adopt non-overlapping 3-year forward growth as our observation. Our data are from World Bank's World Development indicators. The main analysis is based on a panel of 20 advanced countries, namely, Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, New Zealand, Portugal, Spain, Sweden, United Kingdom, and United States.

Before we move on the regression analysis, we firstly examine the debt-growth nexus alone. **Figure 5** provides a scatter plot of government debt and subsequent GDP growth (3-years average). It illustrates the simple negative correlation between government debt and GDP growth. As we can notice, the negative correlation is not very clear according to the scatter plot. In the simple OLS regression, 10 percent increase in public debt is associated with a slowdown in subsequent growth around 0.1 percent annually.

As for the development of estimated model, we consult the approach design by Kumar and Woo. They argue that the regression model should focus on a core set of explanatory variables that have been shown to be consistently associated with output growth. Therefore, we follow the core set of growth determinants provided by Doppelhofer et al. (2004). We will consider pooled OLS and fixed effect panel regression.

The basic estimation equation is as follows:

$$\text{Growth}_{it+k} = \alpha + \beta \ln(\text{GDP/cap})_{it} + \gamma \text{Debt}_{it} + \iota \text{Trade}_{it} + \kappa \text{Human}_{it} + \lambda \text{inflation}_{it} + \nu \text{Pop.aging}_{it} + \upsilon \text{Capital growth}_{it} + \phi \text{banking crisis}_{it} + \theta_i + \eta_t + \varepsilon_{i,t}$$

Where growth_{it+k} = the growth rate of GDP per capita, $k=3$ (3-year cumulative non-overlapping growth rate) In addition to gross government debt that we want to see, the log of per capital GDP is a proxy for physical capital (logarithm of the level

of GDP per capita). Other control variables that we use in the estimating model include:

- Population growth; (growth rate of total population)
- Trade openness; (sum of exports and imports)
- Human capital; (labor force with secondary education)
- Inflation rate; (Annual rate of change in GDP deflator)
- Total dependency ratio; (population aging)
- Capital formation growth; (growth rate of gross capital formation)
- Banking crisis (banking crisis incidence).

3.3 Empirical result:

The main results are provided in [Table 5](#). The coefficients of government debt are negative and significant at the 1 percent level in first and third columns. Nevertheless, when we add the country-specific fixed effect, though the coefficients are still negative, they become insignificant. The pooled OLS model in first column suggests that a 10 percentage points of debt/GDP increase is associated with decrease in subsequent GDP growth about 0.11 percent. After we consider time-specific effect, the effect of government debt becomes slightly larger, as shown in the third column. This result is very similar to the conclusions from Cechetti et al. (2011) and Kumar and Woo (2010).

Unfortunately, what we concern the most is the result in the fourth column. The coefficient of government debt is negative but insignificant, while we add both country-specific and time specific effects. The fixed effect on government debt is particularly sensitive to if country-specific effects are included or not in the regression. As a consequence, we cannot confidently argue the debt is negatively correlated with growth in selected countries during 1995-2009. According to our discussion in chapter 2, we know the negative debt-growth relationship has become more vague in more recent time. It is possible that in this period that the effect of debt on economic growth is somehow trivial. Concerning other explanatory variables, per capita GDP, trade openness, capital formation and banking crisis are mostly significant at 1 percent level in the fourth column. The coefficients of other variables are roughly consistent with theory. The rises of education and trade openness have a positive impact on growth. Moreover, the changes in population and dependency ratio bring a

negative impact on growth. According to our regression result, it shows an inverse relationship between public debt and succeeding growth. It estimates a 10 percent points increase in government debt is associated with 0.13 percent points decline in annual GDP growth during 1995-2009.

Chapter 4: Causation

4.1 Correlation or causation

Through the above discussion, the negative correlation between budget deficit and GDP growth has been confirmed theoretically or empirically. Whether simple statistical interpretation or advanced econometrics analysis, the current studies find a non-linear impact of debt on growth and beyond certain level the government deficits starts to stifle the growth. In chapter 2, we have proved that the non-linear relationship occurs within most of countries' debt-growth relationship (inverted U-shape) and the aggregate debt-growth relationship for all countries was caused by overlapped data of both low and high-debt countries. The existence of debt limit only reflects the effect of debt in high-debt countries and neglects effect of time difference. Still, the negative correlation between debt and growth exists in most of countries. As a result, a permanent and relatively high government deficit is truly associated with weak economic growth without a doubt in most of countries.

However, though the empirical results are backed up by many theories, correlation does not imply causation. The negative correlation between high debt ratios and weak GDP growth can be explained in another plausible arguments. During a recession, the government budget automatically goes into a deficit and debt ratio rises. The negative correlation will be certainly appeared but the causation runs from slow growth to high debt (Nersisyan and Wray, 2013). Therefore, a permanent low productivity can make the public debt keep climbing. The current financial crisis is a very good example of this link. Under the effect of global economic recession, countries' debts have been soaring into higher levels. Hence, the result of effect of debt on economic growth is likely to be exaggerated and inaccurate. Until now, economists still fail to precisely prove the causation running from debt to growth. The casual effect of public debt on economic growth is still undetermined (Panizza, Presbitero, 2012). In particular, many outlier cases and inconsistent countries' patterns make people query the debt-growth causation. For instance, Greek average GDP growth is up to 4.3 from 2000 to 2007, but its government debt is also very high around 105 percent of GDP. In the meantime, the average GDP of Austria is only 2.3 with 57 percent of debt/GDP ratio.

In fact, none of studies have convincingly proven the debt's causal effect on GDP growth. Many previous studies omit this factor that would cause their results biased. We cannot deny that the economic growth simultaneously influence the change of debt. Especially in recession, a shock of demand side would prompt the debt rise rapidly, since the tax revenue shrinks and government increases spending. While in economic boom, government has surplus and has less public spending. Consequently, if the causation is reverse, it implies that there is no necessary to adopt austerity in the recession. Whether to adopt an austerity in a recession is very controversial. That is where the current debate comes in. The debt-growth causation is actually very important for policy implication.

The direction of causality has been discussed in previous strands of literature. Many studies find supporting evidence that causality runs from debt to growth, showing a negative and notable impact of debt on growth (Chowdhurt, 2001; Patilli et al., 2004). Nevertheless, Easterly (2001) argues that the causality runs in the opposite direction, since the growth slowdown causes the debt crisis of the middle-income countries in the 1980s and the crisis of Highly Indebted Poor Countries in 1980s and 1990s. As a consequence, both causalities may be right and exist concurrently. Ferreira (2008) argues that the causality is always bi-directional between the GDP growth and public debt. It represents not only public debt restrain economic growth but also GDP growth affects the evolution of public debt.

Accordingly, before we predict the debt-growth link, we should consider the reverse causation that runs from slow growth to debt. When it comes to the effect of growth on debt, it is based on the argument that public debt is driven by the economic growth. In other words, the annual change of public debt is influenced by the economic growth. Regarding this, the annual change of government debt-to-GDP ratio has been proven that it is highly statistically significant and negatively associated with the economic growth rate (Cristina, Rother, 2010). In general conditions, the negative correlation between economic growth and change of public debt is straightforward to see. For example, the recession can bring a shock on both respects of receipt and expenditure, since government has to face a temporary disequilibrium of balance of payments. In financial revenue respect, there is a sharp shrink of tax revenue because many bankrupt companies or money-losing business cannot pay the tax or pay less tax. Also, low consumer confidence also depresses public revenue. In financial

expenditure respect, government would be passively and actively overspending its budget. The unemployment subsidy for unemployed workers and bailout funds for companies would cause government increase a large amount of deficit. At the same time, economic stimulus policy would also exasperate government finance. As a consequence, economic growth essentially has an impact on evolution of government debt in the short-run.

4.2 Simulation model of causation

In view of complex situations in the real world, we create an analogue model to simulate the possible causations between debt and growth. We admit that the causation between debt and growth is dynamic and two-way so that we shall not exclude the causation, which runs from growth to debt. We suppose that the two types of causations both simultaneously exist in debt-growth relationship. For simplicity, we use the perspective of absolute amount of debt.

In the simulation model, we firstly consider the economic effect on change of debt. Imagine there is one country with 0 national debt in the beginning. Unfortunately, it has a long-run problem with its productivity. Let us suppose that its GDP growth is minus 1 every year, and because of the low GDP outcome its debt has increased 5 percent of debt/GDP ratio every year. The circumstance has persisted for 10 years. If we don't consider the effect of debt on GDP growth, the increase of debt is only driven by the low economic growth, as shown in [Figure 6](#).

Subsequently, we add the impact of debt on economic growth in the simulation model. We suppose that when government debt increases by 5 percent of GDP, the economic growth would drop 0.5 percent per year. We assume debt effect is linear in the simulation model. The relationship is shown as [Figure 7](#).

After considering the effect of debt, the weaker economic growth simultaneously speeds up the rise of debt in turn. However, it is impossible that the interaction would continue in the real world, because all movements led by the causations are to happen simultaneously so that both debt and growth rates are shown their value in the equilibrium.

The simulation model shows the essential difference of two effects. The effect of debt on economic growth is conditional, which means when the government achieve certain levels of debt, the economic growth may start to be stifled. However, the effect of economic growth on debt is immediate and at any time. Whether GDP is weak or strong, its influence promptly changes the national debt.

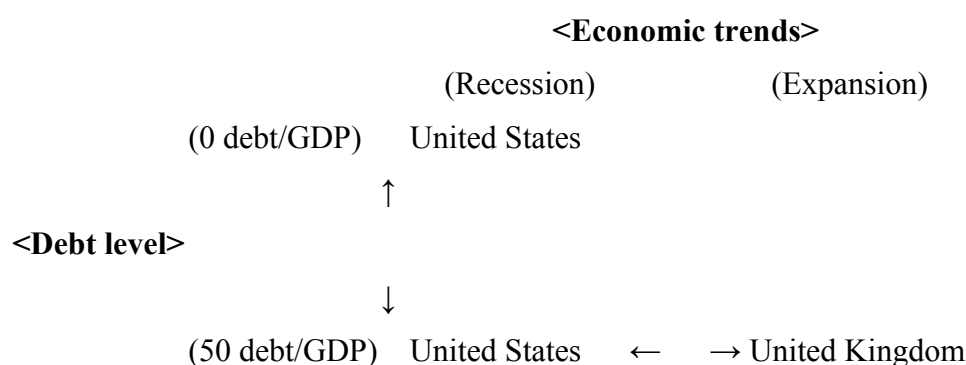
4.3 Estimation Strategy

In order to accurately predict the effect of debt on growth, we design a new approach to consider the short-run impact of growth. We suppose the relationship between debt and growth is dynamic and two-way, that is, they are interactively affecting each other and changing over time. We also assume that the every change of debt is reversely driven by annual economic growth. Hence, every drop or rise of national debt will be regarded as economic negative or positive impact on debt. The approach allows us to consider the effect of economic growth on debt first, and then to see how levels of debt affect economic growth.

The design of methodology is to control the effect of economic growth on debt, and then compare the results by levels of debt. We categorize all data into two types by the trend of debt, upward trend and downward trend. The upward trend of debt means that government debt is growing, and the downward trend of debt represents government debt is declining. This classification method allows us to see whether economic growth has the impact on the trend of debt or not. Moreover, after considering the economic effect, we use the levels of debt to see if the impact of debt still exists.

Take one example to make it more clear, we suppose United States has 0 debt at the beginning. However, in next 5 years, the economic growth has been unsatisfactory. Therefore, its debt has risen to 50 percent of GDP simultaneously. It is the causation running from economic growth to debt. Then, suppose United States has the same problem of productivity in another next 5 years. But, this time its debt starts from 50 percent of GDP. If the debt has effect on economic growth, its expected growth would be worse than before, because this time the debt level is higher than the previous one. Higher debt is supposed to make its economic growth weaker. Hence, the gap between two growths is reflecting the effect of debt on GDP growth. The story is not

over yet. Suppose another country, United Kingdom, also has 50 percent debt/GDP ratio. Contrary to United States, it has been experiencing a period of economic expansion. Hence, at the same level of debt, the difference between U.S. and U.K. growths show the effect of economic trends. The relationships between levels of debt and economic trends are shown in the relational figure below.



Hence, every country has two groups of data. The difference of two groups is that the rising debt is reflecting the effect of low GDP growth and the decreasing debt is showing the effect of high GDP growth. This is our assumption of the approach. Ultimately, the levels of debt will be put as a standard. We calculate each average growth rate and compare the results to see the difference of economic growths.

4.4 Case study- the United States

Before we explore the aggregate data, we firstly analyze single country for testing our rightness of our approach. Figure 8 shows the trend of debt in United States during 1946 to 2009. The red dots are GDP growths per year. The upward trend of debt is marked in black and the downward trend of debt is marked as green. In all 64 country-year data, 29 data are upward and 35 data are downward. We can see that U.S. government debt mainly decreases before 1973 and increases in next 15 years. Afterwards, it decreases in next 6 years and goes up until the end.

We can notice that there are 17 growths in the debt levels from 40 percent to 60 percent, 9 dots belonging to the decline of debt and 8 dots representing the rise of debt. Although they are in the same level of debt, their growth rates are 3.26 and 2.75 respectively, differing from each other greatly. This result is consistent with our hypothesis, which supposes lower GDP growth may cause higher debt and higher

GDP growth may drive lower debt. It proves that causation running from economic growth to debt exists in the debt-growth relationship.

The annual change of public debt of United States is shown in figure 9. In the whole period, the decreases of debt are larger than increases of debt as a whole. The debt-reduction after war is noteworthy. The government debt has steadily declined for over 25 years from 1946 to early 1970s. It can be connected with the post-war economic expansion, which is also called the Golden Age of Capitalism. During this period the global economy had experienced a superior economic development. The post-war economic expansion had continued until the 1973 oil crisis happened. The shock of oil price made a great impact on the global economy, and also announced the end of Golden Age of Capitalism. Therefore, the U.S. national debt had increased for 3 years and fluctuated afterwards. From 1981, the U.S. finance started to deteriorate significantly. The rise of national debt is attributed to the “early 1980s recession” that begun in July 1981 causing a severe economic slump not only in United States but also in other OECD countries. The aftereffect engenders many follow-up economic problems such as “savings and loan crisis” in United States and debt crisis in Latin America.

Table 6 shows the result of cross analysis in United States. The vertical shows the effect of debt and the horizontal shows the effect of economic growth. Many previous studies suggest the debt-growth relationship is non-linearity and the GDP growth starts to be negatively affected around 90 percent of GDP. But, when we divide the data by the trend of economy, we can find there is a significant difference between two groups. At the same time, the difference between two groups proves that the economic growth is active to affect the debt. It means causation running from economic growth to debt also plays very important role in the relationship.

According to the result, it empirically suggests that in United States lower GDP growth is associated with higher debt during a recession and GDP growth can be expected stronger with higher debt during an economic boom. The result tells that during the time when economic growth is feeble, economic growth would become weaker with higher levels of debt. On the other hand, when in period of economic boom, debt-growth correlation is positive until it is beyond 100 percent of debt/GDP ratio. In other words, because every increasing change of debt implies a negative

effect of growth on debt, economic growth is relatively weak at particular time. Thus, having taken the effect of economic recession into account, we can see levels of debt influence the growth rates. On the other hand, the result of decreasing debt shows that when there is an economic resurgence, GDP growth is expected to be stronger in higher levels of debt in United States. If the GDP is upward growing, higher national debt seems to lead to higher GDP growth.

This result comes to be seen very absurd at first glance, but if we see the U.S. economic trend in detail; we can find that most of periods of decreasing debt occur in the post-war expansion. It seems that powerful GDP growth would not be affected by high debt in the post-war economic boom, or the powerful GDP growth covers the potential influence of high government debt.

Obviously, the result is not very convincing and academically meaningful to make a conclusion because of data insufficiency and uniqueness if we observe one country alone.

4.5 Result after considering causation

We move to analyze the aggregate data in order to see whether higher debt would depress GDP growth, after we consider the factor of impact of economic trend. In [table 7](#), the effect of debt on GDP growth is shown in the vertical axis; it is as same as the method we used in upper discussion. The horizontal axis is to distinguish between the effects of different economic trends. As we suppose, every drop or rise of debt is considered as positive or negative effect of economic growth. Therefore, the left column shows the results that have considered the effect of weak economic growth across the levels of debt. And the middle column presents the results that have taken the strong economic growth into account across the levels of debt. Result of using total data is shown in the right column. Before we start to analyze, we should notice that we are using the perspective of absolute high debt. It doesn't suggest a general rule fitted to every country. Instead, we use it to see if there is a prevailing difference of growth-debt relationships under effects of different economic trends in selected countries.

Our finding suggests 2 things. First, under the positive effect of economic growth, the

link between growth and debt seems relatively weak below 90 percent debt levels, and negative effect of debt starts at public debt over 90 percent of GDP. It implies that while country is in economic upturn, government debt would not be a serious obstacle in economic development. High-debt countries in a process of declining debt can still have good economic performance. In contrast, during an economic bust, the growth rates affected by debt in a more regular way are consistently decreasing. It can also be explained that high-debt country is more likely to have a serious economic recession. But when in economic upturn, high-debt country would not be affected until its national debt beyond 90 percent of GDP.

It proves a very important argument. In previous literature, many Keynesian economists brought a force question, which asserts, “Is the negative correlation misinterpreted in a wrong direction of causation?” Our finding shows no matter how GDP growth affects debt to increase or decrease at particular time; aggregate debt levels always influence the average expected GDP growth in the long run. During a same economic recession, country with lower debt still has a better GDP growth than country with higher debt. The GDP growth will still be stifled by public debt in an economic takeoff if the debt is too high.

Second, the gap between two groups demonstrates the result under different effects of economic trends at the same debt levels. As can be seen that with the rise of debt the negative effect of debt would become greater in economic recession than in economic boom. When government’s debt is below 30 percent of GDP, the gap between two growths is 1.29. But when government’s debt increases between 60 to 90 percent of GDP, the gap is widened into 2.39. At the same levels of debt, the impact of debt on GDP growth should be at least similar, but the gap significantly widens with the rise of debt. Although we know in the range of low debt levels the result may be influenced by situation of overlapped countries, the widened gap between two groups still implies that the impact of debt is trivial during economic boom.

Figure 10 illustrates how causations work in the debt-growth relationship. Since previous studies do not take the short-term effects of economic trends into account, this approach is designed to control the short-run effect of economic growth on the change of debt, which is the causation we concern, and then calculate the impact of debt on economic growth. Its main purpose is to prove whether high debt would

influence economic growth or not. The results provide an opportunity to re-examine the effect of debt on economic growth after we have considered the effect of economic growth. Generally, the results show that whether economic recession or economic boom, government debt has negative effect on GDP growth. And the negative impact of debt is more consistent and general in recession than in economic upturn.

The results offer a possible explanation for actual situation. We always wonder why high-debt countries can also have superb economic growths sometime and this circumstance is not rare. Which simply means, countries with higher debt are not destined to have a lower GDP growth. For instance, countries with high debt can have a very prosperous economic growth in the postwar economic boom. Our results exactly provide a reasonable answer for it. If the causation running from economic growth to debt occurs in advance, the relationship between debt and growth presents two different modes. According to our empirical result, while one country's economy is in the process of rise, even if its public debt is over 120 percent of GDP, its average expected GDP growth still could be 2.2 percent GDP growth. It is because when country's economy presents a trend of upturn, country's economic growth would not be affected by debt significantly. In other words, after having considered the impact of positive GDP growth on debt, we find that debt is not as harmful as normal.

In order to simplify the multiple impacts of different time periods, we examine the relationship between debt and growth only in the post-war economic boom. **Table 8** shows average economic growths by difference of economic trends across levels of debt in the period of postwar economic expansion from 1946 to 1969. In this period, most of countries had experienced a period of economic prosperity in most of the time. As we can notice, in the group of economic upturn, countries economic growth rates stayed above 5 percent until 90 percent of debt/GDP ratio. Over 90 percent of debt/GDP ratio, impact of high debt starts to appear in the average GDP growth. It illustrates that government debt below 90 percent of GDP wouldn't clearly stifle the economic growth in an economic upturn, according to the empirical outcome.

Even for those which debt higher than 90 percent of GDP, their economic growths still have brilliant performances, though they still decrease under the impact of debt, proving that the impact of debt still exists. In debt levels between 90 and 120, the

GDP growths are still larger than 3. However, during the post-war economic expansion, there are still some countries experiencing economic stagnation at some particular time. Their growth patterns affected by debt are totally different from the group of economic downturn. It is obvious that growths are significantly affected by high debt.

As a consequence, we can compare high public debt as a light yoke that slightly limits the economic growth in economic boom but a heavy burden that bogs down the economic growth into an even worsen degree in economic bust. To apply this conclusion in real world, it can explain why high-debt countries often encounter dire slumps in recession. In addition, it also explains why we seldom see serious problems occurring in high-debt countries during economic upsurge.

Summing up, our empirical result suggests a brand-new conclusion. We agree that the causation is bi-directional in link between economic growth and debt. Despite the fact that economic growth affects debt evolution, we confirm that the high debt indeed restrains economic growth. After considered the causation running from growth to debt, the debt-growth relationships presents two different types. In the bi-directional causation between debt and growth, the causation running from growth to debt firstly happens and is decisive. While country is during a recession at particular time, its level of debt significantly and negatively affects its economic growth rate. But, during an increasing economy, the impact of debt is not as harmful as the other. We cannot even see a significant reduction in GDP growth when debt is below 90 percent of debt/GDP ratio. Consequently, as long as country's economy keeps growing or productivity is flourishing, government debt would not be a big problem deteriorating economic condition. However, when country's economy starts to become lack of power or is influenced by a global recession, debt would be a very important variable, which degrades the GDP growth.

Still, we have to admit the circumstance that during an economic recession the growth consistently decreases was not significant in more recent time. **Table 9** exhibits the growth-debt relationships during 1980 – 2009. The growth in a recession starts to decline notably over 120 percent of debt/GDP, but another growth met the threshold at 90 percent of debt/GDP during an economic boom. Again, different cross-sectional time period influence the debt-growth nexus a lot. Nonetheless, it is still clear that

economic growth is less affected by the debt. As long as country is in an economic upturn, its GDP growth would not be so poor.

Part 2: The channels through which debt affects the economy.

We have used many different approaches to prove that public debt retards economic growth both theoretically and empirically in previous chapters. We illustrate the potential threats of high debt to economic growth from the theoretical discussion. Although the dispute of short-run government deficits' effect between Keynesian and Classical is still in suspense, most of researches tend to agree that government budget deficit is a burden on economic development in terms of long-run impact. The empirical result confirms that high public debt truly fetters the potential of growth to a certain degree and worsens the economic recession. Whether from absolute or relative perspective of amount of debt, high government deficit always has substantial impact on economic development. However, we don't find any evidence for general debt thresholds within countries over time. In view of this, there is no immediate effect of debt would occur at certain debt level. In other words, the impact of debt on economy is chronic and highly dependent on countries' respective patterns.

Accordingly, based on the conclusion of first part, we are going to find the possible channels that the negative impact is through. We start with qualitative analysis of effects of public debt and focus on the economic consequences of government budget deficits. According to different debt-growth nexuses across countries and over time, what are the possible mechanisms happening from debt to growth?

Chapter 5: Private investment contraction

5.1 Debt-investment nexus

From the literature review, we can notice that most arguments are surrounding around the relationship between budget deficit and private investment. The focus is put on the debt's influence on private capital formation and productivity. Whether views are from Classical or Keynesian economics, private capital formation is always the central issue that needs to be addressed. According to Classical economics, government deficits caused by tax cut or over expenditure would bring a shock on private capital formation. Permanent increase in the ratio of debt to national income reduce the interest sensitivity of savings and larger increases in interest rates are required to equilibrate capital markets (Ramazan, 1992). Modigliani (1986) describes the public debt is an intergenerational burden that leads to a smaller stock of capital for future generations. Although Ricardian equivalence gives another possibility that government deficit has no impact on the whole national savings, many theoretical objections and empirical evidences prove it doesn't hold in real practice. Keynesian economists also concern the effect of higher interest rates induced by government borrowing on private investment.⁸ (Keynes, 1936)

Pattilo et al. find that doubling debt in a high debt environment would decrease GDP per capita by 1 percent, two thirds of which would arise from an effect via total factor productivity and one thirds via capital accumulation per capita. (Pattillo, Poirson, Ricci, 2004)

5.2 Importance of private investment

In addition to the direct influence on annual economic growth, private investment has a strong explanatory power of weak productivity in the long run. If private investment is depressed, smaller domestic capital stock can be used in the market. Less capital

⁸ In "The General Theory" Keynes describes, "If, for example, a government employs 100,000 additional men on public works, and if the multiplier is 4, it is not safe to assume that aggregate employment will increase by 400,000. For the new policy may have adverse reactions on investment in other directions... The method of financing the policy and the increased working cash, required by the increased employment and the associated rise of prices, may have the effect of increasing the rate of interest and so retarding investment in other direction."

available results in the higher marginal product of capital so that it raises the interest rate and the return earned by each unit of capital. Hence, lower labor productivity deteriorates the wage and labor income in the end. (Elmendorf, Mankiw, 1999)

In another way to see the importance of private investment in economy, private investment plays the essential role to promote the productivity in very basic idea of economics. Government deficit might limit the endogenous growth. Contrary to consumption, investment is the use of fund that provides people the return and long-term benefits. More investments on machinery, plants, and buildings guarantee more future output. It enlarges the production base and further increases production capacity, allowing the upgrades of production and increasing value added in products or services. Moreover, “technology” has been regarded as an important factor to influence long-term productivity. A real upgrade of productivity is from seeking the breakthrough of science and technology. If we compare technology development to a moving train, the investment would be the fuel. Private capital formation is the key variable to trigger industrial revolutions that plays the important role in improving people’s living standard. Accordingly, as long as high public debt incurs a contraction of private capital formation, we can expect a limit of productivity would happen in the long run.

5.3 Methodology and data

To prove high debt weakens private investment, we examine the country’s GDP composition determined by expenditure approach in order to see whether private investment would be changed as government debt is high or not. Our data are from the database of Organization for Economic Co-operation and Development (OECD). The time period is during the span of 1988 to 2012, since most of the data are only estimating values before 1988. Similar to the approach used in previous chapter, we arrange the data according to debt/GDP ratio and calculate the average of private investment of the data underneath the 25 percentile and of the data above 75 percentile. The first group consists of country-year observations with low debt and the other represents observations where the debt is high.

5.4 The change of private investment in GDP compositions

Our finding provided in [table 10](#) suggests that when country has higher debt, its GDP has less contribution from private investment. We can explain that GDP would be overly dependent on private consumption and government expenditure while national debt is climbing. It seems that private investment is very sensitive to the amount of debt. In particular, most of private investment is transferred into private consumption or government expenditure. With regard of this, we should consider two possibilities in the change of GDP composition during period of high debt. It is possible that private investment actively shrinks, or government expenditure and private consumption are increasing. Still, we can argue that the ratio of private investment in GDP significantly declines with increase of public debt.

5.5 Comparison between impacts of debt and economic growth

However, it is possible that the result is misinterpreted. The decline of private investment in the share of GDP may be because of weak GDP growth, which normally happens with high debt. We may mistakenly regard the effect of low GDP growth on private investment as the impact of high debt. In view of this, we use the same approach but with economic growth this time. We arrange the data according to economic growth from low to high and calculate the average of private investment of the data underneath the 25 percentile and of the data above 75 percentile, and then compare the result with the previous one under the effect of debt afterwards.

The result is shown in [table 11](#). Most of cases show that both effects of debt and economic growth on private investment are directional consistent. That is, low economic growth and high debt depress private investment. Nevertheless, the comparison between impacts of debt and GDP growth clearly delivers a circumstance, that is, private investment is more affected by national debt than GDP growth. Normally, the gap of private investment with economic growth is “between” the gap of private investment with debt. Apparently, in most of countries, gaps of private investment between higher and lower debt are generally larger than those between higher and lower economic growth. It means the impact of debt on private investment is greater than impact of growth. In other words, private investment will be depressed more under the effect of high debt than the impact of slow GDP growth. Take Finland for example, the private investment in high national debt is expected to be only 17.8 as share of GDP. But, the private investment/GDP during period of low GDP growth

is 20.2 percent, which is much higher than 17.8. It explains that the shrink of private investment is directly affected by public debt rather than economic growth. Furthermore, it also implies that the channel of debt's effect, which is running from debt to private investment and then has an impact on economic growth.

Chapter 6: Mechanisms in debt-growth relationship

According to our result in chapter 2, we can know that debt-growth relationships are not similar in terms of different time periods and different countries. Furthermore, we prove the initial economic circumstance (course of debt) is very important to explain the effect of debt in chapter 4. High-debt countries with decreasing debt can still have strong GDP growth. Matched with contemporary economic circumstance, decreasing debt normally implies that it is heavily under the effect of economic upturn. In light of this, we are going to find the possible reasons that explain the debt-growth relationship in different situations.

6.1 Crowding-out effect

To answer why debt accumulation is a drag on economic growth, most of papers attribute it to the crowding-out effect that reduces investment spending affected by higher interest rates under an expansionary financial policy. The rise of interest rate at particular time is the side effect after government starts to overspend. Keynes admits that higher interest rates may cause crowding-out effect in “The General Theory”. He specifies, “If, for example, a government employs 100,000 additional men on public works, and if the multiplier is 4, it is not safe to assume that aggregate employment will increase by 400,000. For the new policy may have adverse reactions on investment in other directions. The method of financing the policy and the increased working cash, required by the increased employment and the associated rise of prices, may have the effect of increasing the rate of interest and so retarding investment in other directions, unless the monetary authority takes steps to the contrary.” (Keynes, 1936) In IS-LM model, when government adopts expansionary fiscal policy that increases public spending, the IS curve will move to the right, causing higher output and higher real interest rates. Hence, crowding out happens while expansionary fiscal policy causes real interest rates to rise, thereby decreasing private investment. With regard to the rise of real interest rates, Dornbusch and Fischer (1993) assert, “as government spending increases, the excess demand for goods leads firms to increase output, and that increase in output and income raises the demand for money. The resulting excess demand for money, in turn, causes interest rates to be bid up”.⁹ They

⁹ According to Dornbusch and Fischer (1993), “Macroeconomics” the 6 edition (p.131).

further indicate that if firms cannot increase output in fully employed economies, the crowding-out effect is possible to occur. With respect to the relationship between public debt and interest rates, Lacubach (2003) estimates that a one percentage point increase in the projected debt-to-GDP ratio is associated with roughly 25 basis points rise in long-term interest rates. Baldacci and Kumar (2010) confirm a permanent government deficits can stifle private capital accumulation and economic growth via higher long-term interest rates.

However, it is arguable that the crowding out caused by higher interest rates would occur in recession, when government often tends to have budget deficits. Tyson (2012) argues that crowding in is more possible to happen in economic recession. She illustrates “when there is considerable excess capacity, an increase in government borrowing to finance an increase in the deficit does not lead to higher interest rates and does not crowd out private investment.”¹⁰ Instead, government overspend or tax cut can increase additional demand that increases output. More saving can be created to stimulate private investment (Tyson, 2012). In an economic downturn, because resource cannot be effectively allocated, capital competition is not as acute as in booming time. Hence, the crowding-in effect is more likely to occur in unemployed economies. Nevertheless, it is not consistent with the empirical result suggesting that debt is more harmful in economic bust than in economic boom. If the crowding out is only effective in economic boom, it fails to explain why high debt depresses economic growth in the economic bust. Furthermore, expansionary monetary policy can offset change of interest rate. Government can choose to print money to move LM curve to the right at same time, causing the interest rate stable.

Moreover, one thing we have to notice is the crowding out caused by higher interest seems only explaining short-term circumstance of government overspend rather than impact of public debt on economic growth in the long run. In other words, it only indirect implies the possibility of debt’s impact in the long run, not clearly explains why higher levels of debt lead to low economic growth. It cannot completely explain the impact of debt on economic growth. For instance, it fails to explain why low economic growth happens when national debt stays high but unchanged. We suppose

¹⁰ According to Tyson (2012), “Confusion about the deficit” [Online] Available at: http://economix.blogs.nytimes.com/2012/06/01/confusion-about-the-deficit/?_php=true&_type=blogs&_r=0

there are two countries, A and B. During 5 years, both of their national debts haven't changed but A country's debt is 0 percent and B country's debt is 100 percent of GDP. The difference of economic growth cannot be explained by the crowding-out effect because there is no change of government budget deficit. Apparently, it hardly explains the debt-growth nexus in the equilibrium.

5 years	5 years
A country (0 debt → 0 debt)	B country (100 debt → 100 debt)
<No crowding-out effect>	<No crowding-out effect>

The possible explanation is that since high public debt is accumulated over time, the shrink of private capital causing scarcity of kinetic energy of productivity finally leads to low economic performance. During the period while crowding-out effect occurs, the debt accumulation degenerates the essential productivity. But the explanation still lacks for practical evidence and a bit far-fetched.

Consequently, crowding out induced by higher interest rate is not a good interpretive mode that can fully explain the reduction of private investment under the impact of high public debt. It is a side effect of government borrowing that brings chronic adverse impact on economic growth.

6.2 Reduced national saving

The relationship between public debt and national saving is also discussed in previous studies. Whether private investment would be affected by reduced national saving is our focus. We adopt the approach proposed by Elmendorf and Mankiw (1998) to demonstrate the impact of debt on national saving and then on private investment.

We set the private sector's model in terms of expenditure:

$$Y = C + S + T$$

Where:

Y = national income,

C = private consumption,

S = private saving,

T = taxes.

Since national income can be represented by national output, we can also describe the

national output by expenditure method.

$$Y = C + I + G + (X-M)$$

Where:

I = investment,

G = government spending of goods and services,

X = exports of goods and services,

M = imports of goods and services,

NX = X-M = net exports of goods and services.

After combining these two equations, we can find that sum of private and public saving equals to aggregate investment and net exports.

$$S + (T - G) = I + NX$$

Then, if we consider net export as a flow of fund, which can be represented by net foreign investment. Hence, the final equation can be written,

$$S + (T - G) = I + NFI$$

Where:

NFI denotes international flows of funds.

According to the equation, we can know if government decides to reduce taxation or to increase its' spending, it will reduce the government saving and create budget deficits so that influence the whole national saving. When government saving is decreasing, its impact on private saving is related to the final change of national saving. However, it is concerned with another debate arguing how private sectors react with government's budget constraint.

If Ricardian Equivalence holds, private saving rises by the same amount as government saving falls; no further adjustments will happen in the national aggregate saving. Government budget deficits would have neutral effect on investment. (Gale and Orszag, 2004; Barro, 1974)

Nonetheless, the conventional view thinks that private saving will rise by less than public saving falls. Reduced government saving causes the whole national saving decline. According to the equation, reduced national saving negatively affects private investment and foreign capital flow. In addition to reduced domestic investment, downgrade of foreign investment also influences the overseas revenues. Furthermore, it indirectly implies that net export would be demoralized due to less foreign

investment. That is the so-called “twin deficits”. (Elmendorf, Mankiw, 1999) As a consequence, high-debt countries would be gradually deficient in capital formation, which leads to a lower output in the future.

Through the deduction, the casual impact of government budget deficits on private capital stock rests with whether Ricardian equivalence holds or not. If so, government budget deficits doesn't adjust the whole national saving so that private investment would not be choked. If Ricardian equivalence doesn't hold, we confirm the possibility that high public debt retards private capital formation, which in turn implies lower output. Gale and Orszag's (2004) empirical study confirms the effect of debt on national saving, suggesting that each percent of GDP in current deficits would reduce national saving by 0.5 to 0.8 percent of GDP.

6.3 Debt overhang theory

Whether crowding out induced by higher interests or reduced national saving that is dependent on Ricardian equivalence, we can find that they put their main attentions on what changes would the short-term government budget deficits cause on economic circumstance. It can be noticed that these arguments are using the perspective of relative amount of debt, investigating what influences will be created by an additional government borrowing. They fail to explain why GDP would drop dramatically after certain debt level in some countries. As for the absolute excessive amount of debt, they are lacking a convincing explanation.

To answer why absolutely excessive public debt, for example, over 120 percent of debt/GDP ratios, is very detrimental to economic growth, debt overhang theory is a more plausible explanation. The argument of debt overhang is concerning the external debt. As Krugman (1988) describes, when high-debt country is unable to discharge its obligation out of current income, the creditors can choose to finance the country in the hope that the country will be able to repay its debt over the long haul, or to sacrifice themselves from reducing the debt level to one that the country can repay. Practical evidences tell us that it is more likely creditors expect a financing bailout rather than a forgiveness. Once country receives the temporary financial help from the creditors, the burden of excessive debt would distort country's incentives, since the benefits of good performance go largely to creditors rather than itself (Krugman, 1988). The

distorted financial incentives will cause country's interests become creditors-oriented so that repels the potential investment. Hence, if a country has kept too much government debt that is larger than the country's repayment ability, expected debt-service costs will discourage further domestic and foreign investment.

In addition to the reduced private investment, we think the influence of debt overhang on economic growth could be more overall and direct. First, it brings out a shock on supply side. Since productive activities might be dispirited by taxation of creditors, private sectors would probably choose to work less to offset their loss in paying the taxation. Second, the "distorted incentive" of country would bring a huge influence on country's economic structure. If the country's interest is creditors-oriented, its financial policy will incline toward short-term benefits rather than long-term benefits. The creditors can sway the country's financial policy that may not seek a long-term solution but a stopgap measure. In aspect of finance, policy makers tend to reduce public expenditure rather than creating extra revenue. For instance, in order to repay the creditors as soon as possible, government may choose to lay people off or lessen the public investment for productive infrastructure. It will not only create a greater shock on consumption and investment but also incur a lot of potential social costs. Evidences can be seen after 2008 financial crisis, the austerity policy seeks to get a speedy financial stability, causing unemployment rates rocket and many severe protests in some high-debt European countries.

Nevertheless, there is also a debt-growth relationship presents a consistent decline curve starting at very low levels of debt in some countries such as Germany and Italy. Debt overhang theory can hardly explain the debt-growth nexus until the default really happens. In other words, though debt overhang is very successful in clarifying how an excessive debt drags down a defaulting country, it cannot explain the pattern under the breaking point of government deficits. Additionally, country with high internal debt like Japan cannot be explained by debt overhang theory. The potential risk of distorted incentive would not happen in Japan.

6.4 Decline of government effectiveness:

Some economists argue the decline of government effectiveness at high levels of debt causes lower economic growth. Although this factor is hard to quantify, it is still a

very important factor that determines the debt-growth relationship. Different from the debt overhang theory that creditors intervene fiscal policy, the decline of government effectiveness is endogenous factor deriving from policymakers worry less about the whether the government spending is most economical offer. According to Wicksell (1896), he interprets this circumstance from a perspective of political economy. He thinks policymakers would have the “inertia” of debt accumulation to ingratiate the voters. When the interest induced by debt becomes a heavy burden on government revenue, policymakers might borrow more and neglect the potential threat of debt accumulation (As cited in Elmendorf and Mankiw, 1998).

If we extend the philosophy of Classical economics to evaluate the impact of high debt, permanent increase in the ratio of debt to national income can be an alarm of government inefficiency. It seems an issue concerning the causality: does high debt cause government effectiveness slump or government inability leads to higher debt. Apparently, both arguments support that higher debt is associated with lower economic growth. Monetarists generally assert government spending financed by either taxing or borrowing from the public is mainly a resource transfer from the private sector to the government, with little net effect on total spending. As a consequence, if government grasps most of resources in one country, we can bravely assume its economic growth would be depressed to certain level, since the competitiveness and productiveness between public and private sectors are not comparable. Previous paper attributes the negative impact of debt to myopic policymakers that alter the political process to determine fiscal policy (Elmendorf and Mankiw, 1998). However, we argue that negative impact of high government deficit is induced by excessive unproductive government expenditure.

In line with the reasons explaining why state-owned corporation are usually less competitive, government has the congenital defect in arranging its capital. Although government can stimulate economy by tax cut or spending more, it still exploits the limited resource in the market and then utilizes the resource in a less productive way. This argument somehow mistrusts what Keynesian believes. Many Keynesian supporters may suggest, “The government should pay people to dig holes in the ground and then fill them up.” They emphasize that government can be a leader to trigger the demand in the market. Nevertheless, this argument is also evidence proving that resource is used in less productive way by public sector. Obviously,

public sector is less competitive than private sector. If government cannot keep exploiting its resource in productive investment such as infrastructure, the more it borrow means the less corporations can use.

On the other hand, most of people expect their government should be a “big government” that can maximize the social welfare as good as possible. Compared with individual who simply pursue his or her maximization of profit, government is more like a role, who plays half regulator and half manager, trying to get a balance between profitable and unprofitable activities, which are beneficial to the whole social system. Examples include unemployment subsidy or retirement pay. In the name of pursuing maximization of welfare of whole country, government operates many non-profitable and inefficient investments and activities to sustain the whole country. For example, some health care systems are famous for their inefficiency like capital black hole in many advanced countries. Many countries invest a lot but the results are very disappointing. If this circumstance continues, not only private investment but also productive public investment would be crowded out by the financial black hole.

Furthermore, in current political system the allocation of government budget seems to be a conclusion of multiple political wrestling. Similar debate is also aroused in recent economic crisis. Whether permanent public debt would depress the transfer expenditure? Whether high-debt country would have essential problems in resource allocation or tax system?

It can explain why high-debt countries have been criticized nowadays. People criticize the government is short of efficiency and providence. Too much cost of unproductive activities drag down the economic competitiveness. Over the centuries, government has been thought as an artificially inefficient organism that spend its money in less productive way, though government has kept evolving to be more productive in modern history such as transformation from dictatorship to democracy. Still, cost of bureaucracy and wrong policies stays high in the world. It causes huge waste and valueless investment. More extreme examples are shown in military investment and disused public properties. When government is unable to effectively invest its resource on constructive way, it virtually stifles the potential economic growth.

Concluding Remarks:

This paper principally has two parts. In part 1, we discuss the debt-growth relationship from different perspectives. Our analysis suggests: 1) There is no common debt threshold can be observed in selected countries. Actually, the debt threshold and debt-growth relationship are different across countries and over time. In particular, the negative correlation between debt and growth has become insignificant in more recent time according to econometrics analysis. 2) Higher public debt is associated with slow GDP growth. This negative correlation happens in most of selected countries. 3) Differentiating the causation between debt and growth is a crucial thing to understand the precise impact of debt on economic growth. High-debt countries in an economic boom can achieve a good economic performance. In part 2, we prove that the private investment is very sensitive to high debt that is in line with the Classical economics thinking. We also investigate the potential mechanisms running from high debt to low GDP growth. The analysis of mechanisms tends to support our argument, which contends no common threshold can be applied in all countries, since there is no mechanisms can fully explain that economic growth would drop dramatically at certain level of debt unless countries at high debt levels are simultaneously in the economic downturn.

We further suggest that impact of debt on economic growth is highly dependent on other factors such as influence of global economic trends, different usages of debt, and country's own competitiveness. Countries not only have different endurances of government debt but also have different mechanisms in their forms of debt-growth relationship. As a consequence, there is no reason to adopt a general standard for policy suggestion. In general, our paper confirms the negative impact of debt on growth, but it is not as serious and fateful as what previous papers argued. It implies that current austerity needs more exhaustive considerations.

Reference:

Auerbach, A. J., & Kotlikoff, L. J. (1987). *Dynamic fiscal policy* (Vol. 11). Cambridge: Cambridge University Press.

Aschauer, D. A. (1989). Is public expenditure productive?. *Journal of monetary economics*, 23(2), 177-200.

Ash, M., Herndon T., and Pollin, R., (2013). 'Does High Public Debt Consistently Stifle Economic Growth? A Critique of Reinhart and Rogoff.' Working Paper Series 332, University of Massachusetts Amherst.

Barro R., (1974) "Are Government Bonds Net Wealth?", *Journal of Political Economy*, 82(6), pp. 1095-1117.

Barro, R. J. (1989). The Ricardian approach to budget deficits. *The Journal of Economic Perspectives*, Vol. 3, No.2, 37-54.

Bernheim, B. D. (1989). A neoclassical perspective on budget deficits. *Journal of Economic Perspectives*, 3(2), 55-72.

Caner, M., Grennes, T., & Koehler-Geib, F. (2010). *Finding the Tipping Point: When Sovereign Debt Turns Bad*. World Bank.

Cecchetti, S., Mohanty, M., & Zampolli, F. (2011). Achieving growth amid fiscal imbalances: the real effects of debt. In *Economic Symposium Conference Proceedings*. Federal Reserve Bank of Kansas City (pp. 145-196).

Checherita, Cristina and Philipp Rother. 2010. The impact of high and growing government debt on economic growth: an empirical investigation for the euro area. Working Paper Series 1237 European Central Bank.

Chowdhury, A. (2001, August). Foreign debt and growth in developing countries: a sensitivity and causality analysis using panel data. In *WIDER Conference on Debt Relief*, Helsinki (pp. 17-18).

Diamond, P. (1965), "National Debt in a Neoclassical Growth Model", *American Economic Review*, 55 (5), p. 1126-1150.

Doppelhofer, G., Miller, R. I., & Sala-i-Martin, X. (2000). Determinants of long-term growth: A Bayesian averaging of classical estimates (BACE) approach (No. w7750). National bureau of economic research.

Dornbusch, R. & Fischer, S. *Macroeconomics* (1993) sixth edition. McGraw-Hill College, Blacklick, Ohio, U.S.A.

Easterly, W. R. (2001). Growth implosions and debt explosions: do growth slowdowns cause public debt crises?. *Contributions in Macroeconomics*, 1(1).

Eisner Robert, (1989) "Budget Deficits: Rhetoric and Reality" *TJOEP*, Vol. 3, N. 2 Spring. pp. 73-95.

Eisner, R. (1994). National saving and budget deficits. *The Review of Economics and Statistics*, 181-186.

Elmendorf, D. W., & Gregory Mankiw, N. (1999). Government debt. *Handbook of macroeconomics*, 1, 1615-1669.

Ferreira, M. C. (2009). Public debt and economic growth: a Granger causality panel data approach. *DE Working Papers* No. 24-2009/DE/UECE.

Fischer, S., & Easterly, W. (1990). The economics of the government budget constraint. *The World Bank Research Observer*, 5(2), 127-142.

Gale, W. G., & Orszag, P. R. (2004). Budget deficits, national saving, and interest rates. *Brookings Papers on Economic Activity*, 2004(2), 101-210.

Hatano, T. (2010). Crowding-in Effect of Public Investment on Private Investment. *Ministry of Finance of Japan Public Policy Review*, 6.

Imbs, J., & Ranciere, R. (2005). The overhang hangover. Economics Working Papers 878, Department of Economics and Business, Universitat Pompeu Fabra.

Keynes, J. M. (1936). General theory of employment, interest and money. DE Moggridge (Ed.), 7.

Krugman, Paul. 1988. "Financing vs. forgiving a debt overhang." Journal of Development Economics 29(3):253–268.

Kumar, M. S., & Baldacci, E. (2010). Fiscal deficits, public debt, and sovereign bond yields. International Monetary Fund.

Laubach, T. (2009). New evidence on the interest rate effects of budget deficits and debt. Journal of the European Economic Association, 7(4), 858-885.

Modigliani, F. (2005). Long-run implications of alternative fiscal policies and the burden of the national debt. The collected papers of Franco Modigliani, 6, 79-106.

Nersisyan, Y., & Wray, L. R. (2013). 'Does Excessive Sovereign Debt Really Hurt Growth? A Critique of 'This Time is Different'', by Reinhart and Rogoff. A Critique of 'This Time is Different', by Reinhart and Rogoff (June 21, 2010). The Levy Economics Institute Working Paper, (603).

Panizza, U., & Presbitero, A. F. (2012). Public debt and economic growth: is there a causal effect?. POLIS working papers, 168.

Panizza, U., & Presbitero, A. F. (2013). Public debt and economic growth in advanced economies: A survey. Swiss Journal of Economics and Statistics, 149(2), 175-204.

Pattillo, C. A., Poirson, H., & Ricci, L. A. (2004). What are the channels through which external debt affects growth?. International Monetary Fund.

Ramazan TAŞ, "Theoretical and Empirical Aspects of Budget Deficits", Ankara Üniversitesi SBF Dergisi , 327-341 pp., 1992.

Reinhart, C. M. and Rogoff, K. S. (2010a). 'Growth in a Time of Debt.' American Economic Review: Papers & Proceedings, 100.

Reinhart, C. M. and Rogoff, K. S. (2010b). 'Growth in a Time of Debt.' Working Paper 15639, National Bureau of Economic Research.

Reinhart, C. M., Rogoff, K. S., and Savastano, M. A. (2003). Debt Intolerance. Brookings Papers on Economic Activity, 34(1):1-74.

Serven, L. (1996). Does Public Capital Crowd-out Private Capital?: Evidence from India (No. 1613). World Bank Publications.

Smith, A. (1937). The wealth of nations (1776). New York: Modern Library, 740.

Tsoufidis, L. (2007). Classical economists and public debt. International Review of Economics, 54(1), 1-12.

Laura D'Andrea Tyson (2012). Confusion About the Deficit. [ONLINE] Available at: http://economix.blogs.nytimes.com/2012/06/01/confusion-about-the-deficit/?_php=true&_type=blogs&_r=0.

Wicksell, K. (1896) A new principle of just taxation, in Richard A. Musgrave and Alan T. Peacock, eds., Classics in the Theory of Public Finance, London: MacMillan Press (1956).

Woo, J., & Kumar, M. S. (2010). Public debt and growth. International Monetary Fund.

Appendix

Tables:

Table 1: 20 advanced countries over 1946-2009.

Country	Coverage of data	Country-Years
Australia	1946-2009	64
Austria	1948-2009	62
Belgium	1947-2009	63
Canada	1946-2009	64
Denmark	1950-1975; 1980-2009	56
Finland	1946-2009	64
France	1950-1972; 1979-2009	54
Germany	1951-2009	59
Greece	1970-2009	40
Ireland	1947-2009	63
Italy	1951-2009	59
Japan	1956-2009	54
Netherland	1957-2009	53
New Zealand	1946-2009	64
Norway	1946-2009	64
Portugal	1950-2009	58
Spain	1946-1958; 1981-2009	42
Sweden	1946-2009	64
United of Kingdom	1946-2009	64
United of States	1946-2009	64

Note. There are some missing data in the original dataset. The problem of data gaps was fully discussed in the paper, “Does high public debt consistently stifle economic growth? A critique of Reinhart and Rogoff”, published by Ash, Herndon and Pollin. (2013)

Source: Data sample is from Reinhart and Rogoff.

Table 2: Real GDP growth by public debt/GDP category, 10-year periods

Period	Public debt/GDP category				
	Below 30	30to60	60to90	90to120	Above120
Before 1950	7.4	6.7	6.5	3.2	1.9
1950-1959	5.2	3.8	4.1	2.3	2.5
1960-1969	5.6	4.9	4.0	3.7	/
1970-1979	3.9	3.5	4.3	/	/
1980-1989	2.4	2.5	2.4	2.6	/
1990-1999	2.6	3.0	3.0	2.0	/
2000-2009	2.7	1.9	1.3	2.2	0.5

Notes. Table 2 shows the debt-growth nexus across different periods. The symbol, “/”, represents there is no observation in that time section.

Source: Author’s calculations from working spreadsheet of Reinhart and Rogoff (2010a and 2010b).

Table 3:

Average real GDP growth by country's debt in quarters, each country

		Quarters of data				
		0-25%	25-50%	50-75%	75-100%	Average
Australia	Debt	8.8	18.4	35.3	95.3	39.5
	Growth	2.8	3.6	4.6	3.9	3.7
Austria	Debt	10.7	16.2	40.4	57.6	31.1
	Growth	5.3	4.8	4.6	2.0	4.2
Denmark	Debt	7.0	28.7	50.7	70.0	39.1
	Growth	3.5	2.7	1.9	2.6	2.7
Finland	Debt	8.0	13.9	23.2	52.4	39.1
	Growth	3.7	4.4	2.3	3.9	2.7
France	Debt	15.8	27.0	47.9	63.5	38.5
	Growth	5.7	3.7	2.8	2.9	3.8
Germany	Debt	7.2	10.9	20.0	34.3	17.8
	Growth	5.3	4.5	2.3	1.0	3.3
Netherland	Debt	21.1	34.6	45.5	56.6	40.0
	Growth	3.4	3.3	2.4	3.0	3.0
Norway	Debt	18.9	23.9	27.0	37.9	26.9
	Growth	2.7	3.7	3.8	5.2	3.8
Portugal	Debt	10.3	15.9	23.0	55.6	26.4
	Growth	4.1	6.1	3.1	2.8	4.0
Spain	Debt	24.0	35.9	42.0	53.8	38.9
	Growth	2.6	4.3	3.9	2.8	3.2
Belgium	Debt	47.8	66.4	88.7	110.1	78.4
	Growth	4.0	3.3	2.9	2.6	3.2
Canada	Debt	33.9	45.5	56	86.0	55.4
	Growth	2.7	4.4	3.3	4.2	3.7
Greece	Debt	20.1	43.4	99.6	107.9	67.7
	Growth	5.4	0.8	1.6	3.9	2.9
Ireland	Debt	28.8	57.9	73.8	93.3	64.0
	Growth	4.1	4.6	4.0	3.0	3.9
Italy	Debt	18.0	30.2	70.2	94.8	53.9
	Growth	5.3	4.8	2.2	0.8	3.3

Japan	Debt	7.3	22.5	54.4	134.2	54.0
	Growth	9.0	4.9	3.5	0.5	4.4
New Zealand	Debt	28.5	46.3	58.7	86.2	54.9
	Growth	2.8	2.9	2.2	4.4	3.1
Sweden	Debt	22.5	32.7	45.0	65.8	41.5
	Growth	3.7	2.8	3.3	2.5	3.1
United Kingdom	Debt	39.1	44.5	69.7	159.8	78.3
	Growth	1.9	2.4	2.7	2.2	2.3
United States	Debt	34.4	48.4	61.2	80.1	56.0
	Growth	2.8	4.5	2.6	2.2	3.0

Notes. All selected countries' data are quartered into four parts according to their low-to-high public debt. The corresponding average GDP growth is shown under the column of debt. The approach is designed to see whether higher debt is associated with slow GDP growth in individual country pattern.

Source: Author's calculations from working spreadsheet of Reinhart and Rogoff (2010a and 2010b).

Table 4:

Real GDP growth by public debt/GDP category, each country

Public debt/GDP category

Country	Category	Below 30 percent	30 to 60 percent	60 to 90 percent	90 to 120 percent	Above 120 percent
Australia	Growth (Debt)	2.8(8.8), 3.6(18.4)	4.6(35.3),		3.9(95.3)	
Austria	Growth (Debt)	5.3(10.7) 4.8(16.2)	4.6(40.4) 2.0(57.6)			
Denmark	Growth (Debt)	3.5(7.0) 2.7(28.7)	1.9(50.7)	2.6(70.0)		
Finland	Growth (Debt)	3.7(8.0) 4.4(13.9) 2.3(23.2)	3.9(52.4)			
France	Growth (Debt)	5.7(15.8) 3.7(27.0)	2.8(47.9)	2.9(63.5)		
Germany	Growth (Debt)	5.3(7.2) 4.5(10.9) 2.3(20.0)	1.0(34.3)			
Netherland	Growth (Debt)	3.4(21.1)	3.3(34.6) 2.4(45.5) 3.0(56.6)			
Norway	Growth (Debt)	2.7(18.9) 3.7(23.9) 3.8(27.0)	5.2(37.9)			
Portugal	Growth (Debt)	4.1(10.3) 6.1(15.9) 3.1(23.0)	2.8(55.6)			
Spain	Growth (Debt)	2.6(24.0)	4.3(35.9) 3.9(42.0) 2.8(53.8)			
Belgium	Growth (Debt)		4.0(47.8)	3.3(66.4) 2.9(88.7)	2.6(110.1)	

Canada	Growth (Debt)		2.7(33.9) 4.4(45.5) 3.3(56.0)	4.2(86.0)		
Greece	Growth (Debt)	5.4(20.1)	0.8(43.4)		1.6(99.6) 3.9(107.9)	
Ireland	Growth (Debt)	4.1(28.8)	4.6(57.9)	4.0(73.8)	3.0(93.3)	
Italy	Growth (Debt)	5.3 (18.0)	4.8(30.2)	2.2(70.2)	0.8(94.8)	
Japan	Growth (Debt)	9.0(7.3) 4.9(22.5)	3.5(54.4)			0.5(134.2)
New Zealand	Growth (Debt)	2.8(28.5)	2.9(46.3) 2.2(58.7)	4.4(86.2)		
Sweden	Growth (Debt)	3.7(22.5)	2.8(32.7) 3.3(45.0)	2.5(65.8)		
United Kingdom	Growth (Debt)		1.9(39.1) 2.4(44.5)	2.7(69.7)		2.2(159.8)
United States	Growth (Debt)		2.8(34.4) 4.5(48.4)	2.6(61.2) 2.2(80.1)		

Notes. Table 4 shows the countries' individual debt-growth patterns in the levels of debt.

Source: Author's calculations from working spreadsheet of Reinhart and Rogoff (2010a and 2010b).

Table 5: Panel regression: relationship between government debt and GDP growth, 1995-2009 (Cumulative 3-year non-overlapping growth rate)

Explanatory Variables	(1) Pooled OLS	(2) Fixed Effect	(3) Pooled OLS	(4) Fixed Effect
Government debt	-.011*** .004	-.004 .008	-.013*** .003	-.005 .006
Per capita GDP	-2.174*** .542	-11.83*** 1.285	-1.36*** 0.4	-7.97*** 1.96
Population growth	.162 .230	-.449 .287	.516*** .169	-.228 .226
Trade openness	.023*** .006	.080*** .023	.023*** .005	.129*** .021
Level of human capital	.017 .011*	.057* .024	.014** .008	.028 .019
Inflation rate	-.006 .049	-.041 .045	.044 .037	.009 .035
Total dependency ratio	.035 .038	-.141** .071	.041 .027	-.126** .056
Capital formation growth	.093*** .012	.081*** .01	.102*** .013	.094*** .011
Banking crisis	-1.796*** .284	-1.48*** .249	-.456 .284	-.708*** .261
R2	0.44	0.63	0.74	0.80
Time-fixed effect	No	No	Yes	Yes

Note. The dependent variable is the GDP growth rate (cumulative 3-year non-overlapping). The explanatory variables are public debt, per capita GDP, population growth, trade openness, education levels, inflation rate, total dependency ratio, capital formation growth, and banking crisis. Countries included in the analysis: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, United Kingdom, and United States. Levels of significance: *** 1 percent, ** 5 percent, * 10 percent.

Source: Author's own compilation

Table 6: Case study – United States. (1946-2009)

Real GDP growth by debt/GDP categories (vertical axis) and by courses of debt (horizontal axis).

Levels of debt	Difference of debt trends		
	Increasing debt (Recession)	Decreasing debt (Boom)	Total
0-20	/	/	/
20-40	2.75	3.26	3.06
40-60	2.66	4.40	3.67
60-80	2.19	4.75	3.29
80-100	-1.62	6.57	2.47
100-	/	*-5.92	-5.92

Note. The first column shows the country-years are in the increasing course of debt (we assume they are in the economic upturn). The second column shows the country-years are in the decreasing course of debt (we assume they are in the economic downturn). The third column illustrates the total result by debt/GDP categories. * Only one observation over 100 percent of GDP. Source: Author's calculations from working spreadsheet of Reinhart and Rogoff (2010a and 2010b).

Table 7: All selected countries. (1946-2009)

Real GDP growth by debt/GDP categories (vertical axis) and by courses of debt (horizontal axis).

Levels of debt	Increasing debt (Recession)	Decreasing debt (Boom)	Total
0-30	3.46	4.75	4.17
30-60	2.11	4.00	3.09
60-90	1.92	4.31	3.19
90-120	1.38	3.14	2.41
120-	0.37	2.22	1.56

Note. The first column shows the country-years are in the increasing course of debt. The second column shows the country-years are in the decreasing course of debt. The third column illustrates the total result by debt/GDP categories.

Source: Author's calculations from working spreadsheet of Reinhart and Rogoff (2010a and 2010b).

Table 8: All selected countries. (1946-1969)

Real GDP growth by debt/GDP categories (vertical axis) and by courses of debt (horizontal axis).

Levels of debt	Increasing debt (Recession)	Decreasing debt (Boom)
0-30	5.30	5.78
30-60	2.67	5.44
60-90	1.46	5.08
90-120	-4.07	3.95
120-150	*2.17	3.09
150-180	/	2.27
180-	/	0.35

Note. The first column shows the country-years are in the increasing course of debt. The second column shows the country-years are in the decreasing course of debt. The third column illustrates the total result by debt/GDP categories. * Only one observation between 120 and 150 percent of GDP.

Source: Author's calculations from working spreadsheet of Reinhart and Rogoff (2010a and 2010b).

Table 9: All selected countries. (1980-2009)

Real GDP growth by debt/GDP categories (vertical axis) and by courses of debt (horizontal axis).

Levels of debt	Increasing debt (Recession)	Decreasing debt (Boom)	Total
0-30	1.81	3.30	2.67
30-60	1.91	3.22	2.40
60-90	1.90	3.21	2.46
90-120	1.88	2.58	2.12
120-	0.20	2.34	0.41

Note. The first column shows the country-years are in the increasing course of debt. The second column shows the country-years are in the decreasing course of debt. The third column illustrates the total result by debt/GDP categories.

Source: Author's calculations from working spreadsheet of Reinhart and Rogoff (2010a and 2010b).

Table 10: The changes of GDP compositions determined by expenditure approach and by levels of debt.

Australia	Private investment	Consumption	Government expenditure	Net export
Low debt	27.6%	56.9%	17.3%	-2.1%
High debt	24.7%	57.4%	18.0%	-0.8%

Austria	Private investment	Consumption	Government expenditure	Net export
Low debt	23.7%	55.9%	18.8%	0.6%
High debt	22.0%	55.2%	19.6%	2.1%

Belgium	Private investment	Consumption	Government expenditure	Net export
Low debt	20.9%	51.7%	22.9%	3.2%
High debt	20.7%	54.8%	21.0%	2.8%

Italy	Private investment	Consumption	Government expenditure	Net export
Low debt	21.7%	58.0%	19.7%	0.2%
High debt	18.9%	59.6%	19.4%	1.6%

France	Private investment	Consumption	Government expenditure	Net export
Low debt	19.8%	57.5%	22.4%	-0.1%
High debt	19.9%	57.6%	24.3%	-2.0%

Canada	Private investment	Consumption	Government expenditure	Net export
Low debt	23.0%	54.3%	20.1%	1.9%
High debt	19.5%	56.7%	21.5%	2.0%

Denmark	Private investment	Consumption	Government expenditure	Net export
Low debt	19.8%	48.5%	27.2%	3.8%
High debt	18.0%	51.0%	25.6%	4.5%

Iceland	Private investment	Consumption	Government expenditure	Net export
Low debt	25.5%	58.7%	23.0%	-7.6%
High debt	15.9%	53.3%	25.0%	5.7%

Finland	Private investment	Consumption	Government expenditure	Net export
Low debt	25.0%	51.8%	21.9%	0.6%
High debt	17.8%	53.5%	23.6%	5.2%

Germany	Private investment	Consumption	Government expenditure	Net export
Low debt	22.5%	57.9%	19.3%	0.2%
High debt	17.6%	58.0%	19.2%	5.4%

Greece	Private investment	Consumption	Government expenditure	Net export
Low debt	20.2%	74.8%	14.7%	-10.5%
High debt	18.5%	72.7%	18.2%	-9.9%

Ireland	Private investment	Consumption	Government expenditure	Net export
Low debt	24.7%	45.9%	16.4%	13.1%
High debt	14.0%	56.6%	17.1%	12.3%

Japan	Private investment	Consumption	Government expenditure	Net export
Low debt	30.7%	53.5%	13.6%	1.7%
High debt	21.2%	59.4%	19.6%	0.05%

Netherland	Private investment	Consumption	Government expenditure	Net export
Low debt	20.2%	48.4%	24.1%	7.1%
High debt	20.3%	48.8%	24.4%	6.3%

New Zealand	Private investment	Consumption	Government expenditure	Net export
Low debt	22.6%	58.3%	18.7%	0.04%
High debt	18.9%	59.4%	18.6%	2.6%

Norway	Private investment	Consumption	Government expenditure	Net export
Low debt	22.2	48.1	21.1	7.4
High debt	20.2	44.6	20.5	12.3

Portugal	Private investment	Consumption	Government expenditure	Net export
Low debt	26.7	63.4	18.6	-9.5
High debt	19.8	65.8	20.3	-6.4

Spain	Private investment	Consumption	Government expenditure	Net export
Low debt	27.3	59.1	17.4	-4.4
High debt	21.3	59.5	18.7	0.1

Sweden	Private investment	Consumption	Government expenditure	Net export
Low debt	19.1	47.7	26.3	6.4
High debt	15.8	50.4	27.5	5.8

UK	Private investment	Consumption	Government expenditure	Net export
Low debt	18.4	63.2	20.0	-1.4
High debt	15.4	64.5	21.5	-1.5

US	Private investment	Consumption	Government expenditure	Net export
Low debt	22.2	66.1	14.8	-3.4
High debt	19.0	67.8	16.2	-3.2

Source: Author's calculations from OECD during 1988-2012.

Table 11: Comparison between impacts of debt and economic growth on private investment

Australia	Private investment		Private investment
Low debt	27.6%	High growth	26.6%
High debt	24.7%	Low growth	25.9%
Austria	Private investment		Private investment
Low debt	23.7%	High growth	23.1%
High debt	22.0%	Low growth	22.7%
Belgium	Private investment		Private investment
Low debt	20.9%	High growth	20.6%
High debt	20.7%	Low growth	20.6%
Italy	Private investment		Private investment
Low debt	21.7%	High growth	20.7%
High debt	18.9%	Low growth	19.5%
France	Private investment		Private investment
Low debt	19.8%	High growth	19.3%
High debt	19.9%	Low growth	19.2%
Canada	Private investment		Private investment
Low debt	23.0%	High growth	20.6%
High debt	19.5%	Low growth	21.1%
Denmark	Private investment		Private investment
Low debt	19.8%	High growth	19.3%
High debt	18.0%	Low growth	18.8%
Iceland	Private investment		Private investment
Low debt	25.5%	High growth	23.8%
High debt	15.9%	Low growth	16.6%
Finland	Private investment		Private investment
Low debt	25.0%	High growth	22.5%
High debt	17.8%	Low growth	20.2%
Germany	Private investment		Private investment
Low debt	22.5%	High growth	19.2%
High debt	17.6%	Low growth	18.6%
Greece	Private investment		Private investment
Low debt	20.2%	High growth	21.7%
High debt	18.5%	Low growth	17.8%
Ireland	Private investment		Private investment
Low debt	24.7%	High growth	20.5%
High debt	14.0%	Low growth	14.6%
Japan	Private investment		Private investment
Low debt	30.7%	High growth	28.8%
High debt	21.2%	Low growth	24.1%

Netherland	Private investment		Private investment
Low debt	20.2%	High growth	19.5%
High debt	20.3%	Low growth	20.4%

New Zealand	Private investment		Private investment
Low debt	22.6%	High growth	20.6%
High debt	18.9%	Low growth	19.9%

Norway	Private investment		Private investment
Low debt	22.2%	High growth	22.0%
High debt	20.2%	Low growth	19.8%

Portugal	Private investment		Private investment
Low debt	26.7%	High growth	26.5%
High debt	19.8%	Low growth	20.6%

Spain	Private investment		Private investment
Low debt	27.3%	High growth	24.0%
High debt	21.3%	Low growth	21.5%

Sweden	Private investment		Private investment
Low debt	19.1%	High growth	18.5%
High debt	15.8%	Low growth	17.1%

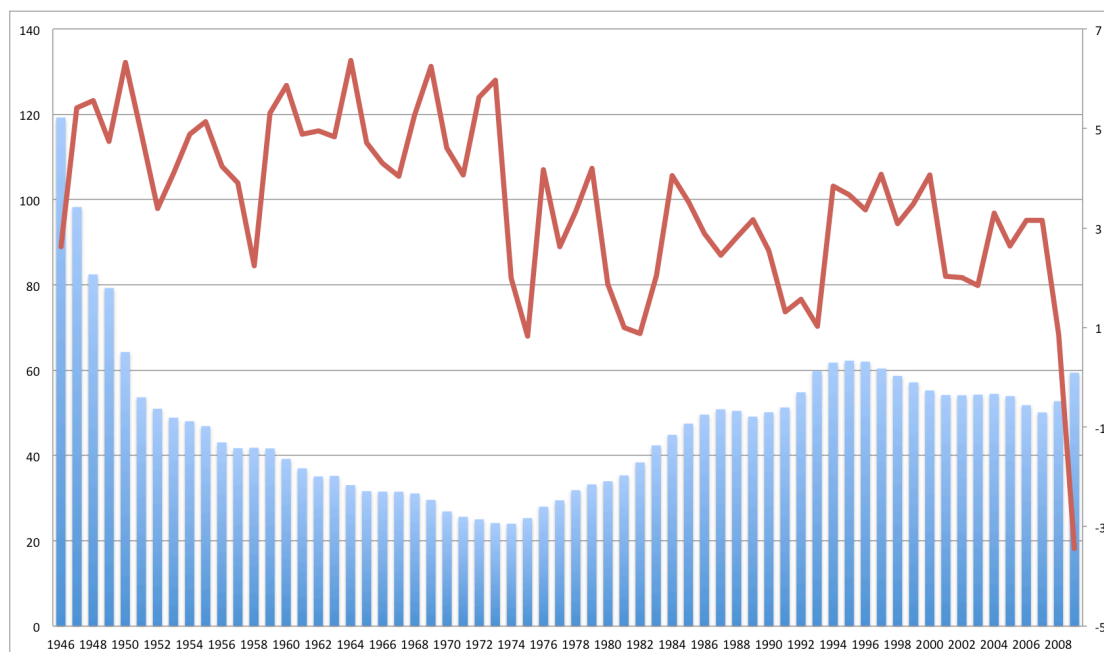
UK	Private investment		Private investment
Low debt	18.4%	High growth	17.6%
High debt	15.4%	Low growth	15.9%

US	Private investment		Private investment
Low debt	22.2%	High growth	22.0%
High debt	19.0%	Low growth	20.8%

Source: Author's calculations from OECD during 1988-2012.

Figures

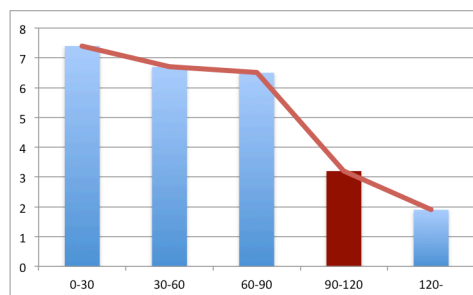
Figure 1: The trend of debt/GDP ratios and GDP growths



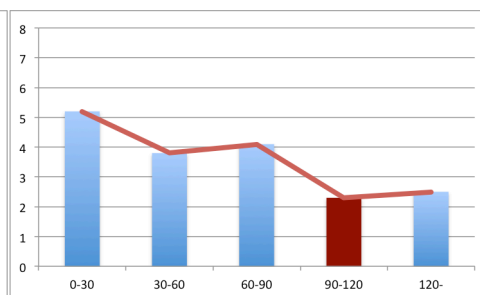
Note. Figure 1 shows the trend for average debt/GDP ratios and average economic growths for all selected advanced countries during 1946-2009. The histogram presents the debt/GDP ratios (left axis) and the curved line is the trend of GDP growth (right axis). Source: Author's own compilation from working spreadsheet of Reinhart and Rogoff. (2010a and 2010b)

Figure 2: Real GDP growth by public debt/GDP categories in different time periods

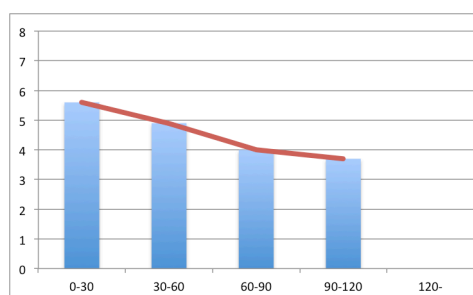
<Before 1950>



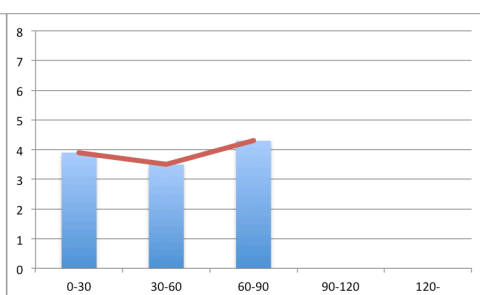
<1950-1959>



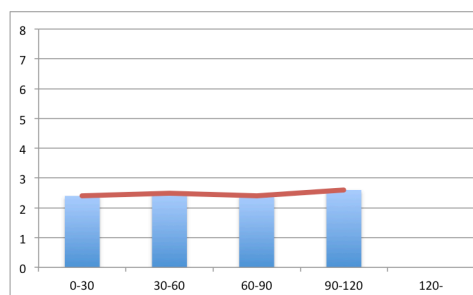
<1960-1969>



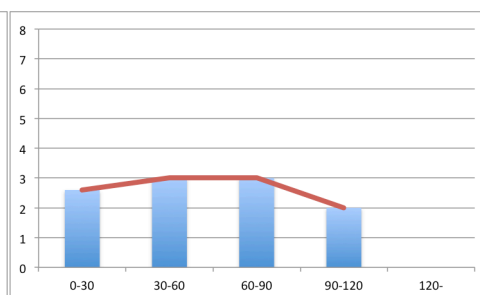
<1970-1979>



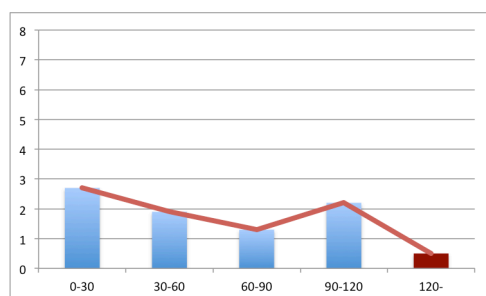
<1980-1989>



<1990-1999>



<2000-2009>

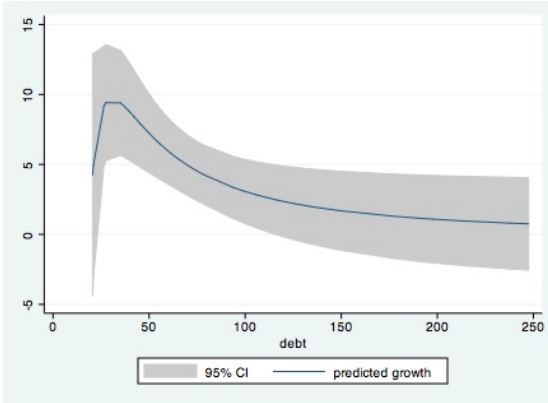


Notes. In each plot the bars represent mean growth rates. The curve line shows the trend of growth rates.

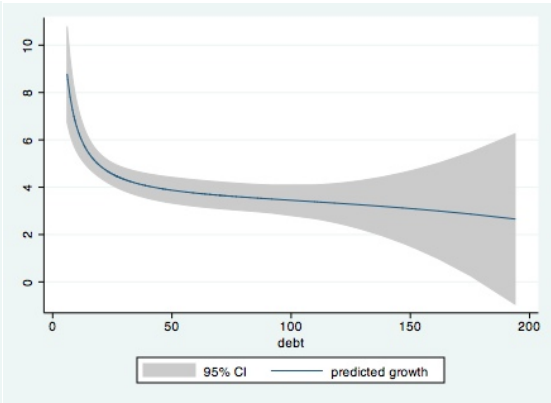
Source: Author's compilation from working spreadsheet of Reinhart and Rogoff (2010a and 2010b).

Figure 3: Time-specific debt-growth relationship

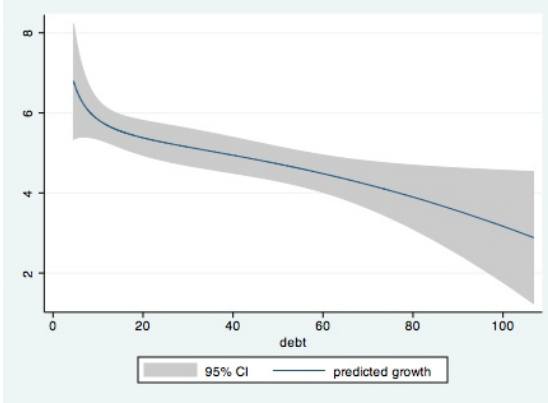
Before 1950



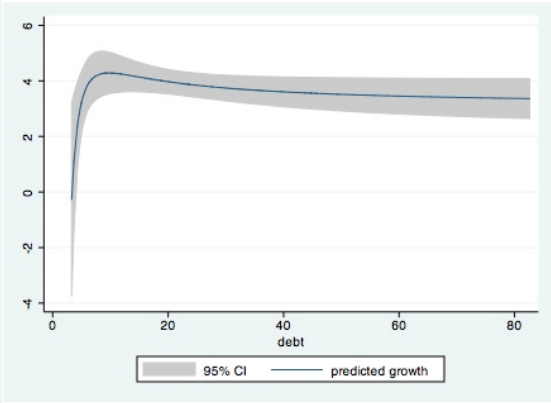
1950-1959



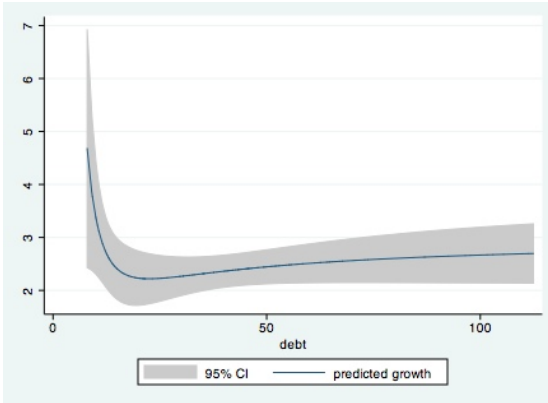
1960-1969



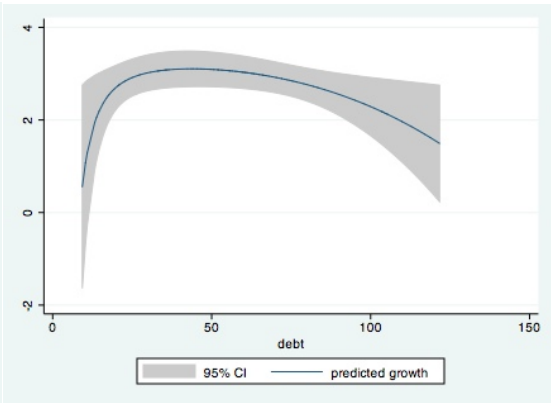
1970-1979



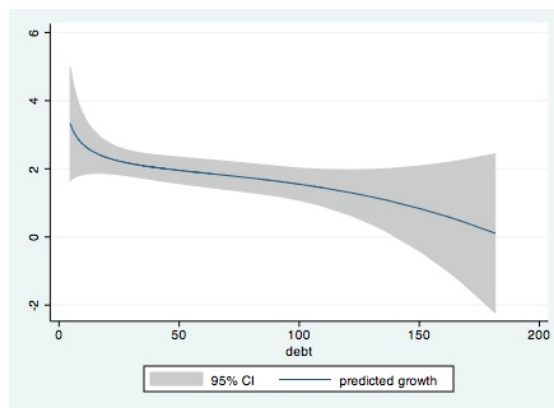
1980-1989



1990-1999



2000-2009

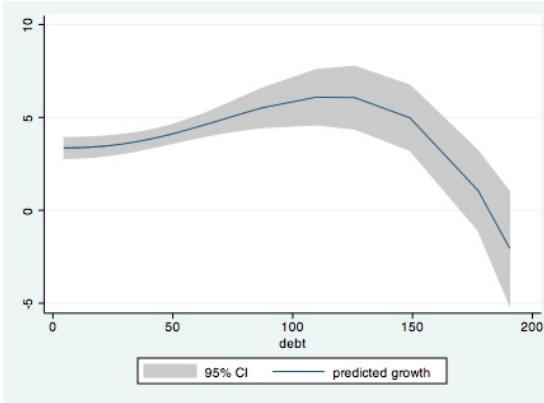


Note. Figure 3 shows the time-specific debt-growth relationship. We use fractional polynomial regression to prove that debt-growth relationship would change in different time periods (shaded 95% confidence intervals).

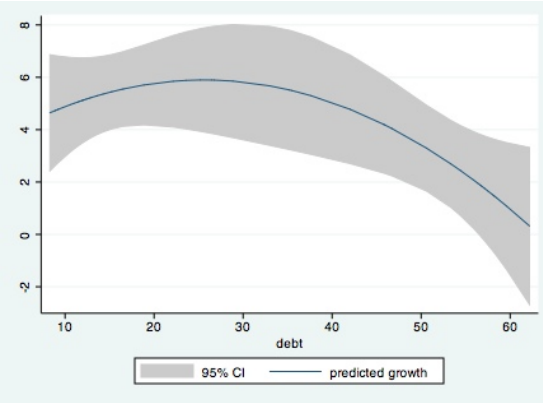
Source: Author's compilation from working spreadsheet of Reinhart and Rogoff (2010a and 2010b).

Figure 4: Country-specific debt-growth relationship

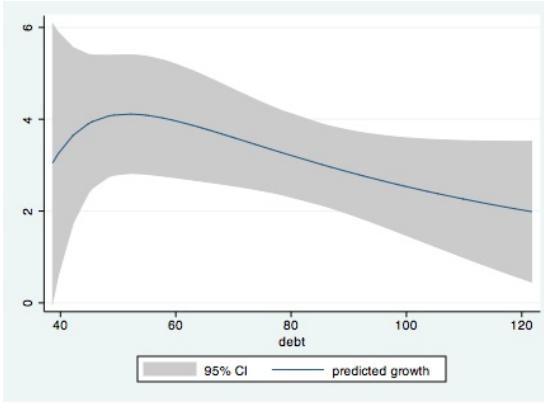
Australia



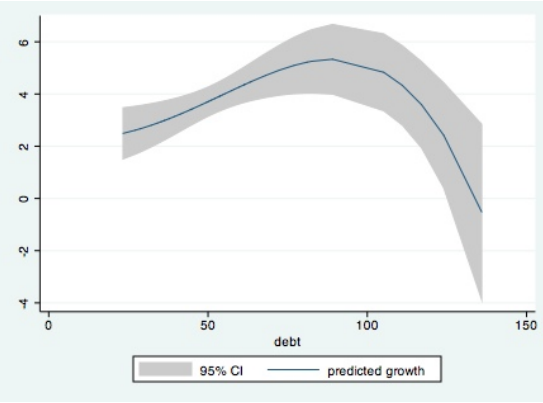
Austria



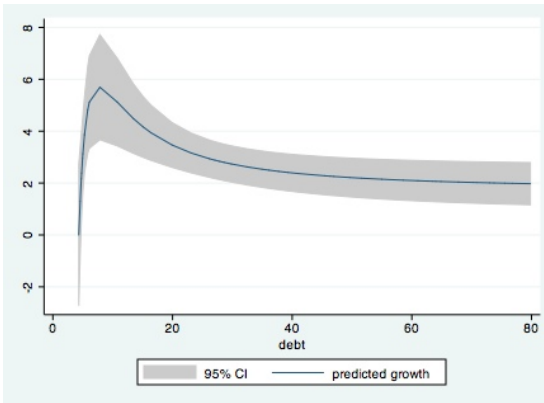
Belgium



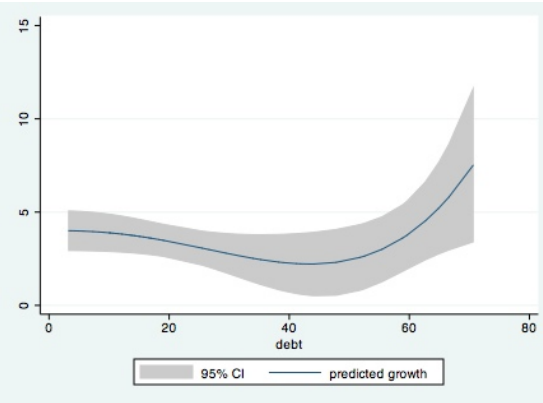
Canada



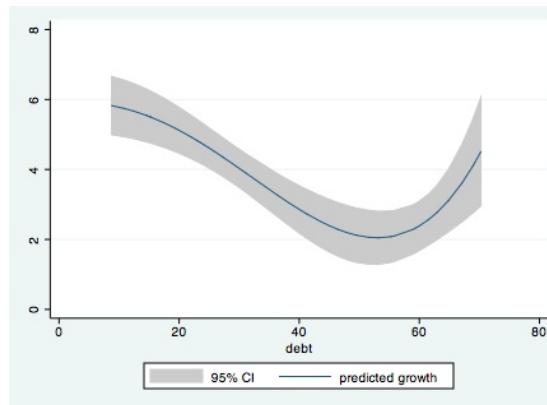
Denmark



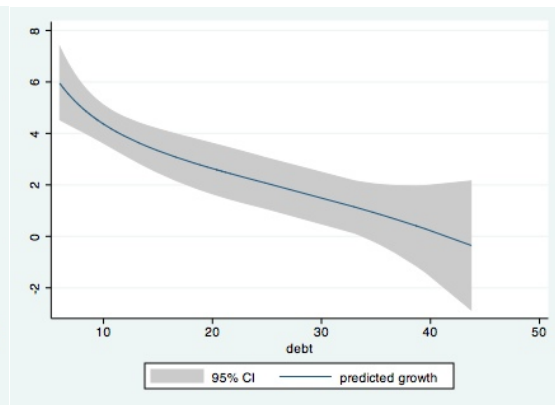
Finland



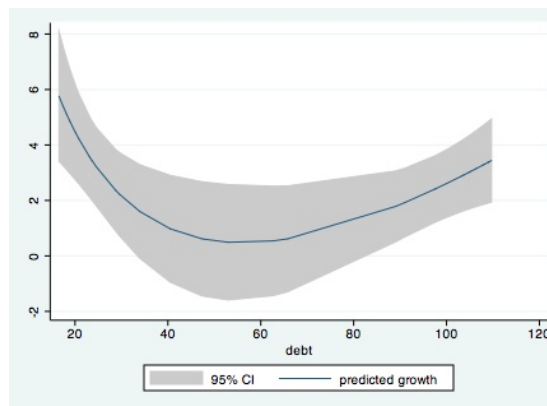
France



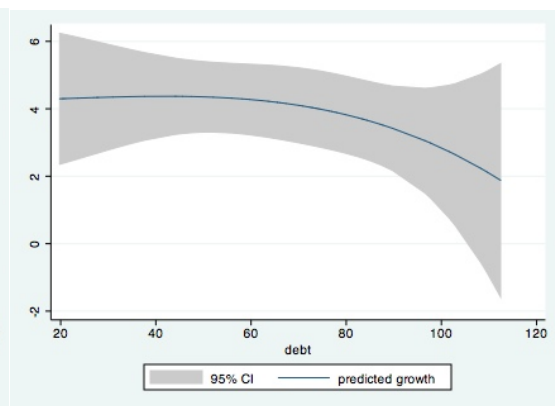
Germany



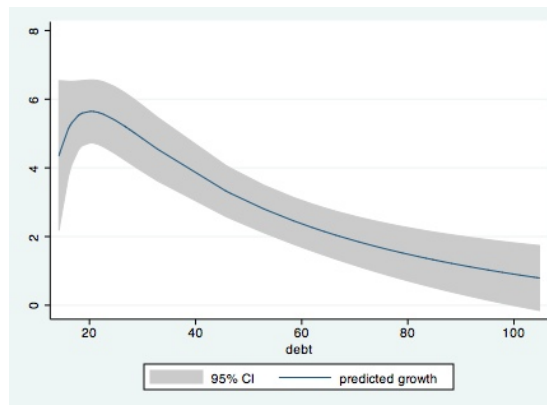
Greece



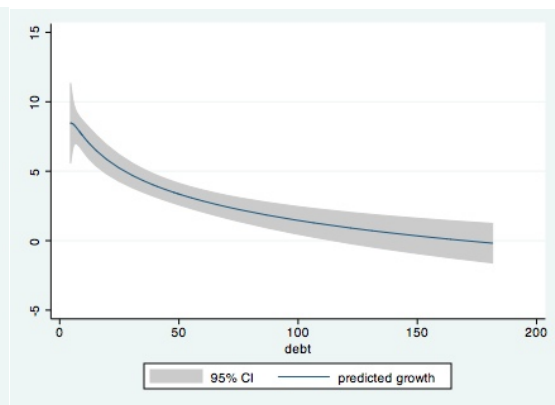
Ireland



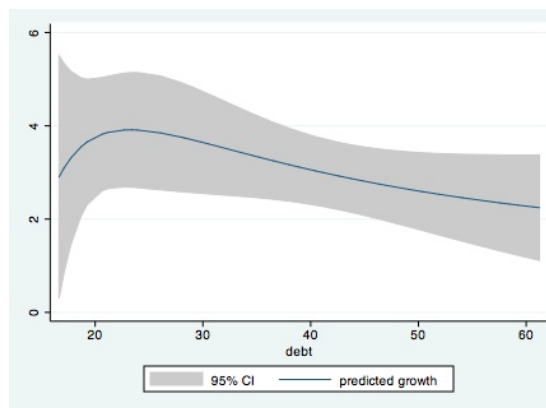
Italy



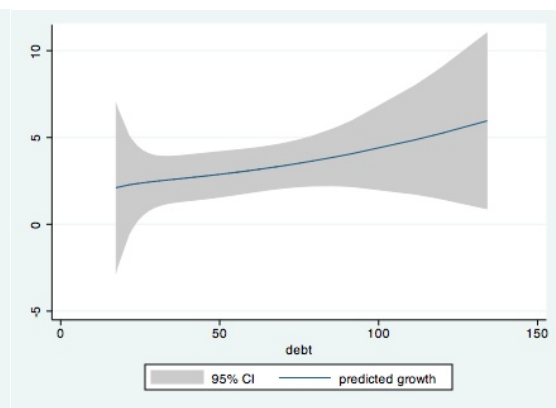
Japan



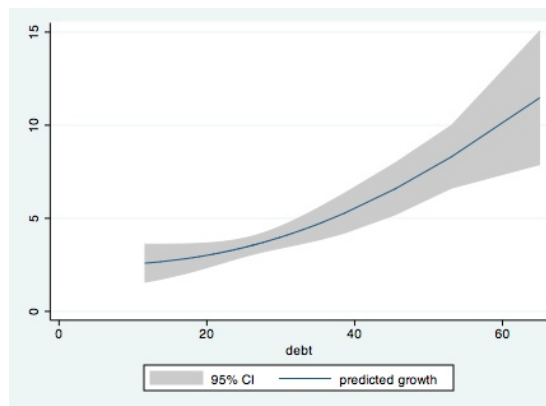
Netherland



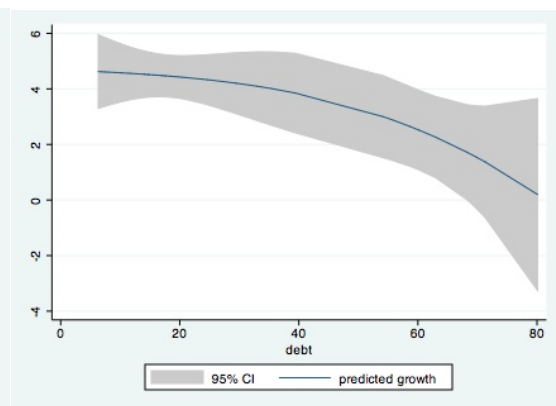
New Zealand



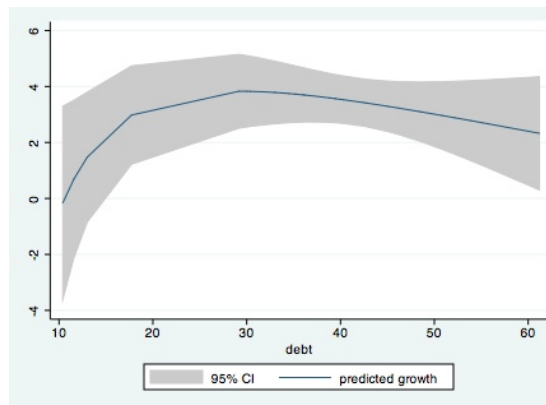
Norway



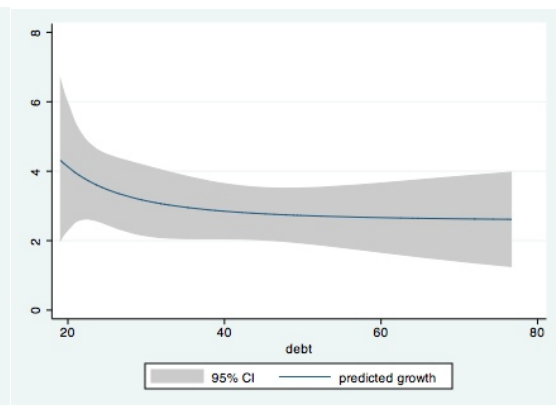
Portugal



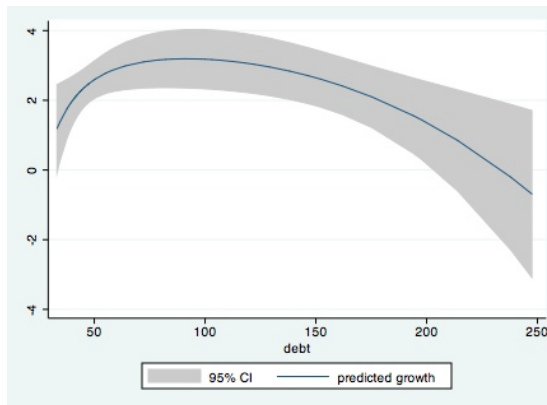
Spain



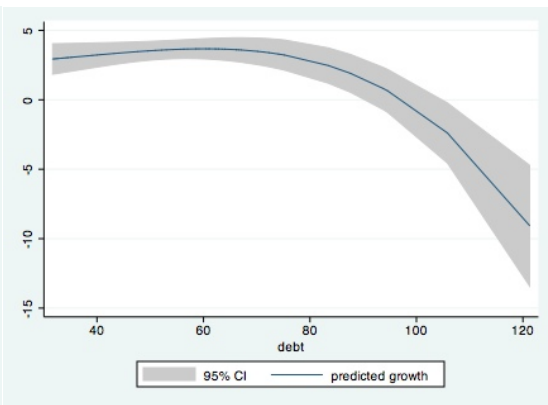
Sweden



UK



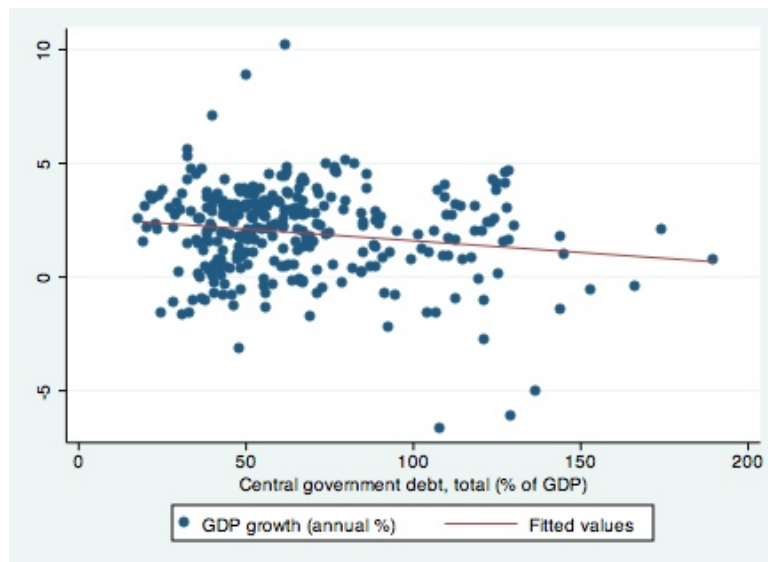
US



Note. Figure 4 illustrates the country-specific debt-growth relationship. We use fractional polynomial regression to prove that debt-growth relationships are totally diverse in different countries (shaded 95% confidence intervals).

Source: Author's compilation from working spreadsheet of Reinhart and Rogoff (2010a and 2010b).

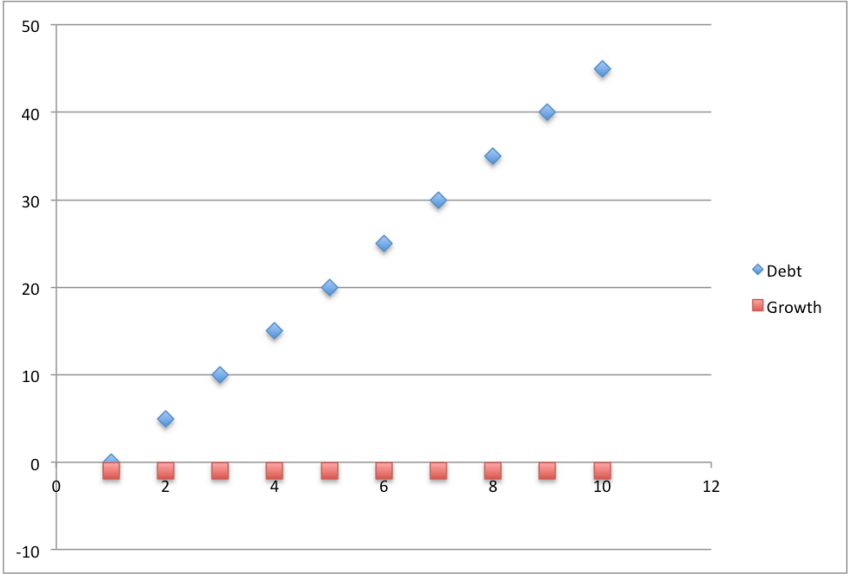
Figure 5: Public debt and subsequent growth during 1995-2009 (3-year average growth).



Note. We employ OLS regression to show the simple relationship between debt and growth in period of 1995-2009.

Source: Author's compilation from World Bank's World Development indicators.

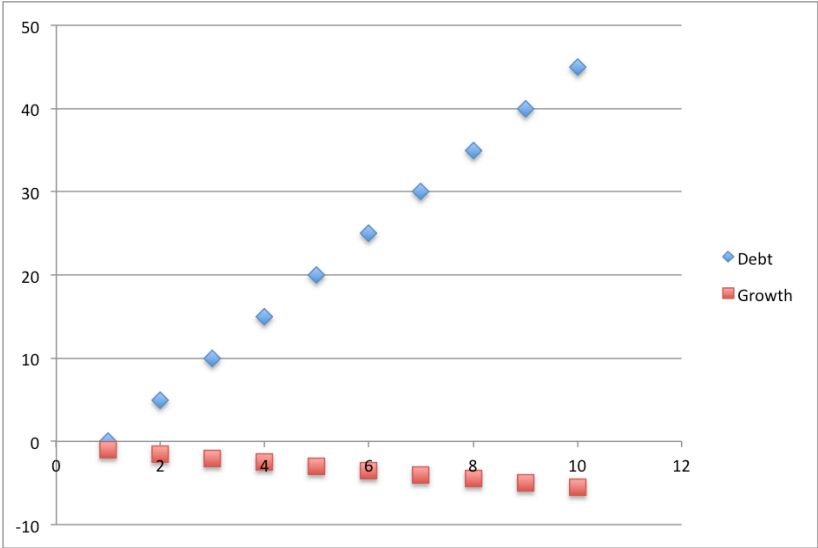
Figure 6: Simulation model- debt evolution driven by slow growth



Note. Public debt increases because of low productivity.

Source: Author’s own compilation.

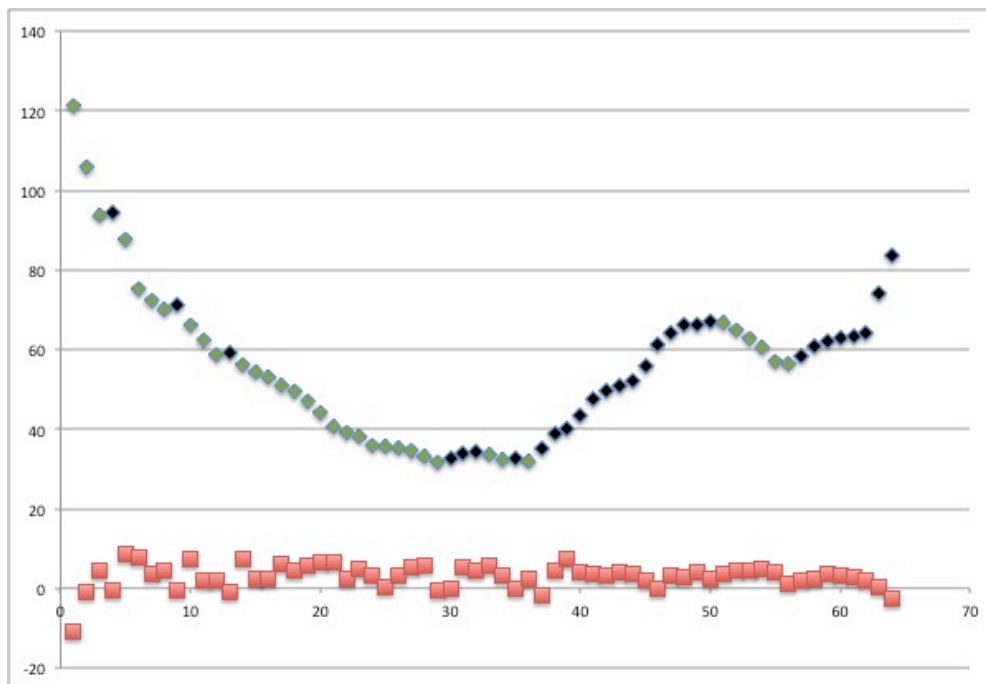
Figure 7: Simulation model- economic growth depressed by levels of debt



Note. Economic growth declines since higher levels of debt.

Source: Author’s own compilation.

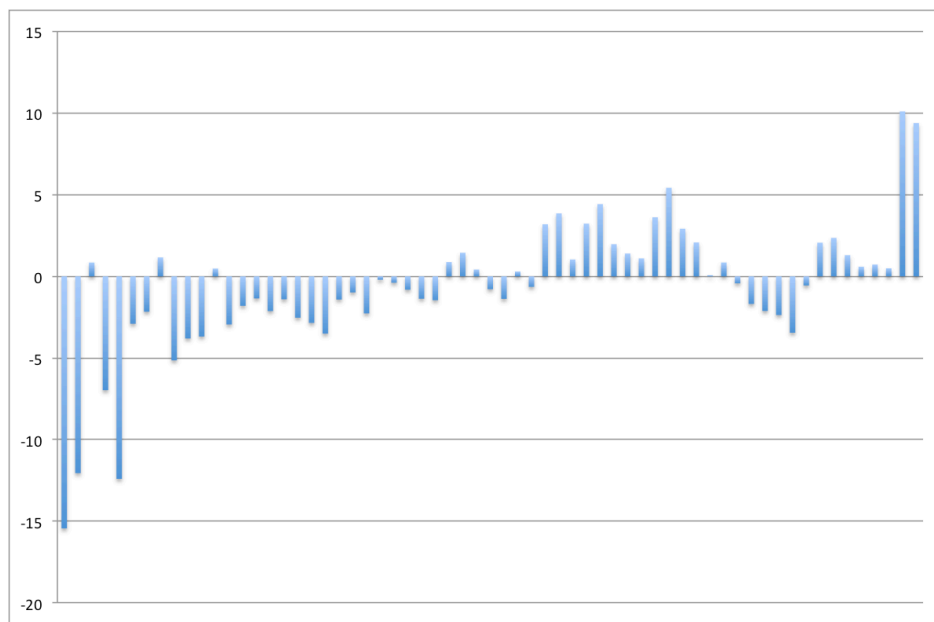
Figure 8: The course of debt in United States (1946-2009)



Note. When the debt is decreasing, the country-year is marked in light color. When the debt is increasing, the country-year is marked in dark color. The annual GDP growth is shown below.

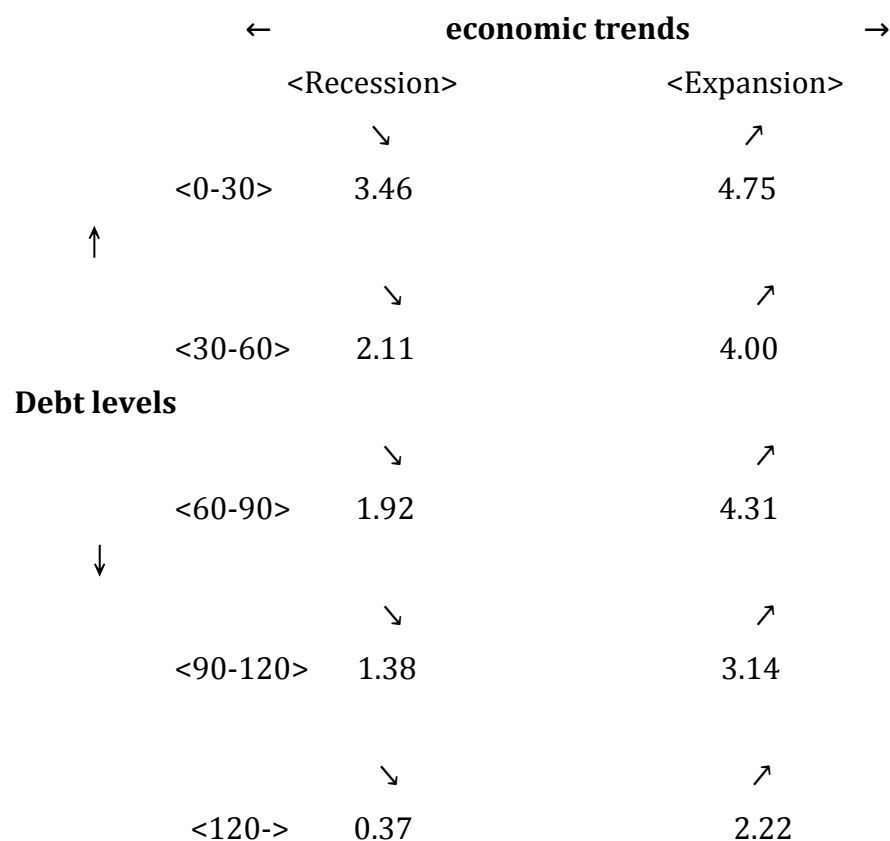
Source: Author's compilation from working spreadsheet of Reinhart and Rogoff (2010a and 2010b).

Figure 9: The annual change of government debt in United States (1946-2009)



Source: Author's compilation from working spreadsheet of Reinhart and Rogoff (2010a and 2010b)

Figure 10:



Note. Figure 10 shows the cross-relationship between debt and growth that comprises the short-run effect of growth on change of debt and the long-run effect of debt on the mean GDP growth. The debt levels are shown in vertical axis and the economic trends (debt course) are divided in horizontal axis.

Source: Author's compilation from working spreadsheet of Reinhart and Rogoff (2010a and 2010b).