AN EMPIRICAL INVESTIGATION OF PUBLIC DEBT AND ECONOMIC GROWTH NEXUS IN TURKEY AND SELECTED COUNTRIES

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IN
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Supervisor: Assoc. Prof. Dr. Selim YILDIRIM

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ÖZET

KAMU BORCU VE EKONOMİK BÜYÜMENİN TÜRKİYE VE SEÇİLMİŞ ÜLKELERDE AMPİRİK İNCELEMESİ

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Bu çalışmada, Türkiye ve seçilmiş ülke gruplarında kamu borcunun ekonomik büyüme üzerindeki etkisi araştırılmıştır. Seçilen ülke grupları on dört Avrupa ülkesinden oluşmaktadır. Öncelikle, kamu borçlarının ekonomik büyümeye etkilerini anlamak için Türkiye'de 2003-2018 yılları arasında zaman serisi analizi yapılmaktadır. ARDL modelini içeren zaman serisi analizi ile kamu borcunun büyüme üzerindeki etkisinin hem kısa hem de uzun vadeli ilişkilerinin açıklanması amaçlanmaktadır. Ardından, seçilen Avrupa ülkelerinin kamu borç oranına duyarlılığını ölçmek için panel analizi 1980-2017 yılları arasında uygulanmaktadır. Seçilen ülkeler için tahmin edilen panel analizi, kamu borcunun uzun vadeli etkilerini gösteren AMG ve FMOLS analizlerini içermektedir. Çalışmanın temel amacı kamu borcunun ekonomik büyümeyi nasıl etkilediğinin araştırılması ve etkinin büyüklüğünün ölçülmesidir. Başlangıçta, Türkiye için zaman serileri analizinin tahmin edilmesi, kamu borçlarının ekonomik büyümeyi kısa vadede olumlu, uzun vadede olumsuz etkilediği sonucuna varmıştır. İkinci olarak, seçilen ülkeler için uygulanan panel analizi, kamu borcunun ekonomik büyüme üzerindeki ters etkisiyle sonuçlanmaktadır. Bu bağlamda, araştırmanın beklenen sonucu, kamu borcunun çoğu durumda ekonomik büyümeyi olumsuz etkilemesidir.

Anahtar Kelimeler: Kamu borcu, Ekonomik büyüme, Zaman serisi analizi, Panel analizi, ARDL, AMG, FMOLS.

ABSTRACT

AN EMPIRICAL INVESTIGATION OF PUBLIC DEBT AND ECONOMIC GROWTH NEXUS IN TURKEY AND SELECTED COUNTRIES

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The study has researched the impact of public debt on economic growth in Turkey and selected country groups. The selected country groups have consisted of fourteen European countries. Primarily, the time series analysis is made in Turkey for the period from 2003 to 2018, to understand the effects of public debt on economic growth. The explanation of the effect of public debt on growth for both short and long-term relationships is aimed at time series analysis that includes the ARDL model. Subsequently, the panel analysis is applied between the period 1980 and 2017, to measure the sensitivity of selected European countries against the public debt ratio. Panel analysis that is estimated for selected countries, includes analyses of AMG and FMOLS which show long-terms effects of public debt. The primary aim of the study is that investigate how public debt influences economic growth and measurement of the size of the effect. Initially, estimation of time series analysis for Turkey is concluded that public debt affects economic growth via positively for the short-term and negatively for the long-term. Secondarily, panel analysis applied for selected countries results in an inverse impact of public debt on economic growth. In this context, the expected outcome of the investigation is that public debt affects economic growth negatively in most cases.

Keywords: Public debt, Economic growth, Time series analysis, Panel analysis, ARDL, AMG, FMOLS.

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STATEMENT OF COMPLIANCE WITH ETHICAL PRINCIPLES AND RULES

I hereby truthfully declare that this thesis is an original work prepared by me; that I have behaved in accordance with the scientific ethical principles and rules throughout the stages of preparation, data collection, analysis and presentation of my work; that I have cited the sources of all the data and information that could be obtained within the scope of this study, and included these sources in the references section; and that this study has been scanned for plagiarism with "scientific plagiarism detection program" used by Anadolu University, and that "it does not have any plagiarism" whatsoever. I also declare that, if a case contrary to my declaration is detected in my work at any time, I hereby express my consent to all the ethical and legal consequences that are involved.

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ABBREVEATIONS

ADF : Augmented Dickey-Fuller Test

AIC : Akaike Information Criteria

AMG : Augmented Mean Group

ARDL : Autoregressive Distributed Lag Bound Test

BE : Between Estimator

CPI : Consumer Price Index

CADF : Cross-sectionally Augmented Dickey Fuller test

CUSUM : Cumulative Sum

DEBT : Debt-to-GDP ratio

DEBT_SA: Seasonally adjusted Debt-to-GDP ratio

ECM : Error Correction Model

FE : Fixed Effect

FMOLS : Fully Modified Ordinary Least Squares

GCF : Gross Fixed Capital Formation

GCF_SA : Seasonally Adjusted Gross Fixed Capital Formation

GDP : Gross Domestic Product

GMM : Generalized Method of Moments

H_0 & H_1 : Null Hypothesis & Alternative Hypothesis

HQ : Hannan-Quinn Criteria

IMF : International Monetary Fund

LM : Lagrange Multiplier

MW : Maddala and Wu

MG : Mean Group Estimator

OECD : Organisation for Economic Co-operation and Development

OLS : Ordinary Least Squares

PMG : Pooled Mean Group Estimator

PP : Phillips-Perron Test

RGDP : Real Gross Domestic Product

RGDP_SA: Seasonally Adjusted Real Gross Domestic Product

SGMM : System Generalized Method of Moments

VAR : Vector Autoregression Model

INTRODUCTION

The materiality of economic growth is an indisputable truth throughout economic history. Humanity who is in a struggle for survival, always need for consumption and corresponding production. In this context, economic growth which expresses the productivity capacity of nations becomes the main macroeconomic indicator on a global scale. This indicator does not only show the productivity capacity of nations but also informs about the level of welfare of countries. Nevertheless, the driving force of growth can be directly related to incomes that are obtained mostly from nations' natural resources. However, every nation cannot be fortunate in terms of natural resources. At this stage, states should use income that is obtained from the nation's output, to outproduce and achieve growth. Unfortunately, the income of nations' which is known as Gross Domestic Product (GDP), cannot be always sufficient to perform economic activities. Under these circumstances, nations have three options to fund-raise economies such as taxation, emission, and borrowing.

Despite it is applied rarely in the past, among others borrowing or public debt becomes one of the most preferred methods as a foundation at the present times. The reason is that economies that get involved globalization process, desire to increase the development and growth of nations to catch up with developed economies. To that end, governments raise their expenditures and correspondingly expect to achieve growth. However, in most cases, especially for developing countries, budget deficit, which is an excess of government expenditures than government revenues, can be inevitable. In this context, public debt is a favorable method for the nations who either have a budget deficit or cannot have sufficient income. The other fund-raising methods, taxation or emission, can be applied to finance government expenditure or generating income but these methods can cause several negative consequences. The governments already use taxation as methods to ensure budget balance. However, because of the existing situation of high government purchases, tax ratios should be risen to compensate for the economy's expenditure sides. As consequences of higher tax ratio, the results can be either lower economic activity based upon a decline in consumption of individuals or crowding-out effect which is experienced by the private sector. Since the importance of these negative impacts on the economy is major, the states cannot choose to push the border of their economies and they consider the other options. The emission, another option, cannot be

preferred at will. The reason is that nations have to present gold reserves in return for emission. Moreover, emission induces inflation problems in economies. These reasons explain why emission cannot be preferred frequently for government financing.

Taking into consideration government finance methods, it cannot be surprising that public debt or borrowing is the most preferential. On the other hand, the presence of public debt leads to various results in the economy. The impacts of public debt on the economy especially economic growth become the much-debated subject in the economy. Accordingly, several studies exist in literature about public debt however results of these researches differ in terms of features. Therefore, the study expresses the effects of public debt on economic growth based on the most recent dates to either sharing information for the right usage of borrowing or consider from a different angle.

Consideration of all these circumstances, the main objective of the analysis is clarifying the impact of public debt on economic growth and correspondingly the present study consists of three chapters. The first chapter includes the determination of basic concepts such as public debt, economic growth, and existing studies in the literature. It can be thought that the main structure of the study takes place in here. After examining the main notions, the study makes differ from other researches via analyzing methods. In the second chapter, time series analysis is applied for Turkey by the years 2003 to 2018. The Autoregressive Distributed Lag Bound Test (ARDL) model is preferred for this analysis. Additionally, the last chapter express panel analysis based on Augmented Mean Group (AMG) tests and Fully Modified Ordinary Least Squares (FMOLS), for selected European countries for the period 1980 - 2017. In conclusion, the testing relationship between public debt and economic growth gives information about the impacts of the dimension and course of public debt. Herewith, governments of nations can be able to understand the effects of implementing public debt on the economy and make an inference about how they should react or which politics they should use against to causes of debt.

CHAPTER 1

1. PUBLIC DEBT AND ECONOMIC GROWTH

As a matter of fact, public debt has an important place in the economy. The reason is that the economy of nations works for reaching the objectives of socio-economic development and economic growth. However, there can be situations of lack of sources as a financial need in the economy. In such circumstances, the importance of public debt can be seen obviously for any economy. According to the report of the German National Academy, there are three intended purposes of the government debt. One of the stabilizing functions, which the government uses its debt channels to stabilize the economy in a crisis period and increase or decrease debt for economic performance. The second one is the bridging function that the government debt is used as a borrowing when the government cannot interfere with the economy with tax channel. The last one is the burden-sharing function, which debt is using for sharing tax burden because the government needs sources to stimulate and grow the economy that is possible with higher taxation or public debt. It means that the government uses debt channels to decrease the tax burden (Holtfrerich, and others, 2015).

To be able to understand the place of the debt in the economy, the worldwide position of the public debt must be considered. In this situation, the debt-to-GDP ratio must pay regard as essential tools. In this way, general government debt which is the debt-to-GDP ratio, that clarifies the course of the public debt for world economies is indicated in Figure 1.1.

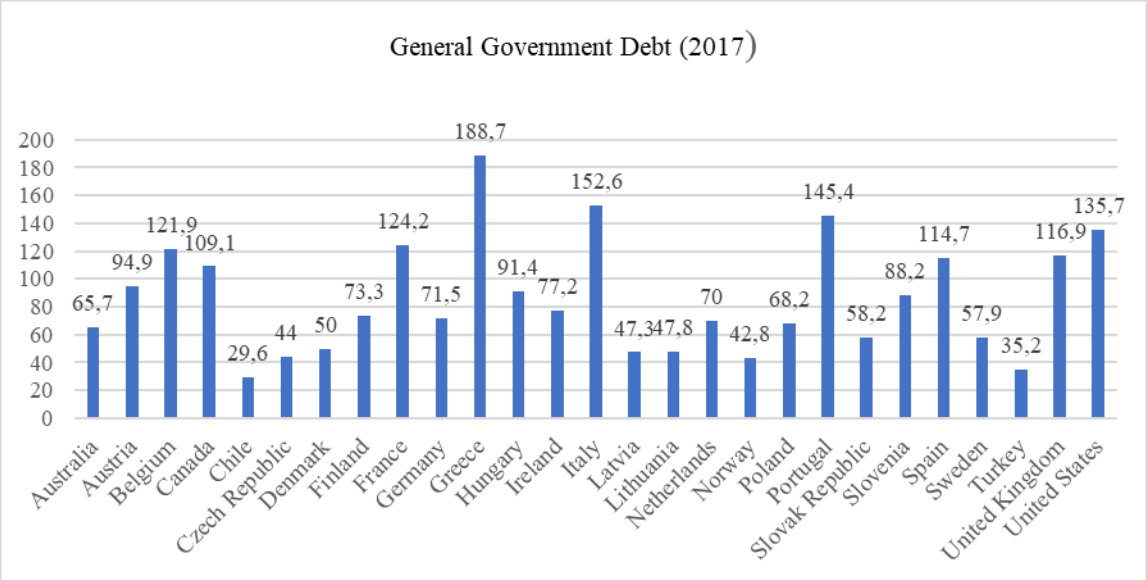

Figure 1.1. *General government debt (OECD)*

General government debt-to-GDP ratios are taken from OECD and these data reflect only values of 2017. Figure 1.1 represents that Greece has a maximum debt ratio of 188,7%. Thereafter, debt-to-GDP ratios follow respectively Italy (152,6%), Portugal (145,4%), United States (135,7%), France (124,2%) et cetera. Turkey has a 35,2% debt ratio. Moreover, Chile has a minimum ratio, 29,6%. Depending on the general overview of the presented countries, the general government debt of Turkey is lower than the others. After an examination of general government debt, the importance of the public debt can be acceptable unavoidably for all economies and their growth.

1.1. The Public Debt

1.1.1. The definition of public debt

The lexical meaning of the debt is money which is received by individuals or institutions with the condition of repayment. The necessity of debt occurs when individuals or entities cannot cover the expenditures with the revenues. The governments as a corporate entity, in a similar way, experience the situation that cannot afford expenditures through revenues. In the circumstances, the government has alternatives which are taxation, emission, and/or borrowing (Özçelik, 2005).

The debt of the government which is referred to as "Government's overdraft" (Irwin, 2015) purposes to balance the budget revenue, finance the budget deficit, fund-raising to use at the time of war and natural disasters, obtain finance of new investment project and refund to pay for the existing debt.

Therefore, the definition of public debt can be considered as the necessity of the debt that arises when the government cannot afford its responsibilities from other sources to finance the country and perform tasks. The public debt is one of the important sources of the government to sustain economic activity.

1.1.2. The classification of the public debt

The government applies several techniques to meet the requirement of debt raised. The structure of the public debt consists of respect to different properties of the debts. In other words, public debt can be classified into three categories that are showed in Figure 1.2. The public debt has been categorized with a view to sources, maturity, and option. In point of the source includes internal and external debts; the classification according to

maturity consists of short-term, medium-term, and long-term debts; and there is voluntary and compulsory debt in terms of option (Yılmaz, 2013; Aybarç, 2019).

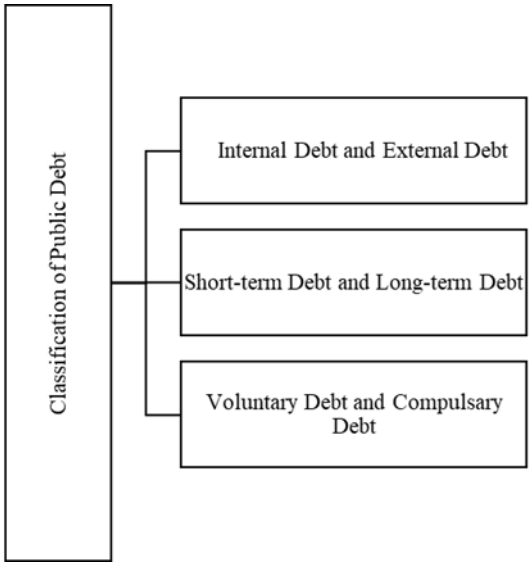

Figure 1.2. *The classification of public debt (Yılmaz, 2013)*

1.1.2.1. *Internal Debt and External Debt*

Regarding its source, public debt is classified as internal and external debt. When the public debt is classified according to sources, the thing to take into consideration is the market where the public debt is supplied. This is a question for whether the debt is internal or external. In this type of classification, maturity, and option of public debt is not significant. Furthermore, the government needs borrowing based on various reasons for both internal and external debt (Bilge, 2012).

The debt that is provided within the country is internal debt. Internal debt is procured from the domestic market such as individuals, institutions and organizations, private sector, commercial banks, and the Central Bank. The repayable of internal debt must be with domestic currency. There are several reasons for the necessity of using the internal debt. The government uses internal debts in these cases:

- The limited management of tax which means being unable to rise tax-ratio or levy on a new tax,
- The economic imbalance between the government's revenues and expenditure and using as a tool of fiscal policy,
- The satisfying needs of the public sector's finance,
- The non-use of the external debt because of the existence of inconvenient international market conditions.

In case of the existence of insufficient internal debt and/or being unable to meet a demand of domestic resources, the government can need to arise for finding external debt.

On the other hand, external debt is the amount that residents of the country provide the loan from non-residents subject to repay in the future (IMF, 2013). Naturally, external debts must repay in terms of foreign currency. External debt comprises of international financial institutions, multinational corporations' funds, and foreign capital investments. The external debt, generally, is in use by a developing or underdeveloped country due to a lack of sources and have regular fund requirement. Therefore, the reasons for external debt are extensive. The leading causes for the government to apply for external debt are as follows:

- There is an impossible situation to apply internal debt,
- The requirement of fund for consolidation of the country in areas of industrialization and development,
- To maintain the production and meet of imports' finance,
- To preserve the value of the national currency,
- The funding expenditure in the existence of the state of emergency like natural disasters and war,
- Financing of the budget deficit,
- Financing of military expenditure and arms import,
- Financing of making investment and economic reforms for economic growth,
- Meeting the deficit that derives from the trade deficit and balance of payment deficit,
- Refunding for payment of the matured liability,
- Developed countries lend to countries in need of funds considering their interests.

By taking into consideration the reasons for the external debt, the government of countries can stand external debts at any time to maintain the economic balance and support of financing economic growth.

1.1.2.2. *Short-term Debt and Long-term Debt*

One of the important things in case of having debt is the duration of the debt from the point of signatories to the contract. The reason is that conditions of the debts can change to the debts' maturity period. The classification of the public debt according to maturity, tripartite as short-term debt, medium-term debt, and long-term debt.

The maturity period of the short-term debt is approximately 1 year. These debts, also, known as floating debts because of that the public debt must be perpetual to sustain public service without administrative disruption. At the same time, the revenues of the government cannot be able to standardize. The public revenue can vary from period to period as a decrease or increase. Therefore, floating debts or short-term debts are borrowed by the treasury to continue economic activity in case of a lack of public revenue (Yılmaz, 2013). Types of short-term debt are treasury bills, treasury bonds in the money market. Also, the interest rates of short-term debt are generally low (Çataloluk, 2009).

The maturity period of medium-term debt is in between from 1-year to 5-year (among short-term and long-term debt). In short, the interest rate of this type of debt is intermediate and effects on government budget are less than the short-term debt.

The long-term debt has a maturity period of five years or more. The long-term debts can be practicable in terms of filling a gap for the lack of government revenue in the long run. The interest rates, however, are high for long-term debts and these debts are supplied by capital markets.

1.1.2.3. *Voluntary Debt and Compulsory Debt*

The public debt is, also, classified as voluntary and compulsory debt to option. The necessity of a democratic and modern era requires the voluntary debt which is given by citizens at own requests to the government. The government uses announcement power to float loans by issuing bonds, certificates. Therefore, all receivers who are banks, financial institutions, and individuals can purchase these securities to fund-raising of the government. Nevertheless, even a little there can be compulsion in practice because the government is the only one who stipulates debt. The voluntary debt is the most frequently referred method of public debt.

In other respects, the compulsory debt is that the government takes on debt from individuals or institutions by using the sovereign right and coercive power. The compulsory debt must be taken in case of running out of all possibilities that the debt is taken voluntarily. In this case, compulsory debt means the government borrows the debt by the force which bears a resemblance to impose a tax. Besides, there is a marked difference between the tax and compulsory debt that there is the non-existence of repayment of tax, but the compulsory debts must be repaid-with interest rate by the government. Moreover, reasons for the government's request for compulsory debt can be

for special circumstances and during emergencies such as war, crisis, and natural calamities (Çataloluk, 2009).

1.2. Theoretical Framework of Public Debt

The importance of public debt in terms of the world economy is a stubborn fact as indicated above. The public debt becomes an essential source of the nations' economy over the centuries. In this context, particular approaches occur to explain the impacts of public debt on economic growth. Theories of public debt can be collected under three titles. These are in order of Classical theory, Keynesian theory, and Ricardian Equivalence theory (Butkus & Seputiene, 2018; Karazijienė, 2015). The theoretical framework of public debt is expressed in Figure 1.3.

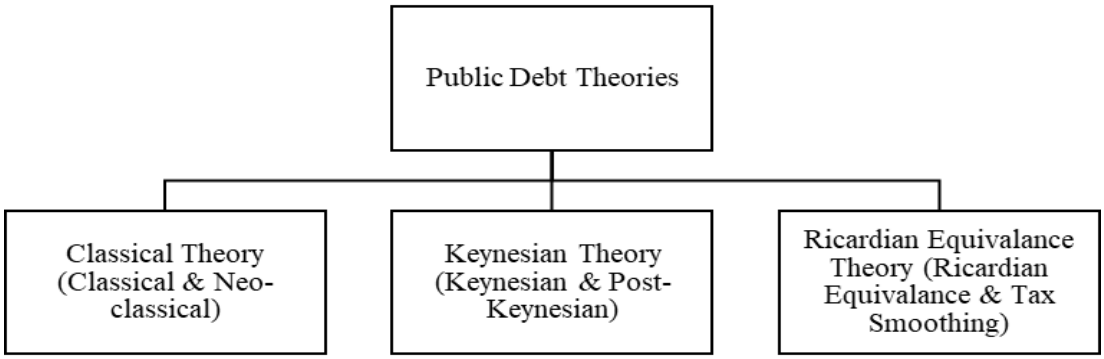

Figure 1.3. *The theoretical framework of public debt*

1.2.1. Classical Theory

The content of the title consists of both traditional Classical theory and Neo-Classical theory. The appearance of the Classical approach, the core idea becomes "Laissez Faire" which restrict state authority except for some basic duties such as defense, education, and health. The classical theory considers no government interventions necessary for economic activities since the existence of perfect competitions in the economy. In addition, government interventions should be limited in terms of public debt.

According to the views of Classical theory, there is no need for government expenditure because the economy can self-regulate itself without any intervention. Moreover, government expenditure or public debt imposes a burden on society. The

reason for the debt burden arises from higher repayment of debt that includes debt itself and its interest. Public debt is a burden to future generations, especially because the process of indebtedness is a long-term economic activity for Classical views. In this context, the presence of government expenditure creates important adverse consequences for the economy and sure economic growth (Karazijienė, 2015). The Classical theory is criticized for the inverse effect of government expenditure on the economy. Because of future generations have some revenues together with debt. Besides some revenues, in case of usage of borrowed funds as resources to make investment and production, expenditures lead growth instead of deterioration.

The Neo-Classical theory is an extended version of the Classical approach. Therefore, most assumptions of Neo-Classical theories have similarities with Classical theory. However, the most important thought that affects the behavior of the Neo-Classical approach on government expenditure is the limited lifetime of individuals. The rational people who know to have a limited lifespan behave accordingly and plans their lifetime for this period. Bernheim (1989) points out that rises of taxes to repay government expenditure decrease consumptions and indirectly savings of individuals. In this sense, taxation and borrowing have similar effects to obtain finance of public debt. The neo-Classical theory emphasizes the detrimental effect of government expenditures that both financial instruments cause the transfer of funds from the private sector to the public sector. Moreover, the government sells treasury bonds to finance its debt and causes higher interest rates. As a result, funds transfers to the public sector and the presence of high-interest rates induces no application of funds by the private sector and concludes exclusion of private investments which is called the crowding-out effect of public debt (Bernheim, "A Neoclassical Perspective on Budget Deficits", 1989; Karazijienė, 2015).

1.2.2. Keynesian Theory

The accepted fact is that the appearance of a Keynesian theory begins with the great depression of the 1930s. On the contrary of Classical views, Keynesian theory can be proof of the magnitude of fiscal policy. The mainspring of this is the advocacy of the Keynesian approach about the requirement of government intervention for economic activity. The main idea of Keynesian theory is necessary for state intervention because the economy is not always in full employment. There is an also underemployment equilibrium for the economy and only the government can control and fix market

equilibrium. To determine the Keynesian approach in terms of public debt, functional finance theory can be used.

Lerner's functional finance theory implies that there is no burden for future generations as an effect of public debt because the reflection of either taxation or requirement which is income-generating thanks to public debt is equal. Since the advantages and disadvantages of the debt are identical, government expenditures do not create a burden on future generations (Karazijienė, 2015). Briefly, Keynesian views agree with the existence of public debt has a positive effect on economic growth mostly in the short run.

Post-Keynesian theory, which is based on the ground of Keynesian theory, also has some dissimilarities. Looking from the viewpoint of public debt, the Post-Keynesian approach is determined by Buchanan who improved the Keynesian modern theory of public debt and gets results that the real burden of debt shifts to the next-generation (Wagner, 2014). The Keynesian and Post-Keynesian theories have opposite consequences about the effect of public debt.

1.2.3. Ricardian Equivalence Theory

Ricardian equivalence theory is mentioned for the first time by Robert Barro in 1970. However, the theory is dedicated to David Ricardo with the realization that he is the first person to defend the same opinion determined by Barro. The view behind the Ricardian equivalence theory is that borrowing and taxation which are financial instruments of government, show similarity in terms of macroeconomic impacts in the economy. Briefly, government expenditures can pay off with both tax or public debt and these two methods have the same consequences economically in respect of Ricardian equivalence theory (Tsoulfidis, 2008). The fundamental assumptions of Ricardian equivalence theory are classified below by Bernheim (1987):

- Generations are depending on each other for sacrifice.
- Individuals or consumers are rational.
- Postponement of taxes cannot cause a redistribution of sources between generations.
- Since taxes are non-distortionary, it has no predatory practice.
- The existence of the deficit does not create values for the economy.

As is seen, there is no difference between borrowing or taxation as financing methods because tax deductions do not change the consumption decisions of individuals.

The reason is that the government redeems its debt via borrowing instead of raising taxes. Rational people who know that the state uses the power of levy to pay off public debt, respond not to tax deductions since today's tax deduction is equal tomorrow's tax boost (Bernheim, "Ricardian Equivalence: An Evaluation of Theory and Evidenceé, 1987).

The Ricardian theory is mostly criticized for the existence of the distortion effect of taxes. According to criticisms, this effect induces the alternation of consumers' behaviors. Thereafter, Barro describes the tax smoothing theory as a reaction to criticisms. Tax smoothing theory is based on the idea that tax rates remain the same in time. The steady tax ratio is effective usage of public debt as of fiscal policy and raises the wealth of citizens who are taxpayers. In this context, the distortion effect of taxes can be smoothed (Karazijienė, 2015).

Besides all these, Robert Barro explains the "government spending model" depending on endogenous growth theory to clarify the relationship between public debt and economic growth. According to the findings of Barro's studying for 98 countries, an increase in the debt-to-GDP ratio affects economic growth negatively. Especially, the situation of the government uses its expenditures for non-productive resources. According to Barro, however, the government can make productive investments and so economic growth is affected positively. In brief, Barro's view is that the course of economic growth can be changeable with the usage of public debt (Barro, 1990).

There are several theories in the literature about the effects of public debt. General views can be grouped in third ways. The first of these depends on the opinion that the presence of public debt creates a real burden on society. The first group consists of theories of Classical, Neo-Classical, and Post-Keynesian which each of them based on different approaches. The second group who are Keynesian, Ricardian equivalence, and Barro's tax smoothing theories, think that there is no real burden on society depending on public debt. The third group consists of some of the Classical theorists and Barro's government spending model explains different consequences of public debt either positive or negative impact. These theorists argue that the effects of public debt can be related to how expenditures are evaluated. In this way, the impact of government expenditures can give particular results. Under these circumstances, findings of analyses have importance for the study.

1.3. The Economic Growth

1.3.1. The description of economic growth

Most of the time, economic conditions between nations can differ greatly. Some countries can be rich while others suffer from poverty. In this case, economic growth reaches significance because of differences between nations' economies based on the growth criteria. Thus, economic growth can be determined as a rise in the production of goods and services of a nation, which denotes the potential output of the economy for a period. To measure economic growth, Gross Domestic Product (GDP) is used as equipment. The thinking behind rising in GDP is that increase in the total income of the national economy brings on overproduction of output in the economy (Aghion & Howitt, 2009; Rittenberg & Tregarthen, 2012; Mankiw, 2016).

Another perspective about economic growth is whether growth changes or affects the standard of living. There are lots of information about how economic growth affects the life quality of the individual. This being the case, all economists come to agree that economic growth affects the welfare and well-being of people dramatically. Besides, to increase economic growth, humanity has a better standard of living almost in all areas. It is impossible comparing conditions of a hundred years ago and today. The significant differences between these terms are an undeniable fact. These differences consist of all areas that raise the quality of life such as improvement of health, education, economy, social life, housing, nutrition, technology so on, and so forth. Thence, people are able to increase life expectancy and quality of life, have better living conditions and make life easier. These circumstances are appropriate to emphasize the importance of economic growth (Rittenberg & Tregarthen, 2012; Aghion & Howitt, 2009).

1.3.2. Economic growth theories

Throughout human history, the existence of an economy becomes a requirement to maintain life. The economy reveals the importance of economic growth to have a better standard of living. Accordingly, every historical period has its economic growth theories related to conditions of the period. Economic growth theories can be diversified starting with the mercantilism theory of 15th century and to alternate Physiocracy, Classical theories, Innovative growth theory of Schumpeter, Keynesian theories, Post-Keynesian (Neo-Keynesian) theories, Neoclassical theories, and the last one Endogenous Growth theories of 20th century (Sharipov, 2015). Economic growth theories are various because the source of these theories can change to economists and the features of that period. In

this study, to take into consideration of relation with public debt, economic growth is analyzed roughly in three categories. In the first place, Keynesian and Post-Keynesian (Harrod-Domar) theory; Secondly, Neoclassical theory especially the Solow growth model; Lastly, Endogenous growth theories and Barro's "Government spending model" are explained.

1.3.2.1.Keynesian and Harrod-Domar theories

John Maynard Keynes has developed the theory based on the aggregate demand side of the economy. The Keynesian theory explains changes in economic activities stem from aggregate demand such as national income, consumption, investment, and saving. According to the view of Keynes, there can be situations that the market cannot be self-regulating itself in economic crises or depression times. In these times, the government should intervene economy by using its tools to stimulate the economy. Keynesian theory is known as the solution for the Great Depression in 1929 with this perspective. The Keynesian theory emphasizes the importance of two conditions. One of them is decreasing the interest rate as monetary policy to increase aggregate demand; and one another is that the government must invest in infrastructure as fiscal policy. Therefore, things are necessary for economic growth and activity. Keynesian theory is significant because it remarks on the requirement for government interference. Herewith, the government can use public debt as a tool to compensate for financial difficulties to sustain economic growth (Sharipov, 2015).

After Keynesian theory, Harrod-Domar theory is developed that known as Post-Keynesian and/or Neo-Keynesian. In fact, two theirs are constituted separately by Evsey Domar and Roy Harrod. Thanks to similarities of their theory, it is mentioned Harrod-Domar's theory. According to Harrod-Domar's theory, achieving growth is related to more investment. In this theory, a simple economic growth model is used (Todaro & Smith, 2014). According to Harrod-Domar theory indicates that GDP growth rate, comprise of the net national savings ratio and capital-output ratio. Harrod-Domar model implies that the growth rate of GDP or national income is positively related to saving ratio while it is negatively related to the capital-output ratio. Briefly, the economy with a higher capital-output ratio experiences a lower rate of GDP growth. The principal of the Harrod-Domar model is that saving and investment are the golden rules in achieving growth.

Harrod- Domar theory explains that investment is a significant factor for economic growth. However, the theory does not consider labor and technological processes. These

are limitations of the Harrod-Domar. Keynesian and Post-Keynesian theories have similarities. In the economy, savings can be used for financial investment but in the situation of lack of enough savings, the government can prefer borrowing to stimulate its economy. These theories are important to define the need of public debts (Çoban & Çöğürcü, 2011; Sharipov, 2015).

1.3.2.2.Neoclassical theories

Neoclassical theory is based upon the classical approach that is completely reverse of Keynesian theory. Instead of government intervention, the theory focuses on competitive markets to balance economic growth. Also, the neoclassical theory is considered capital and labor with the possibility of changing their coefficient. The theory defends the opinion that Keynesian growth theory is meaningless because the only factor for growth is an investment. However, the Keynesian theory ignores the most important factor that is technological progress. Neoclassical theory lay stress on technological progress for economic growth. The Solow growth model is attracted considerable attention in neoclassical theories (Sharipov, 2015; Mankiw, 2016; Todaro & Smith, 2014).

Solow growth model explains that the reasons for nations' different growth levels and whether it is possible to catch up with the same growth level of countries. In this study, the model is outlined. Firstly, according to the Solow model, capital accumulation achieves economic growth. An increase in investment or a decrease in population growth rate increases the capital-labor ratio (capital per worker) which raises output per worker. There is a "Steady State" condition in the Solow model that symbolizes long-term equilibrium in the economy. In a steady-state, economy have constant capital per worker and output per worker.

Another view of the Solow growth model, there is a "Golden Rule" that is the maximum amount of capital-labor ratio at a maximum consumption level. This level is the ultimate level of capital-labor ratio and output per worker. At the same time, the "Golden Rule" is the limitation of growth. After this certain level, increasing capital per worker causes consumption decreases and output directly (Jones, 1998).

The main point of the Solow model is technological progress. According to the Solow model, sustainability in growth is possible with the addition of technological progress to the model (which is the constant initially). The Solow model takes a stand of technological progress is the only way to achieve and sustain economic growth.

1.3.2.3.Endogenous growth theory

Endogenous growth theory is also known as "new growth theory" and the theory rejects the exogenous technological change of Solow's. Endogenous growth theory is based on these assumptions: There is no diminishing marginal productivity of capital (reverse of neoclassical); to exist increasing returns to scale in production, and externality effects of capital investment are important.

In new growth theory, as distinct from Solow growth theory, technological changes are explained endogenously. Endogenous growth theory requires the technological change must be formed investment in human capital that includes education and health qualities and knowledge-intensive industries to achieve economic growth. On the other hand, new growth theory is based upon the idea that the government should play an active role to encourage development and investment in human capital, knowledge-intensive industries, science, and new technological advancements. The remark can be made as an adverse opinion of neoclassical however, endogenous growth theory is based on the opinion that government intervention and incentive policies are necessary for the process of technological development.

Hence, endogenous growth theories have the opinion that to achieve and sustain economic growth is possible with technological improvements which are the development of human capital, research, and development technologies, and science (Todaro & Smith, 2014; Mankiw, 2016; Sharipov, 2015).

In view of all economic growth theories, the economy is vital to survive and exist for all nations. In the sense of having a strong and macroeconomy, nations must take into consideration the importance of economic growth. To achieve economic growth cannot possible with nations' scope and resources. In this respect, the necessity of public debt becomes critical. Herewith, the effect of public debt on economic growth should explain.

1.4. The Impact of Public Debt on Economic Growth

Recently, the matter in hand is the impact of public debt on growth. Beyond all questions, the existence of public debt has a significant effect on the economy. First of all, a clear understanding of the effects of public debt requires knowledge about the usage of the public debt. According to some point of view, public debt can be acceptable as long as debt should be used to increase production. This means that the productiveness of nations should increase with efficient usage of the public debt. Thus, excess production meets the expense of debt. Correspondingly, the usage area of public debt should be

education, infrastructure, management of public institutions, and reduce tax. These usage areas can be duplicable.

Furthermore, the government should make investment areas that enhance productivity to cover the public debt. In such circumstances, public debt is the preferable means to balance the economy. On the other hand, there are some views that public debt can be a serious problem for economies. To understand better, the impact of public debt is analyzed dichotomously such as short-term and long-term effects (Nautet & Meense, 2011; Chudik, Mohaddes, Pesaran, & Raissi, 2018).

1.4.1. Short-term impact

There are different considerations about the short-term impact of public debt on the economy. In general studies, short-term public debt sustains economic growth via using debt as a fiscal expansion that increases aggregate demand. As a consequence of the rising of aggregate demand, the economy will be recovered. There are, however, another idea is the existence of a negative impact on economic growth against the notion that public debt affects economic growth positively.

The short-term impact of public debt cannot be as negative as it is thought. The adverse impact of public debt is very small. One of the reasons for the weaker negative effect is that transfer regulations affect economic activity lesser than the positive impacts of consumption and investment changes. In the short-term, the government uses transfers as a tool via increasing subsidy or decreasing taxes. Though, these tools have little effect on economic growth. Another reason is that the government avoid increasing interest rates for short-term debt. In this case, the private sector can still invest. These reasons cannot restrict economic activities and the short-term negative impact of public debt is restricted.

A substantial part of the short-term impact of public debt is related to the situation of the economy. For instance, an open economy is less effected from public debt than a closed economy or the countries that have efficient policies of the central bank is less sensitive than the countries that have weaker central bank policies or the situation of existence of fixed exchange rate is more affected from public debt than the presence of floating exchange rate in the country.

1.4.2. Long-term impact

In literature, the overmuch studies are played a part in the relationship between public debt and economic growth. The findings of these studies can be diversified. Some

of them find that public debt has a certain negative effect on economic growth while others' remark is no specific relation between public debt and economic growth. The results of studies differ greatly because every economy has a unique structure and the size of the debt is, also, important. The intention of the size of debt means the threshold level for public debt. Briefly, the development level of several countries, the threshold level of public debt, and the method of analysis can be reasons for variety.

Actually, the general view about the long-term impact of public debt is that damages economic growth. The harmful long-term impact of high public debt can be classified such as a decline in national savings, higher interest rates and taxation, crowding-out effect, and the existence of debt trajectory.

The first negative impact of long-term public debt is a decrease in national savings. An increase in public debt causes that the government must reduce its positive saving and/or national savings. The decrease in national savings leads to interest rate to be higher. This situation decelerates capital accumulation. A decrease in national savings causes labor productivity to low.

Secondly, as a result of an increase in public debt, the expenditure of the government will be higher. In a word, high interest rates become revenue charges. Under this circumstance, the government has to increase productivity or use tax addition to pay off.

The crowding-out is another result of the negative impact of public debt on the economy. The government uses its bonds and treasury bills as a tool of debt in the economy. In this case, the state sells treasury securities in return for borrowing. The private sector purchases securities, fund-raising the government. Since the private sector buys securities for a part of their budget, however, the investment and saving of the private sector have to diminish. Concisely, crowding-out is the situation of that higher public debt causes a decrease in investment and saving of the private sector.

The last adverse impact of high public debt on economic growth is an ordinary course of the debt which causes the expectation of investors about having confidence in the economy. The lack of confidence and presence of uncertainty are reasons to avoid these high debt economies. In such a case, investors require higher interest rates which means more expenditure for the high debt countries. The higher revenue charges put a strain on the economy in the long run. This situation even can lead to economic crises by triggering a decrease in confidence in the economy.

To authenticate these short-term and long-term effects, the study makes an econometric analysis for both Turkey and selected countries. Before analysis, a literature review should be investigated to be well-versed in the relation between public debt and economic growth.

1.5. The General Assessment of Existing Studies

Reinhart & Rogoff[1] examine the economic growth and inflation for a different kind level of public debt. The study includes 3,700 observations for forty-four countries on condition that advanced and emerging countries. In respect to this article, the relationship is investigated for twenty advanced countries over the period 1946-2009. The advanced countries comprise Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, the United Kingdom, and the United States. There are four groups of public debt to GDP levels. The first one is the low debt which below 30 percent; the second one is medium debt that between 30 and 60 percent; the third one is high debt where the debt 60 to 90 percent; and the fourth one is very high which debt/GDP ratio is above 90 percent. Reinhart & Rogoff performs average and median GDP growth for each of the four debt groups. The study includes 1,180 observations in total. In separately, 443 observations for low debt; 442 observations for medium debt; 199 observations for high debt; and 96 for the very high debt group. The finding is that the relationship between public debt and growth is significant when the debt reaches a 90 percent threshold. In this way, the group that debt to GDP ratio over 90 percent has 1 percent less median growth and 4 percent lower average growth.

Additionally, Reinhart & Rogoff apply the same debt ratio groups for the periods 1946-2009 and 24 emerging countries including Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Ghana, India, Indonesia, Kenya, Korea, Malaysia, Mexico, Nigeria, Peru, Philippines, Singapore, South Africa, Sri Lanka, Thailand, Turkey, Uruguay, and Venezuela. The number of observations is 1,142 in total which consist of for debt/GDP below 30% (low debt) is 502; for debt/GDP 30 to 60% (medium debt) is 385; 145 observations for debt/GDP 60 to 90% (high debt); and 110 for debt/GDP above 90% (very high debt). Furthermore, the study also includes identical debt ratios and selected emerging countries for the period 1900-2009. As a conclusion of

[1] The study of Reinhart & Rogoff is published on 2010.

applying, the decline in the median and average GDP growth for the first-three debt groups (less than 90 percent of GDP) is about 4-4.5 percent while the very high debt group (above 90 percent) falls substantially 2.9 percent.

One more analysis of Reinhart & Rogoff is that public and private debts generate external debt. In this study, there are 20 emerging market countries included are Argentina, Bolivia, Brazil, Chile, China, Colombia, Egypt, India, Indonesia, Korea, Malaysia, Mexico, Nigeria, Peru, Philippines, South Africa, Thailand, Turkey, Uruguay, and Venezuela. In the total of 755 annual observations, the number of observations for 252 for the low debt; 309 for the medium debt; 120 for the high debt; and 74 for the very high debt group. The analysis generates that the thresholds of external debt with over 60 percent is significantly lower than for the threshold of public debt.

The remarks of Reinhart & Rogoff, according to the analysis of 44 countries in terms of the public debt, inflation, and economic growth is that economic growth lowers considerably when there is high public debt to GDP ratio (90 percent and above) for both emerging and advanced market economies. The 90 percent threshold is significant because of "debt tolerance"[2]. This is because an excessive rise in debt levels causes the governments to become indebted and increase in risk premia. The governments aspire to reduce risk premia to attract investors.

On the other hand, depending on the view of Kumar and Woo[3], the study involves the relationship between initial dept and subsequent growth of real per capita GDP and the impact of threshold on this relationship on spanning period 1970-2007 for 38 advanced and emerging market economies. The research includes econometric analysis which is pooled OLS, robust regression, between estimator (BE), fixed effect (FE), and SGMM regression. In respect to this study, there are several numbers of sources of bias. One of them is heterogeneity bias which arises from the potential correlation between regressors and fixed effects. Heterogeneity bias causes inconsistent estimates of pooled OLS and BE. The second one is that a possible correlation between regressors and the error term creates an endogeneity problem, which affects the consistency of pooled OLS, BE, and FE estimators. The third one is classical measurement errors that error in independent variables. The consistency of pooled OLS, BE and FE estimators are affected

[2] The concept of "debt tolerance" comes from previous analysis of Reinhart, Rogoff, and Savastano in 2003.
[3] The analysis of Kumar and Woo in 2010.

because of classical measurement errors. Kumar and Woo allege that the existence of heterogeneity bias and classical measurement errors, BE is the better estimators in terms of total bias rather than pooled OLS, FE, and difference GMM. Therefore, Kumar and Woo prefer to use BE and SGMM estimators in this study.

In addition to this, Kumar and Woo, also investigate the nonlinearities between advanced and emerging countries. The study includes dummy variables and consists of three debt ranges for low, medium, and high debt. The low debt is less than 30 percent of GDP, the medium debt is the debt between 30 and 90 percent of GDP and high debt is the over 90 percent of GDP. In the FE and SGMM estimators, the coefficient of low debt is insignificant. While the pooled OLS estimation concludes the coefficient of medium debt is significant, the others (BE, FE, and SGMM) find the coefficient of medium debt as an insignificant. According to BE, OLS and SGMM estimate the significant negative coefficient.

According to statistical inference, there is an adverse relationship between initial debt and subsequent growth. If a rise in the initial debt-to-GDP ratio a 10 percentage causes to diminish 0.2 percentage of annual real per capita GDP. However, the paper indicates that advanced economies with a decreasing 0.15 percentage ratio are affected smaller than the emerging market economies. Also, the nonlinearity holds with a higher threshold, 90 percent of GDP, demonstrates the existence of a significant negative effect on growth.

The analysis of Kumar and Woo consisted of 38 advanced and emerging countries that have a population of over five million for the period 1970-2008. In 2015, Kumar and Woo are advanced their analysis by use of 79 advanced, emerging, and developing countries and there is no restriction for the population in the new analysis. The finding of the study is similar in terms of the inverse relationship between public debt and economic growth earlier with paper in 2010. (10% increase in the initial debt-to-GDP ratio is related to a 0.2% decrease in real per capita GDP growth). However, specifying the exact threshold level (above 90% of GDP; high debt) can be difficult. As a result of the inverse relationship, because of decreasing investment and slower capital accumulation, the labor productivity growth decelerates.

The alternative study about the effect of debt on economic growth is performed by Cecchetti, Mohanty, and Zampolli in 2011. The study consists of debt levels of 18 OECD countries for the period from 1980 to 2010. The impact of debts is examined separately

as household, non-financial corporate, and government debt. The authors of the article think about the debt that the usage of debt is substantial because if it is used wisely and moderately, the welfare improves. The usage of debt, however, is excessive and improvident, it can cause a loss in the economy. Firstly, the growth rate of per capita income is estimated by using overlapping five-year averages. Also, to avoid the problem of reverse causation (minimizing the endogeneity bias), all explanatory variables (exception of population growth) are predetermined concerning five-year averages. The explanatory variables including gross savings; population growth; openness to trade; the number of years spent in the second equation; the total dependency ratio; CPI inflation; the ratio of liquid liabilities to GDP; and control for banking crises taking the value of zero if there are no banking crises in five years.

Cecchetti, Mohanty, and Zampolli, also, examine the threshold effect to identify the point which returns the debts from good to bad. The estimation of the equation includes a series of debt-to-GDP ratio and likelihood ratio (LR) statistic is used to measure the statistical significance of the threshold level.

The statistical findings of Cecchetti, Mohanty, and Zampolli are that the public debt has the threshold is about 85% GDP; the threshold of corporate debt is closer to 90% of GDP, and the household debt is in a range of 85% of GDP. The general result of the study indicates that reaching a certain level of debt harms economic growth.

The analysis of Caner, Grennes, and Koehler-Geib consists of the impact of public debt on economic growth and the existence of the threshold effect. In this study, the estimation is done by using 101 developing and developed countries for the period from 1980 to 2008. As the methodology of the study least squares regression and pooled least squares regression are used to estimate threshold value. According to the results of the study, the impact of public debt on economic growth is negative. The threshold value, however, is associated with the countries' income per capita. In the circumstances, the threshold value of the public debt to GDP on economic growth for the full sample is 77%. The rise in public debt from this threshold level causes a decrease in economic growth by 0.017%. To consider the threshold value for the subsample of developing countries, the threshold value becomes 64% which demonstrates the effect of threshold value damages developing countries further rather than developed countries. An additional increase in the public debt decreases economic growth by 0.02% for developing countries.

Checherita and Rother examine the 12-euro area countries namely, Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain to measure the non-linear effect of the public debt on economic growth more than forty years from starting in 1970. The study implements FE and GMM estimators, robustness checks, and calculates the confidence interval for the turning point of the debt. The estimation results are that there is a non-linear impact of the public debt on economic growth and the concave relationship between public debt and economic growth has a 90-100% debt turning point. The debt turning point shows that any debt level above this point decreases long-term growth. Also, the statistical confidence level of these countries is around 70-80% of GDP which means from these levels, the public debt can affect economic growth negatively. In addition to this, the results of the study include that the change of public debt level has an impact on economic growth rates which are private saving, public investment, total factor productivity, and long-term nominal and real interest rates.

Chudik, Mohaddes, Pesaran & Raissi (2018) perform threshold and long-term analysis to understand the impact of public debt on the economy for 40 economies and spanning the period 1966 to 2010. According to the results of the analysis, the threshold value that more than 60% has a negative impact on growth. Moreover, a statistically significant long-term relationship between public debt and economic growth indicates that the annual pace of 3% debt-to-GDP ratio is related to lower GDP growth about between 0.2% and 0.3%.

Afonso and Jalles analyze the relationship between economic growth, productivity, and government debt. The relationship is evaluated by the examination of the existence of nonlinearities, the threshold effects, simultaneity, and endogeneity. The study includes a panel analysis of 155 OECD, emerging and developing countries for the period 1970-2008. Cross sectional-time series data is used to make panel analysis.

The empirical results of this study show that the government debt ratio and economic growth are negatively related, for all samples in the dataset. However, only the OECD sub-group, the longer average maturity causes higher economic growth. Additionally, the results for the threshold effects are that the debt ratios above 90% of GDP lead to lower economic growth rather than the countries have debt ratio levels under 30% of GDP. In this way, an increase in the 10% debt ratio, lowers economic growth -0.2% which has a debt ratio of more than 90% of GDP while the others' economic growth

decreases 0.1%. Moreover, the threshold debt ratio is determined by 59% of GDP for the full sample and more specifically 58% of GDP for the Euro area and 79% of GDP for emerging countries. Also, the higher debt ratios are significant for TFP (total factor productivity) growth.

Panizza and Presbitero (2014), are questioned whether there is a causal effect from public debt to economic growth that contains OECD countries. The study emphasizes that the existence of foreign currency debt has a direct and mechanical effect on the debt-to-GDP ratio by changing the country's exchange rate. In that case, the public debt has no causal effect on economic growth in OECD countries when the public debt is instrumented. The good instrument, also, requires the correlation with the endogenous variable. Additionally, the study checks robustness.

The appointment of the study is that the debt has no causal effect on economic growth in advanced economies. Furthermore, the paper measures the threshold effect. The general studies show that if there is a high threshold effect (when the debt-to-GDP ratio reaches 90 percent), causes a negative impact on economic growth. Panizza and Presbitero, However, point out that there is no threshold effect in which the impact of debt is inverse to economic growth. The paper concludes that the structure of debt is important, and the instrumented debt cannot cause the diminish of economic growth.

Égert (2015), searches for the validity of the threshold of public debt (exceeds 90% of GDP) which harms economic growth. The study tests threshold for central government debt of the Reinhart&Rogoff dataset for the period from 1946 to 2009. Subsequently, the threshold effect is measured by a multivariate growth framework that adding general government debt and combining with the Bayesian model for the period 1960-2010. The results of estimations are extremely sensitive to the description of public debt, the time dimension, and country coverage considered, data frequency (annual data, multi-year averages).

The result of a formal test of nonlinearity which is based on bivariate regression for central government debt shows that there is a negative linear correlation between public debt and growth for advanced countries for the period of 1946-2009. However, the nonlinear correlation between debt and growth kicks in the level of public debt between 20% and 60% of GDP (very lower level). These results confirm of multivariate growth framework which including general government debt on a shorter dataset for 29 OECD counties at the period from 1960 to 2010. Égert finds a result of estimations that a 90

percent threshold is not a significant or specific number. The threshold and the nonlinearity can change across countries, different samples, and economic conditions.

Arčabić, Tica, Lee, and Sonora, investigate the relationship between public debt and economic growth with the use of a panel VAR model with GMM estimations by Arrelano and Bond (1991). The researchers consider three types of data sets. Firstly, Model A includes annual growth rates for the long-run data from 1880 to 2000. Model B, secondly, the short-run data, annual growth rates are used for the period from 1970 to 2009. Model C, thirdly, five years of frequency data is used for the period from 1960 to 2000. Thereafter, testing causality (granger causality test) and checking robustness, the findings of researchers is that the inter-temporal causal relationship between the public debt and the economic growth is bi-directional. According to the researchers' view, the feedback effect of economic growth is ignored for most of the previous studies. The feedback effect, however, is significant for this relationship.

The whole existing studies about the effect of public debt on economic growth have a different perspective. Most studies are considered that there is a negative impact from the public debt to economic growth for the long-term. However, the threshold value that causes the inverse effect varies. The reasons are that income capita levels and the data differ for each study. Another result of the studies is neither absence of a significant threshold level nor the public debt has a negative effect on economic growth. Nevertheless, there are several types of studies in the literature, the consequences are not the one. Every study, because, has a unique conclusion.

In this paper, the relationship between public debt and economic growth is investigated for Turkey and selected countries with different periods. The sample countries consist of selected fourteen European countries including Turkey. In the first chapter, the study includes existing studies and their results about the relationship and brief theoretical background about the public debt. The second chapter of this paper analysis the relationship between public debt and economic growth for only Turkey via making time-series analyses. Finally, the third chapter, the panel analysis is made for selected country groups to examine the relationship between public debt and economic growth and whether there are significant statistics for long-term relationships between variables. Table 1.1 represents a summary of all existing studies about the relationship between public debt and economic growth.

Table 1.1. *Summary table of literature review*

Author(s) - Year	Data Set	Methodology	Conclusion
Afonso & Jalles (2011)	There are 155 OECD countries which consist of emerging and developing countries from 1970 to 2008.	Panel analysis based on cross-section analysis. Pooled OLS and fixed effect (FE) is used.	The threshold value that is 90% and above decreases economic growth. An increase in the 10% debt-to-GDP ratio by 0.2% for high-level debt while other economies' economic growth decreases by 0.1%. The threshold value is 59% for the full sample, 58% for the Euro area, and 79% for emerging countries.
Arčabić & Tica & Lee and Sonora (2018)	There are 3 models. Long-run data for 1880-2000, Short-run data for 1970-2009- and five-years frequency data for 1960-2000.	Panel VAR, GMM estimations (Arellano and Bond), Granger causality test, and feedback effect are used as a method.	There is an inter-temporal effect between public debt and economic growth however, the effect of public debt on growth is weak.
Canbek (2014)	There are 128 countries that advanced, emerging, and developing for the period 1960-2011.	The fixed effect, cross-sectionally distributed lag (CS-DL), and mean group (MG).	The negative effect of public debt more apparent in emerging markets rather than advanced and developing.
Caner, & Grennes and Koehler-Geib (2010)	The data set consists of 101 developing and developed countries for the period from 1980 to 2008.	Least squares regression and pooled least squares regression are used for investigation.	If the debt-to-GDP ratio is 77% for the general sample, economic growth decreases by 0.017%. The threshold value of only emerging markets is 64% which causes a 0.02% decrease in economic growth.
Cecchetti & Mohanty and Zampolli (2011)	The study includes 18 OECD countries for the period from 1980 to 2010.	The likelihood ratio (LR) statistic is used to estimate threshold values.	There is an adverse relationship between public debt and growth with certain ratio levels. However, debt-to-GDP ratios differ according to debt types. The general threshold value is about 85% of GDP, while the threshold of corporate debt is 90% and the threshold of household debt is 85% of GDP.
Checherita & Rother (2010)	There are 12- euro area countries for 40 years with the starting period from 1970.	Panel fixed effect is used considering heteroskedasticity and autocorrelation	Checking robustness concludes that a 90%-100% threshold is harmful to economic growth. According to the confidence level, the existence of any debt level after 70%-80% of GDP affects economic growth negatively.

Table 1.1. *Summary table of literature review (continue)*

Author(s) - Year	Data Set	Methodology	Conclusion
Chudik, Mohaddes, Pesaran & Raissi (2018)	There are 40 countries for the period from 1966 to 2010.	Panel analysis with CS-ARDL and CS-DL for both threshold effect and long-term effect is considered.	Checking threshold values concludes that above 60% of debt-to-GDP ratios tend to diminish economic growth. Also, the long-term effect of public debt decreases economic growth average 0.2 to 0.3 percent.
Égert (2015)	There are two periods 1946-2009 and 1960-2010 which is a period for 29 OECD countries are included.	Bayesian model averaging and multivariate growth framework are used.	There is no certain threshold value because the analysis threshold value is between 20% and 60%. The threshold can change across countries and samples.
Kumar & Woo (2010)	The period of 1970-2007 for 38 advanced and emerging market economies.	Pooled OLS, robust regression, between estimator (BE), fixed effect (FE), and SGMM regression are used as a method.	There is a negative relationship between public debt and economic growth. A 10% increase in debt-to-GDP ratio causes a 0.2% decrease in real per capita GDP. Advanced economies face a 0.15% decrease in real per capita GDP that is smaller than the general outcome.
Panizza & Presbitero (2014)	OECD countries are used.	Checking correlation, robustness, and threshold effects.	There is no negative relationship between public debt and economic growth. The instrumented debt does not decrease economic growth. Also, there is no certain threshold value to explain this relationship.
Reinhart & Rogoff (2010)	There are 3,700 annual observations for 44 countries that have advanced and emerging market countries.	Four groups of debt-to-GDP ratio level: 30% (low); 30%-60% (medium); 60%-90% (high); above 90% (very high).	A high level of debt/GDP (90% and above) ratio causes a lower growth rate for both emerging and advanced markets. However, emerging markets are more sensitive and the debt-to-GDP threshold is 60%.

CHAPTER 2

2. TIME SERIES ANALYSIS IN TURKEY

The second section of the study consists of time series analysis only for Turkey to understand the effect of public debt on economic growth in this country. In the first place, to analyze Turkey's situation from the point of public debt, public net debt stock and the debt-to-GDP ratio is used that demonstrates for the period between the last quarter of 2000 and the fourth quarter of 2018 by adhering to the study. There are two graphs about the situation of public debt for Turkey. The first graphic is the public net debt stock and the second one shows the ratio of public net debt stock to growth. These data are taken from Turkey's under secretariat of treasury.

The public net debt stock is the indicator that includes the indebtedness of the public sector by taking into consideration of public assets (Derya, 2015). The public net debt stock is measured by removing assets of public and central banks from gross national debt which includes both internal and external debts. In figure 2.1.[4], public net debt stock follows a fluctuating course in Turkey. In time, a decrease and increase occur like a vicious circle.

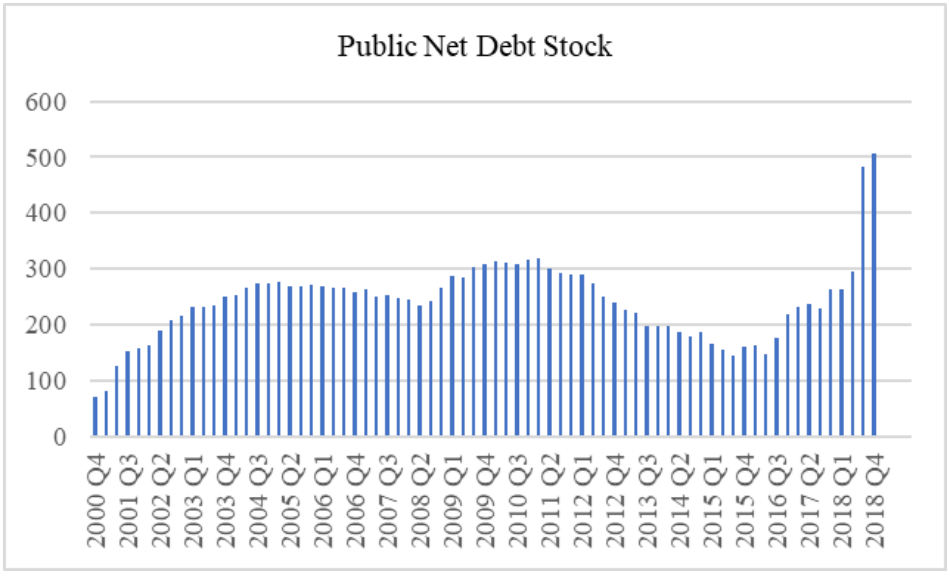

Figure 2.1. *Public net debt stock (Turkey's under secretariat of treasury)*

As it seems in Figure 2.1, public net debt stock was ₺70.8 billion in the last quarter of 2000. Since this time, it is increased until the last quarter of 2005. Then, the stock

[4] Public net debt stock is billion-TL (₺) denominated.

decreased until the third quarter of 2008 and it continued to increase till 2011. After this time the stock decreased by the time 2015. Lastly, the stock increased until today. A general interpretation of public net debt stock can be that the stock tends to rise in a crisis period. The public net debt stock shows an increase in 2001, 2009-2010 (the effect of 2008 crises), and 2018. Especially, there is a sharp rise from 2018 Q2 to 2018 Q3 and the rest. Numerically, the public net debt stock goes up from ₺297 billion to ₺483 billion. The latest record of the debt stock is about ₺ 507 billion for the fourth quarter of 2018.

The debt-to-GDP is the ratio of public net debt stock to GDP of nations (Turkey). The public debt is considered as a percentage of GDP. The Debt-to-GDP ratio indicates the ability of nations to pay their debts that is the importance of the ratio (Perry, 2014). Figure 2.2. represents the debt-to-GDP ratio of Turkey. The course (rise and falls) of the debt-to-GDP ratio is almost the same with public net debt stock. In the last quarter of 2000, the debt-to-GDP ratio was 41.5% and in the second quarter of 2018, it was 9%. As a result, the debt-to-GDP ratio has a decreasing trend within eighteen years. Likely, public net debt stock, the debt-to-GDP ratio has a substantial increase from 8% to 13% by 2018 Q2 to 2018 Q4.

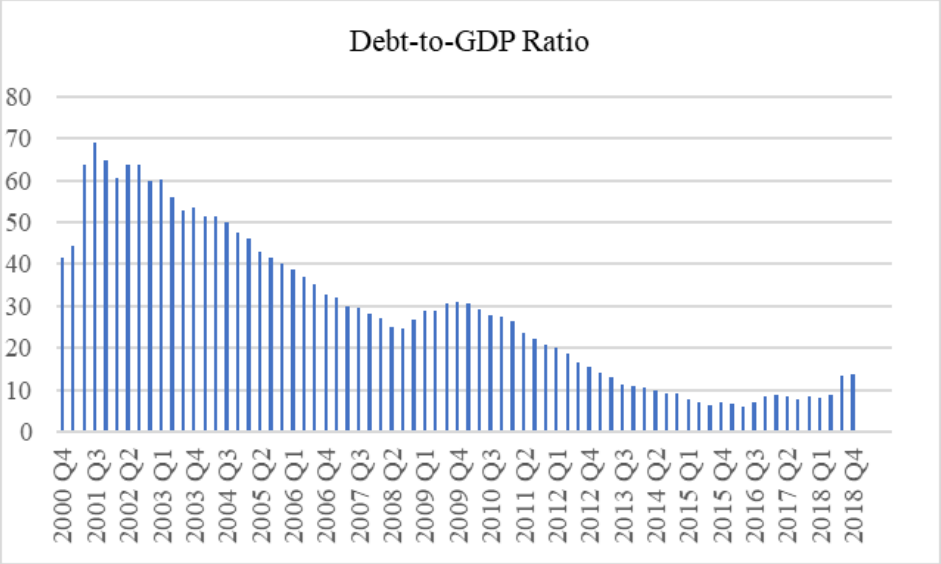

Figure 2.2. *Debt to GDP ratio (Turkey's under secretariat of treasury)*

In this section of the study, the aim is to reveal the relationship between public debt and economic growth in Turkey. The debt-to-GDP ratio is the most significant data to investigate the effect of public debt on economic growth. In this context, time series analysis is made for the period the first quarter of 2003 and the last quarter of 2018 using

quarterly data. The available data starts in the last quarter of 2000. However, 2003 Q1 is the beginning year for this analysis. The reason is the presence of the greatest economic crises of Turkey's history. Generally, this crisis is known as the 2001 crises however in terms of its consequences, includes the process of depression that starting from the 2000s and it has material adverse effect financially. Under these circumstances, time series analyses begin from the first quarter of 2003 to reduce the effect of the crisis on public debt. As an example of the condition of public debt, the debt-to-GDP ratio is 41% in 2000 Q4 then it increases and becomes 64% in 2001 Q4 and it continues to rise until 2002 Q4 and in this time it occurs as 59%. These are ex-post values that are taken from Turkey under the secretariat of the treasury. Values of debt-to-GDP ratio and public net debt stock are denominated in Appendices I.

The second section of the study includes a time series analysis for Turkey which explains data and methodology in the first place. Secondly, the results of the analysis are evaluated.

2.1. The Data and Methodology

In this study, variables consist of real gross domestic product growth rate (RGDP), debt-to-GDP ratio (DEBT), and gross fixed capital formation (GCF). These data have a quarterly frequency for the period of 2003Q1-2018Q4. The debt-to-GDP ratio is taken from Turkey's under secretariat of treasury, the real gross domestic product growth rate is taken from OECD Statistics and gross fixed capital formation is imported from the electronic data system of The Central Bank of The Republic of Turkey. The reason is that the year starting is 2003, existing of 2001 crises in Turkey. In these days, the effect of crises increases directly public debt stock. This situation can be a deviation in the results of the analysis. Therefore, the analysis starts from the first quarter of 2003. The explanation of the data set takes place in Table 2.1.

Table 2.1. *The explanation of the data set*

Variables	Variable Code	Interpretation[5]	Source
Real GDP Growth Rate	RGDP	The growth rate shows the percentage change in GDP compared to the previous quarter.	OECD Statistics
Debt-to-GDP ratio	DEBT	The total stock of debt liabilities issued by the government as a share of GDP.	Turkey's Under secretariat of treasury
Gross fixed capital formation	GCF	Gross fixed capital formation includes land improvements; plant, machinery, and equipment purchase; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings.	The Central Bank of The Republic of Turkey- Electronic Data Transfer System (EVDS)

In the analysis, the debt-to-GDP ratio (DEBT) is the most essential variable to explain real gross domestic product (RGDP). After this, gross fixed capital formation (GCF) can be ranked as the second one. "Gross fixed capital formation (GCF) is defined as the acquisition (including purchases of new or second-hand assets) and creation of assets by producers for their use, minus disposals of produced fixed assets". Higher gross fixed capital formation leads to improved assets via increasing productivity of assets and it, also, leads to an increased volume of investment (OECD, 2009).

Two variables of the data set, RGDP, and DEBT, are imported as a ratio. Therefore, GCF is converted to ratio via percentage change to make easier analysis and interpret findings. Since all variables are seasonally adjusted and ratio, the results of the analysis can be interpreted as a percentage. The model of time series analysis of Turkey that dependent on three variables is demonstrated as:

$$RGDP_t = \beta_0 + \beta_1 DEBT_t + \beta_2 GCF_t + u_t \quad (2.1)$$

where t=1, 2, …, T that t represents time period of analysis and β_0 is constant while β_1 & β_2 are coefficients of variables. In Equation 2.1, RGDP is explained variable, and DEBT and GCF are independent variables.

Time series analysis requires seasonality analysis and stationary tests in the first place. The non-stationary series can have uptrend or downtrend. Likewise, seasonality

[5] Explanation of interpretations are taken by sources.

occurs when the series has seasonal variation. Under these circumstances, the series must be stationary and seasonally adjusted otherwise result of the test can be misleading. Thus, before establishing a model, data must be tested whether it is stationary or not. A time series is stationary if that mean and variance are do not change in time (Asteriou & Hall, 2011). The existence of stationary can be tested via unit root tests. There are two types of unit root tests used for the time series analysis in this study. One of the unit root tests is Augmented Dickey-Fuller (ADF), which is the extended version of Dickey and Fuller tests of the existence of unit root hence the stationary. The ADF test consists of additional lagged values of dependent variables. Estimating regression of the ADF test as follows (Gujarati, 2003):

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{k} \propto_i \Delta Y_{t-1} + \varepsilon_t \qquad (2.2)$$

In Equation 2.2, ΔY_t is the first difference of the variable that tests whether it is stationary, ΔY_{t-1} is lagged values of the first difference variable and t represents the trend variable. "k" is the representative of lag length. In practice, however, k can be determined automatically by Akaike Information Criterion (AIC) or Schwarz Criterion (SC). The Schwarz Criterion is preferred for this study.

Testing ADF is related to whether coefficient δ is equal to zero. The null hypothesis of the ADF test is that there is a unit root in the model and the model is not stationary. Hereafter, the null hypothesis must be rejected to achieve stationary of series. After the estimation of the ADF test, the critical value of MacKinnon and t-statistics of the ADF test must compare to conclude. Ultimately, when the absolute value of the ADF t-statistics is bigger than critical values (%1, %5, %10) or the probability of ADF test is less than 0.05 critical value, the series is stationary and there is no unit root.

The other unit root test used for stationary is developed by Phillips and Perron in 1988. The Phillips–Perron (PP) test is a generalization of the assumption of error terms of the ADF test to resolve the autocorrelation problem. Like the ADF test, lag length can be determined by automatic selection in the PP test. The study used the Schwarz Criterion (SC). Also, the null hypothesis is similar to ADF tests. In order that the series is stationary with using the PP test, the null hypothesis must be rejected via absolute value Phillips–Perron (PP) test statistic must be higher than MacKinnon test critical values (%1, %5, %10) (Asteriou & Hall, 2011).

In the process of time series analysis, after checking the series whether there is stationary or not, the consequence of the ADF test is that the series is not stationary at its level. Under this circumstance, there is a need for a cointegration test to investigate the long-term relationship between non-stationary series. Autoregressive Distributed Lag Bound Test (ARDL) is used as a cointegration test for this study. The ARDL approach is important because ARDL can test different integrated variables. Thus, the series does not have to have the same integration level. The only restriction of the ARDL test is inapplicable in the existence of a second difference or more integration level. The ARDL regression model is summarized in equation 2.3.

$$Y_t = \beta_0 + \sum_{i=1}^{p} \beta_i Y_{t-i} + \sum_{i=1}^{q} \delta_i X_{t-i} - \pi \hat{e}_{t-1} + u_t \quad (2.3)$$

ARDL model uses the lag of explanatory variables in addition to the lag of dependent variables to explain both short-term and long-term relationships between variables. Equation 2.3 shows the ARDL (p, q) model that represents relationships between the dependent variable Y_t explained by p degree lag values and the independent variable X_t that have q lags (Hanck, Arnold, Gerber, & Schmelzer, 2018). Additionally, knowing that $\pi \hat{e}_{t-1}$ reflects Error Correction Model (ECM) of the ARDL (Asteriou & Hall, 2011).

After the ARDL test, if there is no problem in terms of diagnostic test results, variables can be tested to conclude whether there is cointegration or not. The result of the cointegration test relies on compare values of F-statistics and t-bounds test. There are three situations as a result. Firstly, if the F-statistics is greater than the upper bound, then there is cointegration between variables. Secondly, when F-statistics is below than lower bounds, there is no cointegration between variables. And if, F-statistics is the value between lower and upper bound, the existing situation of the zone of indifferences that unknown whether there is cointegration or not. The existence of the cointegration between variables allows to make analyses about relationships. Firstly, long-term relationships and direction of explanatory variables are considered. Then, short-term relationships and its effect on the explained variable are checked. (Yıldırım, Esen, & Kostakoğlu, 2012).

The diagnostic tests should base on autocorrelation, heteroskedasticity, and Ramsey Reset test in the study. Breusch-Godfrey Serial Correlation LM Test for autocorrelation testing and Breusch-Pagan-Godfrey Heteroskedasticity test for heteroskedasticity testing

is used. The existence of autocorrelation and heteroskedasticity is a problem for analysis and it can be a reason for misinterpretation. After these tests are applied, the result F-statistics, and its probability value are checked. The higher probability value than 0.05 means that there is no autocorrelation and heteroskedasticity problem (Azimi, 2016). Moreover, the Ramsey Reset test shows whether there is a functional mistake or not in the model. According to the null hypothesis of this test, Ho, the model is correct functionally and H_1 is the model that has errors functionally. If the probability value is higher than 0.05, the Ho is not rejected, and the model is a correct functional form. Otherwise, the model does not correct functional form.

2.2. Estimation Results

Time series data can be affected by seasonal variations. Therefore, seasonality must be considered in detail before the unit root testing. Seasonality can define as an economic activity that occurs the same month or quarter of the year. Basically, the activity repeats itself for the same period. The seasonal adjustment is required to remove of seasonal effects of time series data. Seasonally adjusted data enables accurate estimation of the relationship of variables via the disappearing of seasonal effects (Dagum & Mazzi, 2018). By taking into consideration seasonality, all variables are seasonally adjusted. To examine whether there are effects of seasonality, the graphs of variables are checked together with raw variable and their seasonally adjusted version one by one.

First of all, real GDP growth (RGDP) is shown in Figure 2.3. The RGDP is raw and RGDP_SA is a seasonally adjusted variable. As it is seen in the figure, there is no vital differentiation and effect of seasonal adjustment for RGDP. The possible source of fluctuations in the graphs is the business cycle, not the seasonality.

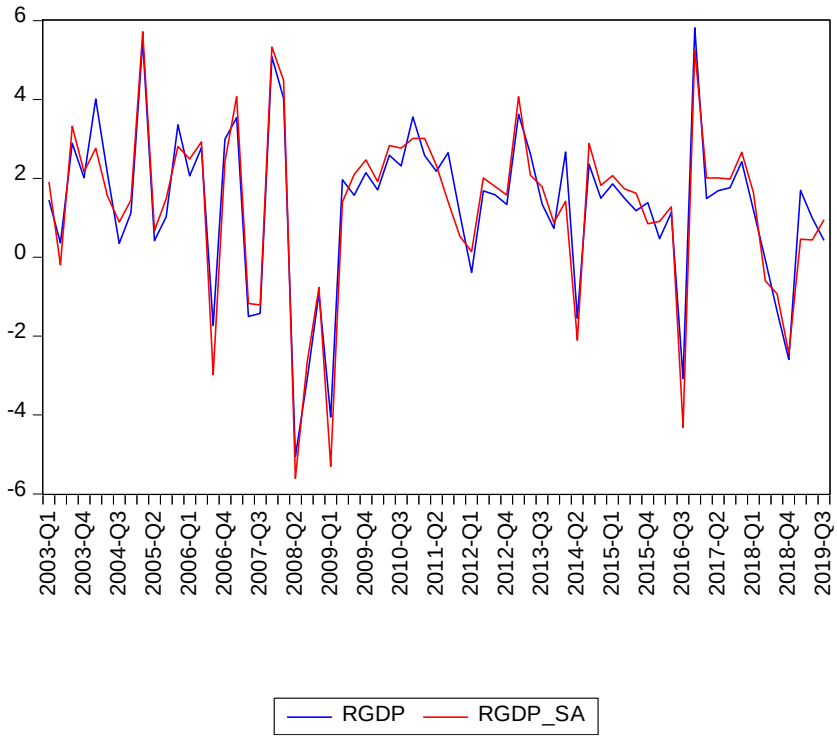

Figure 2.3. *Graphs of original and seasonally adjusted of RGDP*

Secondly, the graph of the debt-to-GDP ratio (DEBT) shows the original variable while DEBT_SA is seasonally adjusted DEBT in Figure 2.4. Since the original version of the variable is a ratio, DEBT is distant from seasonality and the same with DEBT_SA.

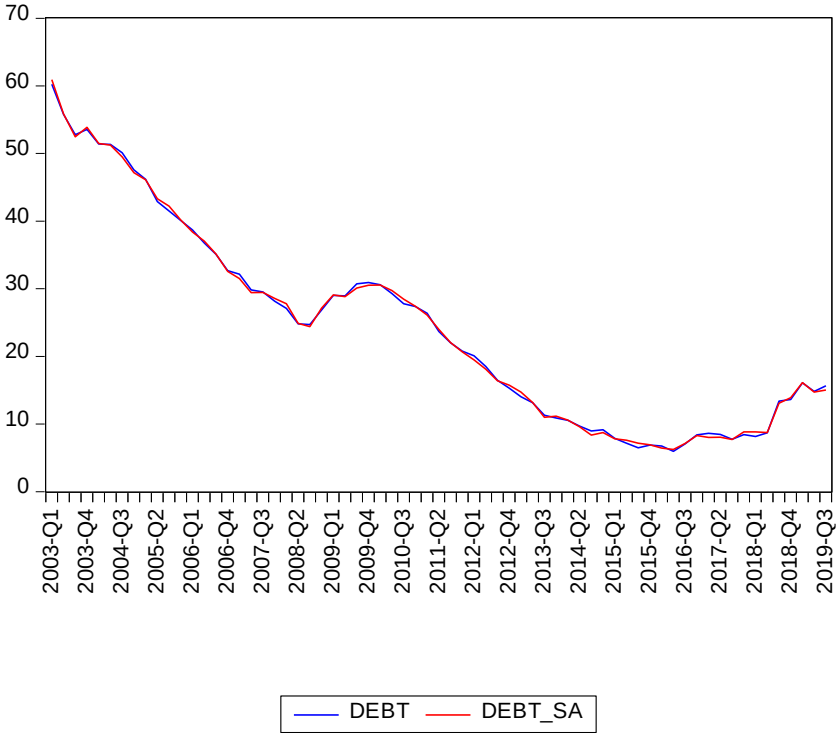

Figure 2.4. *Graphs of original and seasonally adjusted of DEBT*

The third one, Figure 2.5 shows graphics of the gross fixed capital formation (GCF). Likely other variables, the GCF is a graph of the original variable and GCF_SA represents graphs of seasonally adjusted of GCF.

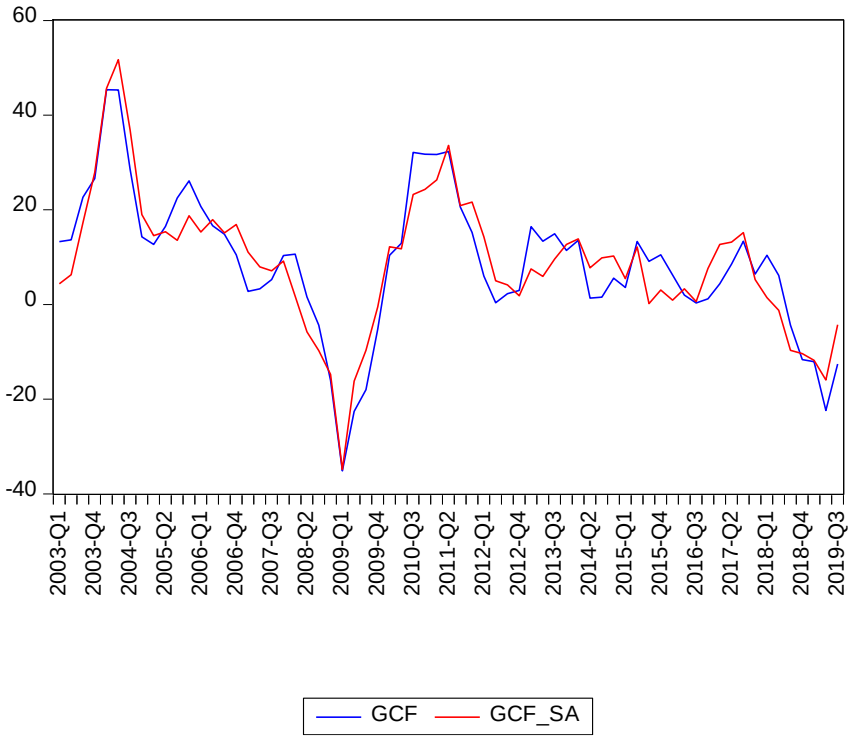

Figure 2.5. *Graphs of original and seasonally adjusted of GCF*

Comparing original variables with their seasonally adjusted version gets a result which the variables used in the study are almost seasonally adjusted and there are no big differences between raw and seasonally adjusted data. Thus, these variables are quite optimal to estimate analysis and get accurate results. Therefore, the study uses original data for all analyses.

After checking seasonality, a unit root test should be done to control the stationary of variables. The study uses two types of unit root testing. Firstly, the Augmented Dickey-Fuller (ADF) test is preferred. Secondly, Phillips-Perron (PP) is tested to control situations of a variable in terms of stationary. These unit root tests are made by using EViews 10.

In the first place, the study examines Augmented Dickey-Fuller (ADF) test results which is in Table 2.2. According to ADF test results, it can be thought that only RGDP of these variables is stationary at its level. The RGDP has no unit root at its level because the absolute value of t-statistics of RGDP is bigger for all test critical values for both

constant and constant and trend. If variables specifically analyze at their level, GCF is only stationary at 10% of constant at its level.

Table 2.2. *Results of Augmented Dickey-Fuller (ADF) tests*

Variables	t-statistics of ADF tests		Test Critical Values		
			1%	5%	10%
RGDP*[6]	Constant:	-7.295388	-3.533204	-2.906210	-2.590628
	Constant and Trend:	-7.338084	-4.103198	3.479367	-3.167404
DEBT	Constant:	-1.897885	-3.536587	2.907660	-2.591396
	Constant and Trend:	-0.326909	-4.107947	-3.481595	-3.168695
GCF	Constant:	-2.765328	-3.540198	-2.909206	-2.592215*
	Constant and Trend:	-2.852514	-4.113017	-3.483970	-3.170071
∆DEBT*	Constant:	-3.663583	-3.536587	-3.536587	-2.591396
	Constant and Trend:	-4.164959	-4.107947	-3.481595	-3.168695
∆GCF*	Constant:	-6.296188	-3.540198	-2.909206	-2.592215
	Constant and Trend:	-6.199981	-4.113017	-3.483970	-3.170071

The DEBT and GCF have unit roots at their level according to ADF test results. Because the absolute value of t-statistics of DEBT and GCF are smaller than their test critical values that 1%, 5%, and 10%. Since the variables are not stationary at their level, the requirement is that taking the difference of variables to make them stationary. After taking differences of variables, test results show that ΔDEBT and ΔGCF become stationary with first differences for both constant and constant and trend. As a result of ADF tests, RGDP is stationary at its level while DEBT and GCF are stationary at its first differences.

Table 2.3. represents the results of the Phillips-Perron (PP) test. According to PP test results, the RGDP has no unit root at its level because the absolute value of test statistics of Phillips- Perron test is bigger than all test critical values for constant and constant and trend. Specifically, DEBT is only stationary for constant at a 1% level, but it cannot be acceptable stationary its level. The DEBT and GCF have unit roots at their level according to PP test results since t-statistics are smaller than test critical values.

[6] The sign (*) represents stationary series.

Table 2.3. *Results of Phillips-Perron (PP) tests*

Variables	t-statistics of PP tests		Test Critical Values		
			1%	5%	10%
RGDP*	Constant:	-7.276554	-3.533204	-2.906210	-2.590628
	Constant and Trend:	-7.340385	-4.103198	-3.479367	-3.167404
DEBT	Constant:	-3.355042	-3.533204*	-2.906210	-2.590628
	Constant and Trend:	-0.731175	-4.103198	-3.479367	-3.167404
GCF	Constant:	-2.540311	-3.533204	-2.906210	2.590628
	Constant and Trend:	-2.941408	-4.103198	-3.479367	-3.167404
∆DEBT*	Constant:	-5.885731	-3.534868	-2.906923	-2.591006
	Constant and Trend:	-6.789626	-4.105534	-3.480463	-3.168039
∆GCF*	Constant:	-6.080599	-3.534868	-2.906923	-2.591006
	Constant and Trend:	-6.034587	-4.105534	-3.480463	-3.168039

Since DEBT and GCF have a unit root at their level, the differences of variables are taken to make them stationary. After taking the first difference of variables, ΔDEBT and ΔGCF become stationary.

The overall picture of testing of unit root tests that ADF and PP have exactly the same results. The general results of the unit root test shown in Table 2.4 which represents the level of stationary of variables.

Table 2.4. *Stationary levels of variables*

Variables	t-statistics of Unit Root Tests	
	ADF	PP
RGDP	I (0)	I (0)
DEBT	I (1)	I (1)
GDP	I (1)	I (1)

The stationary levels consist of I (0) and I (1) in the study. I (0) indicate that the variable is stationary at its level and I (1) show that the variable is stationary at its first differences. Both unit root tests confirm that the RGDP is stationary at its level and DEBT and GCF are stationary after taking their first differences.

After completion of unit root tests, ARDL must be done to explain the cointegration relationship between variables. The application of ARDL enables four types of model

selection criteria. However, the study uses two criteria models to analyze the cointegration relationship more precisely. These criteria consist of Akaike Information Criteria (AIC) and Hannan-Quinn Criteria (HQ).

In this section of the study, the ARDL model is explained for two criteria models. The ARDL models are tested in EViews 10. Also, all estimations include the Breusch-Godfrey Serial Correlation LM test used to check serial correlation and the Breusch-Pagan-Godfrey test used to control heteroskedasticity.

Primarily, the estimation results of the ARDL model are represented in Table 2.5 based on Akaike Information Criteria (AIC). The dependent variable is RGDP and DEBT and GCF take part as an explanatory variable. According to the stochastic and diagnostic results of ARDL (3,8,6), the model is correctly determined. The findings of the model show that there are no serial correlation and heteroskedasticity problem. Also, ARDL (3,8,6) correct functional form. These results make analyses possible with fit model structure. After the model estimation of ARDL (3,8,6), the cointegration relationship must be checked with Long Run Form and Bounds Test which is in Table 2.5.

Table 2.5. *Estimation results of ARDL (3,8,6) model*

Estimation Result of Model of ARDL (3,8,6) – Akaike Information Criteria			
Variables	Coefficients	t-Statistics	Probability
RGDP (-1)	-0.697451	-5.088878	0.0000
RGDP (-2)	-0.887049	-6.927158	0.0000
RGDP (-3)	-0.588304	-4.012547	0.0003
DEBT	-0.267193	-1.316143	0.1958
DEBT (-1)	0.038370	0.139219	0.8900
DEBT (-2)	0.466189	1.694826	0.0981
DEBT (-3)	0.265609	0.908601	0.3691
DEBT (-4)	-0.338992	-1.211277	0.2331
DEBT (-5)	-0.012569	-0.041659	0.9670
DEBT (-6)	-0.406873	-1.463362	0.1514
DEBT (-7)	-0.217722	-0.759016	0.4524
DEBT (-8)	0.426395	2.337575	0.0246
GCF	0.255542	7.338588	0.0000
GCF (-1)	0.014547	0.310425	0.7579
GCF (-2)	0.032802	0.733370	0.4677
GCF (-3)	-0.048515	-1.086191	0.2841
GCF (-4)	0.051377	1.146954	0.2584
GCF (-5)	-0.053560	-1.216477	0.2311
GCF (-6)	0.068131	2.239181	0.0309
C	2.667574	4.946920	0.0000
Diagnostics Test Results			
R^2	0.769745		
Adjusted R^2	0.657570		
Serial Correlation	0.478294 (0.6236)		
Heteroskedasticity	0.828137 (0.6632)		
Ramsey Reset Test	3.153398 (0.0838)		

Table 2.6 performs ARDL Long Run Form and Bounds test directly to examine cointegration relationships between variables.

Table 2.6. *ARDL long run form and bounds test (AIC)*

ARDL Long Run Form and Bounds Test		
F-statistics: 29.64553	I (0)	I (1)
k=2		
5%	3.79	4.85
10%	3.17	4.14

The results of the Long Run Form and Bounds test include that F-statistics and I (0) and I (1) bounds. There is a cointegration relationship between variables for 5% and 10% because the F statistics is bigger than both of I (0) and (1) bounds perceptibly. Since there is a cointegration relationship, the model can be considered in terms of long-term and short-term relationships. The long-term relationship takes place in the Long Run Form and Bounds test, but Error Correction Regression should be analyzed for a short-term relationship which is shown in Table 2.7.

Table 2.7. *Long-term and short-term relations (AIC)*

Long-Term Relationships		
	Coefficient	t-Statistic
DEBT	-0.014746	-2.737971
GCF	0.100959	8.854805
ECM Regression (Short-term Relationships)		
D (DEBT (-3))	0.549760	3.007278
D (DEBT (-7))	-0.426395	-2.451762
D (GCF)	0.255542	8.003571
Coint. Eq. (-1)	-3.172804	-9.669408

The results in Table 2.7 consists of long-term coefficients and short-term coefficients based on the error correction model (ECM). The cointegration relationship is significant for long-term coefficients which conclude the inverse relationship between DEBT and the same parallel relationship between GCF. Thus, 1% increase in DEBT, decreases RGDP about 0,01% and 1% increase in GCF, increases RGDP about 0.10% in the long run. Additional to the long-term relationship, the Error Correction Model also confirms that DEBT and RGDP have a negative relationship in the long run however, there is a positive relationship between them in the short run. 1% increase in DEBT, increase RGDP 0.54% for the third term while it decreases about 0.42% for the seventh term. The GCF is again positively related to RGDP in the short run as a 1% increase in

GCF rises RGDP approximately 0.25%. The coefficient of ECM is also significant which shows that the effect of any possible shock should disappear nearly speed of 3.17%.

In addition, the study includes CUSUM (Cumulative Sum) and CUSUM of Squares tests to check the stability of the ARDL (3,8,6) model. These tests control whether there is a structural change or not in the model. Test results take place in Figure 2.6. CUSUM and CUSUM of squares represent that ARDL (3,8,6) model is stable when it is estimated. Because test results (blue lines) are between the %5 significance level, there is no structural change in this model for the existing period.

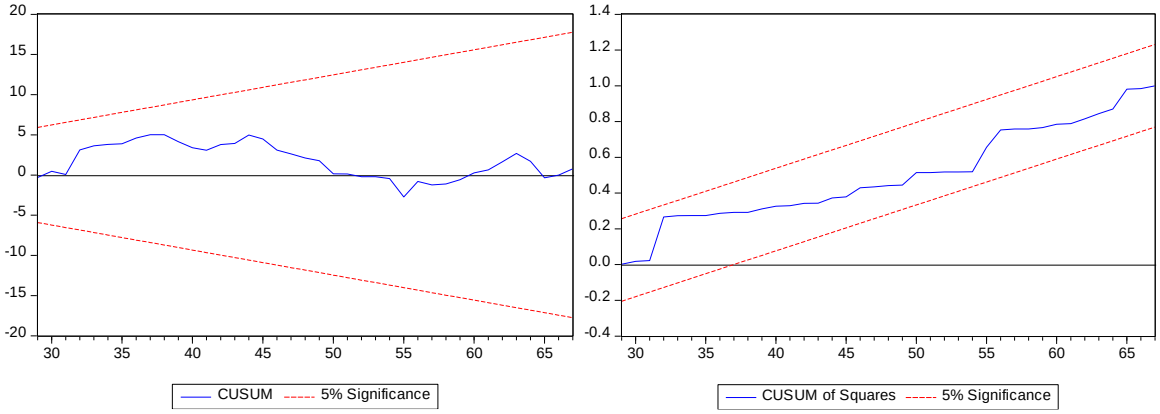

Figure 2.6. *Tests of CUSUM and CUSUM of square – AIC*

Figure 2.7 shows the optimal models of ARDL for Akaike Information for the top 20 models.

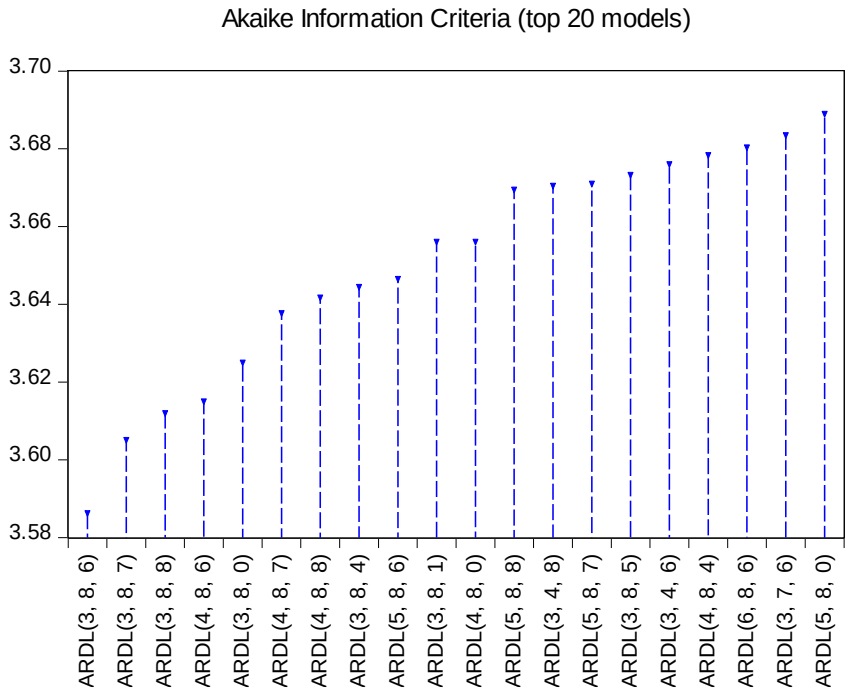

Figure 2.7. *Model criteria graphs*

After making ARDL (3,8,6) with Akaike Information Criteria (AIC), the new ARDL model is tested with the same data for Hannan-Quinn Criteria (HQ) to strengthen the results of the analysis.

Table 2.8 represents the ARDL (3,8,0) model is estimated with HQ criteria. The stochastic and diagnostic results of the ARDL (3,8,0) have no deviation. The problem of serial correlation and heteroskedasticity is not detected in the model. Also, Ramsey Reset shows that the model is correct functionally. Thus, the model is available for cointegration estimation.

Table 2.8. *Estimation results of ARDL (3,8,0) model*

Estimation Result of Model of ARDL (3,8,0) – Hannan-Quinn Criteria			
Variables	Coefficients	t-Statistics	Probability
RGDP (-1)	-0.685636	-5.540893	0.0000
RGDP (-2)	-0.831600	-6.817758	0.0000
RGDP (-3)	-0.616692	-4.569626	0.0000
DEBT	-0.240914	-1.178116	0.2449
DEBT (-1)	-0.084469	-0.309952	0.7580
DEBT (-2)	0.446682	1.771435	0.0833
DEBT (-3)	0.371199	1.377301	0.1752
DEBT (-4)	-0.488904	-1.839119	0.0725
DEBT (-5)	0.133591	0.472376	0.6389
DEBT (-6)	-0.449286	-1.575307	0.1222
DEBT (-7)	-0.237024	-0.811890	0.4211
DEBT (-8)	0.502873	2.813773	0.0072
GCF	0.257271	8.368301	0.0000
C	2.842626	5.102429	0.0000
Diagnostics Test Results			
R^2	0.706664		
Adjusted R^2	0.621922		
Serial Correlation	0.006088 (0.9939)		
Heteroskedasticity	0.457136 (0.9370)		
Ramsey Reset Test	1.889124 (0.1763)		

Since there is no problem with diagnostic test results, the cointegration relationship is checked with ARDL Long Run Form and Bounds Test which is applied and takes place in Table 2.9.

Table 2.9. *ARDL long run form and bounds test (HQ)*

ARDL Long Run Form and Bounds Test		
F-statistics: 37.62865 **k=2**	I (0)	I (1)
5%	3.79	4.85
10%	3.17	4.14

According to bounds test results, there is a strong cointegration relationship between variables because F-statistics is 37.62865, which is much more than I (0) and I (1) for both 5% and 10% level. Thus, RGDP, DEBT, and GCF have common actions with each other in the long run. The existence of cointegration canalizes long-term and short-term coefficients to understand the direction of relationships between variables. The results of these relationships are shown in Table 2.10.

Table 2.10. *Long-term and short-term relations (HQ)*

Long-Term Relationships		
	Coefficient	**t-Statistic**
DEBT	-0.014759	-2.609147
GCF	0.082092	10.39404
ECM Regression (Short-term Relationships)		
D (DEBT (-3))	0.538751	3.264695
D (DEBT (-7))	-0.502873	-3.072370
Coint. Eq. (-1)	-3.133928	-10.85832

The model ARDL (3,8,0) estimated with HQ criteria has almost identical results with the ARDL (3,8,6) estimated with AIC criteria. In the long run, DEBT and RGDP have a negative relationship while GCF and RGDP have a positive relationship. A 1% increase in DEBT will decrease RGDP by about 0.01%. At the same time, a 1% increase in GCF also will increase RGDP by about 0.08%. In addition to this, rises in 1% of DEBT has two effects in ECM Regression. The first effect is that it will increases RDGP by about 0.53% for the third period and then, it will diminish about 0.50% for the seventh period. To put it all in simple terms, DEBT affects RGDP positively in the short-term while it also causes of the decline of RGDP in the long-term.

Furthermore, CUSUM and CUSUM of squares tests are made for checking the stability of ARDL (3,8,0). Figure 2.8 shows the results of these CUSUM tests that is proof of the ARDL (3,8,0) model has not structural change based on the %5 significance level for Hannan-Quinn Criteria. ARDL (3,8,0) is stable for this estimation.

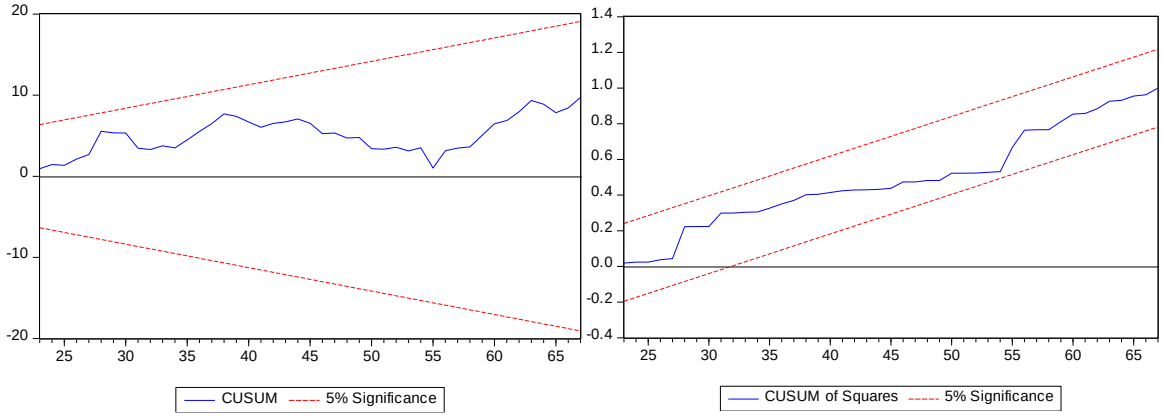

Figure 2.8. *Tests of CUSUM and CUSUM of Square – HQ*

Figure 2.9 shows the optimal models of ARDL for Hannan-Quin Criteria.

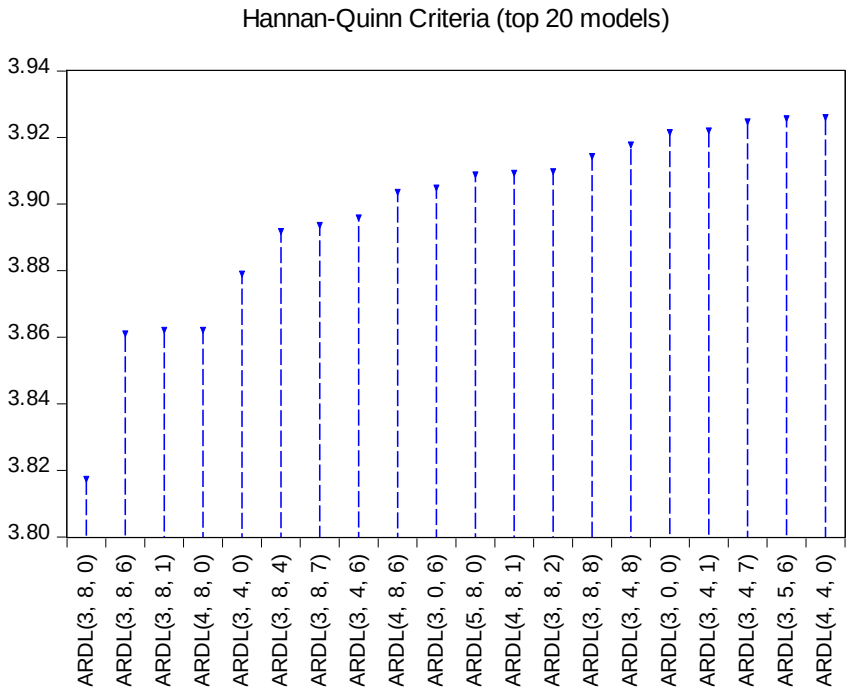

Figure 2.9. *Model criteria graphs*

2.3. Estimation Results of Second Chapter

Aforementioned analysis's subject is based on the effects of the debt-to-GDP ratio on economic growth. In this context, the explained variable of analysis is economic growth ratio (RGDP) which is described by the debt-to-GDP ratio (DEBT) and growth fixed capital formation (GCF) additionally. The key explanatory variable is DEBT since its impact on economic growth is analyzed. In this situation, GCF is an auxiliary variable. Under these circumstances, the ARDL analysis is considered to determine the relationship between variables. Application of the ARDL bounds test concludes the existence of cointegration relationships between variables which are in Table 2.11.

Table 2.11. *Estimation results of ARDL bounds test*

Variables	Models	Information Criteria	ARDL Bounds Test Results	Direction of Relationships	
			5%-10%	Short-term	Long-term
DEBT	ARDL (3,8,6)	AIC	Cointegrated	Positive	Negative
	ARDL (3,8,0)	HQ	Cointegrated	Positive	Negative
GCF	ARDL (3,8,6)	AIC	Cointegrated	Positive	Positive
	ARDL (3,8,0)	HQ	Cointegrated	Positive	Positive

Table 2.11 includes the results of two ARDL models made using Akaike Information Criteria and Hannan-Quinn Criteria. The ARDL models obviously imply that there is a cointegration relationship between variables. The DEBT and GCF take part in Table 2.11 however DEBT is a substantial variable for this study. Nonetheless, the effect of GCF is mentioned above and GCF is positively related to RGDP in long-terms and short-terms. However, the debt-to-GDP ratio has two different impacts on economic growth. ARDL (3,8,6) and ARDL (3,8,0) models confirm that DEBT affects RGDP positively in the short-term while it affects RGDP negatively in the long-term. It can be thought that DEBT has favorable outcome at first, but the effect of DEBT becomes adverse in time.

CHAPTER 3

3. PANEL ANALYSES OF SELECTED EUROPEAN COUNTRIES

The last section, after the previous two sections, includes panel analysis of selected countries to analyze the effect of debt-to-GDP ratio on economic growth. The selected countries have consisted of European countries. Among European countries, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Luxembourg, Norway, Portugal, Spain, Sweden, and Turkey are involved. Before analyzing panel tests, graphs of GDP per capita and debt-to GDP ratio are created to understand the general view of these variables[7]. Figure 3.1 shows the economic growth of selected 14 European countries between 1980 and 2017.

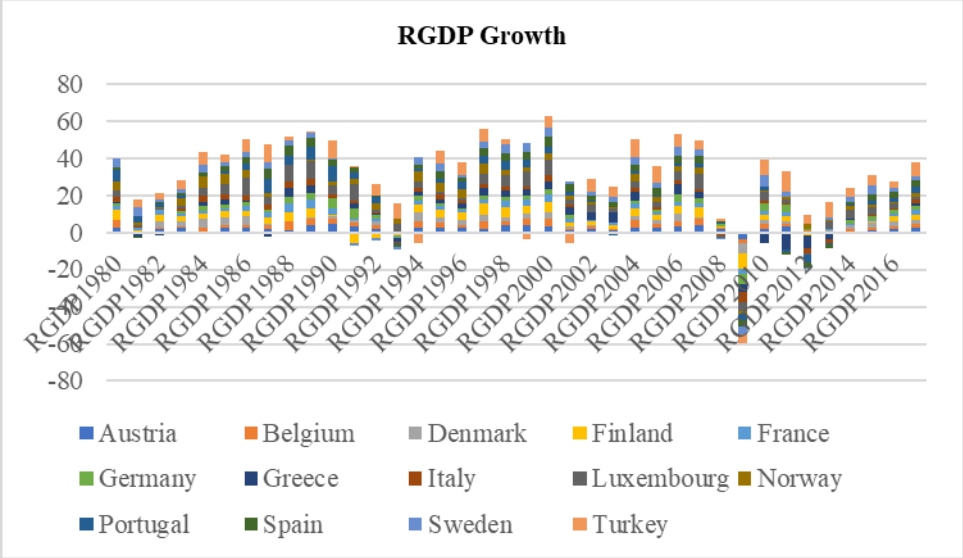

Figure 3.1. *RGDP growth of selected European countries*

Figure 3.1 indicates that the trend line of RGDP growth is not constant and there are rises and falls during the period. The selected European countries meet different growth rates both upward and downward sides. To make a general comment about the course of countries' economic growth, for the ten years between 1980 and 1990 economic growth increases but it decreases till 1994. The years between 1994 and 2000, there are rises and falls. However, there is an obvious decrease in 2002 and it continues to 2004. A rise in 2004 is not a long duration because of the 2008 crises. The graph of stacked columns shows that the largest deviation occurs in 2008 and 2010 that economies grow

[7] The original data set is used when creating graphs.

negatively. After this year, economies grow quickly until 2012 then growth rates diminish and lastly RGDP rises again for European countries to 2017.

Secondarily, the general view of the debt-to-GDP ratio is in Figure 3.2 for the selected European countries to understand the debt structure of nations.

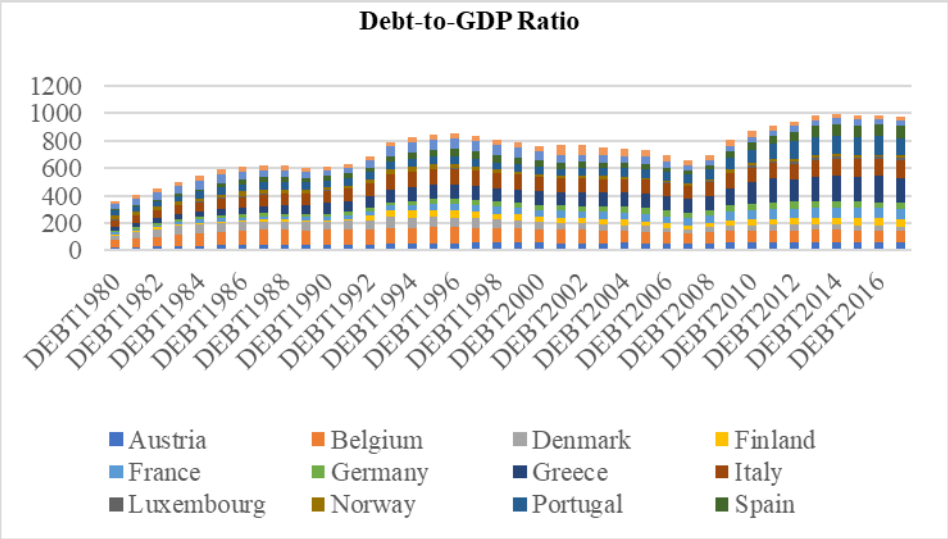

Figure 3.2. *The debt-to-GDP ratio of selected European countries*

Unlike the graph of Real GDP growth, the debt-to-GDP ratio has an upward trend for all selected countries which is as shown in Figure 3.2. There are rises and falls for some years, but the general view shows an increase in the debt-to-GDP ratio over the years.

The course of both graphs of variables has a dissimilar trend. This situation can be thought that the relationship between debt-to-GDP ratio and RGDP growth can be divergent. The general view of variables cannot be sufficient to determine the changing of variables over the years. Thus, examining the original data set where Appendices II, is more sensible.

3.1. Data Set

This section of the study purposes to use a method of panel analysis to research the relationship between economic growth and debt-to-GDP ratio. Similarly, time series analysis, data set of panel analysis consist of Real Gross Domestic Product (RGDP) growth, debt-to-GDP (DEBT) ratio, and gross fixed capital formation (GCF) for time period of 1980-2017 and selected 14 European countries which are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Luxembourg, Norway, Portugal,

Spain, Sweden, and Turkey. The code and content of the variables are involved in Table 3.1

Table 3.1. *Explanation of the data set*

Variables	Variable Code	Interpretation[8]	Source
Real GDP Growth	RGDP	The growth rate shows the percentage change in GDP compared to the previous year.	Organization for Economic Co-operation & Development (OECD) Statistics
Debt-to-GDP ratio	DEBT	The total stock of debt liabilities issued by the central government as a share of GDP.	International Monetary Fund (IMF)
Gross fixed capital formation	GCF	Gross fixed capital formation includes the percentage of weighted means of the current and previous year.	World Bank Indicators (WBI)

The source of variables is different. The economic growth is taken from OECD statistics, the debt-to-GDP ratio is taken from the International Monetary Fund and gross fixed capital formation is obtained from the World Bank. These three-variable used as a ratio in the analysis. The RGDP and DEBT are imported as ratio directly. To ensure the integrity of analyses, however, GCF becomes ratio via weighted mean of the previous year. Thus, variables are real, seasonality adjusted, and ratio that is prepared for the analyses.

Associated with the determination of the data set, the panel model comprises available variables which are expressed as:

$$RGDP_{it} = \beta_0 + \beta_1 DEBT_{it} + \beta_2 GCF_{it} + u_{it} \quad (3.1)$$

where i=1, 2, …, N that is sample observations or cross-sections and t=1, 2, …, T that is time period.

Depending on a simple regression model of panel data analysis, the panel model of the study is constituted in Equation 3.1 based on selected countries for the period 1980 and 2017. The explained or dependent variable of the study is RGDP that means real gross domestic product growth rate and explanatory or independent variables come from DEBT and GCF. DEBT represents a debt-to-GDP ratio that is the main explanatory

[8] Explanation of interpretations are taken by sources.

variable of the study while GCF indicates weighted mean ratios of gross fixed capital formation which is an auxiliary variable for the study. In Equation 3.1, β_0 shows constant, and β_1 and β_2 demonstrate parameters or coefficients of variables. Since panel analysis includes 14 European countries for the period between 1980-2017, N, and T equals 14 and 38 respectively.

3.2. Econometric Methods and Findings

The third section of the study consists of panel analysis when investigating the effect of DEBT on RGDP. In this context, the method of panel ARDL is used for the panel analysis of selected fourteen European countries. Similar to the second chapter, panel ARDL analysis requires the process of unit root testing and ARDL analysis one by one. In addition to this, the homogeneity and cross-sectional dependence test are vital for panel ARDL.

Proverbially, there are three types of data in the literature that are time series, cross-section, and panel data. The panel data compromise of a combination of time series and cross-section. In other words, the panel data consist of a group of observations and variant timeframe (Park, 2011). Therefore, the situation of cross-sectional dependence can be discussed in the analysis of the panel data. The cross-sectional dependence is that every series are affected by any shock that only one series is faced. To sum up, each series are dependent on another in the data set (Henningsen & Henningsen, 2019).

Distinctly from time-series' ARDL, panel ARDL used homogeneity and cross-section dependence tests. Both tests are substantial because of the existence of heterogeneity and dependency can change the types of test used in analyses. The alternation of analysis is explained as follows.

First of all, the slope homogeneity is estimated which is used to understand whether data are homogenous or heterogeneous. The slope homogeneity is tested with Pesaran and Yamagata (2008). Secondly, a cross-sectional dependency test is analyzed to determine whether and dependency exists or not. For this analysis, the Pesaran's CD test (2004) is used. Thirdly, panel unit roots are tested via Breitung (2000), Multipurt, and Pescadf tests to understand whether variables stationary or not. These tests are appropriate for analyses because it allows for cross-sectional dependence. The Multipurt means that first and second generation of panel unit root tests of multiple variables and lags, which includes Maddala and Wu (1999) and CIPS (Cross Sectionally Im-Pesaran-Shin) – Pesaran (2007) tests. The Pesaran (2007) test takes into consideration of cross-section

dependence. The Pescadf is the panel unit root test of Pesaran (2003) that also involves the presence of cross-section dependence. Fourthly, after panel unit root analyses, the cointegration should be tested to explain the effect of the public debt on economic growth. For this purpose, Westerlund (2007) and Pedroni panel cointegration test is performed. The last one of the analyses is Augmented Mean Group (AMG) estimation and Fully Modified Ordinary Least Squares (FMOLS) estimation that is used to measure the direction of the relationship between debt-to-GDP ratio and economic growth. The results of all analyses in the study are interpreted by mostly Stata and EViews program.

At the beginning of analysis, the slope homogeneity test is called Delta (Δ) test suggested by Pesaran and Yamagata (2008). The slope homogeneity test allows for a large number of observations with a cross-sectional and time dimension. According to this test, slope coefficients play an important role to explain homogeneity or heterogeneity. The hypotheses of the test are shown in Equation 3.2.

$$H_0: \beta_i = \beta, \text{ for all i, (slope coefficients are homogeneous)}$$

$$H_1: \beta_i \neq \beta, \text{ (slope coefficients are heterogeneous)} \qquad (3.2)$$

In Equation 3.2, the null hypothesis, H_0, implies all slope coefficients are identical across every unit (presence of homogeneity) while the alternative hypothesis, H_1, represents slope coefficients are different for cross-sectional units (presence of heterogeneity) (Pesaran & Yamagata, "Testing Slope Homogeneity in Large Panels", 2008). The results of the Delta test take place in Table 3.2.

Table 3.2. *Estimation results of slope homogeneity test*

Test	Delta	p-value
Δ	5.167	0.000
$\Delta_{adj.}$	5.462	0.000

There are statistics of Delta (Δ) and adjusted Delta ($\Delta_{adj.}$) in Table 3.2 which indicates H_0 should be rejected since probability values are significant at 1% level. Thus, there is heterogeneity between the slope coefficients of variables.

Additional to slope homogeneity testing, cross-sectional dependence is tested by Pesaran's CD test. Initially, cross-sectional dependence is applied by Breusch Pagan (1980). Then, Pesaran developed the CD test (2004), however, based on the thought that when samples become large, the deviation of test results increases. Therefore, the CD test

implies that the correlation of cross-section must not be equal zero to avoid deviations (Hsiao, Pesaran, & Pick, 2007; & Pesaran, 2004).

The hypothesis of the Pesaran CD test is shown in Equation 3.3 as follows:

$$H_0: \text{Cross-sectional independency}$$
$$H_1: \text{Cross-sectional dependency} \quad (3.3)$$

Equation 3.3 represents that the null hypothesis, H_0, of the CD test is that there is no cross-section dependency and so variables do not affect each other. The alternative hypothesis, H_1, defends the opinion existence of cross-section dependency and means any effect of one variable faced affects the others. The test results of cross-sectional dependency are in Table 3.3.

Table 3.3. *Results of Pesaran CD Test*

Variable	CD-test	p-value
RGDP	27.878	0.000
DEBT	15.477	0.000
GCF	40.385	0.000

The results of the cross-sectional dependency test respond to higher CD-tests values for RGDP, DEBT, and GCF. Since p-values of test results are smaller than 0.05, H_0 can be rejected. Herewith, the consequence of analysis is that there is a cross-sectional dependency between variables. After this point, the methods of analysis and types of tests used should be accordant with the cross-sectional dependence condition.

Associated with the completion of the cross-sectional analysis, the unit-roots should be tested for several methods. Especially, the unit root tests that allow for cross-sectional dependency are used. The study performs three-unit root tests which are Breitung, Multipurt, and Pescadf tests. The hypothesis of these tests is the same that shown in Equation 3.4.

$$H_0: \text{There is a unit root.}$$
$$H_1: \text{There is no unit root.} \quad (3.4)$$

The null hypothesis (H_0) of these panel unit root tests is that the panel contains a unit root. To decide whether the variable is stationary or not, the probability value of

panel unit root tests should be smaller than 0.05 and H_0 should be rejected. Otherwise, the series will have unit root for H_1. The existence of unit roots in the series can be removed by taking differences.

First of all, the Breitung (2007) panel unit root test is applied. Inside of Breitung test's options, trend, demean, robust and lags are used in the analysis. The trend option is an indicator of including time trend, demean option shows that cross-sectional means are removed. Cross-sectional dependence is allowed with a robust option. Additionally, special lags value is determined with the lags option. The lag structure consists of zero and one in this test analysis which is shown in Table 3.4.

Table 3.4. *Estimation results of Breitung unit root test*

Variable	**No Lags**		**Lags (1)**	
	Statistics	P-Value	Statistics	P-Value
RGDP	-5.7818	0.0000*	-4.5610	0.0000*
DEBT	1.2099	0.8868	-0.6162	0.2689
GCF	-3.9347	0.0000*	-3.8745	0.0001*
ΔDEBT	-7.3170	0.0000*	-9.4567	0.0000*

(*) The significance is measured by 5% probability level.

Table 3.4 test results include both estimations of no lags and one lag for all three variables. According to Breitung unit test results, RGDP and GCF are stationary for both situations of no lags and one lag because p-values are less than 0.05 and it means the variables are stationary. On the other hand, DEBT has a unit root at its level for both lag structure since its p-values much more than 0.05. Thus, DEBT becomes stationary with taking first differences that symbolize with ΔDEBT.

After the application of the Breitung test, Maddala and Wu (MW) and Pesaran (CIPS) tests are used to measure the first and second generation of panel unit root test which is called Multipurt. Actually, Maddala and Wu assume that there is no cross-sectional dependency while Pesaran (CIPS) considered cross-sectional dependency between variables (Cristini, M.Fazzari, Greenberg, & Leoni, 2015).

Nevertheless, since both tests are applied together, the study reports all results. However, the CIPS test is more significant than MW technically. Both tests have options of with and without trend for RDGP, DEBT, and GCF with zero and one lag structure. The results of the tests are seen the Table 3.5 below.

Table 3.5. *Estimation results of Multipurt*

Variables	Lags	Maddala and Wu (MW)				Pesaran (CIPS)			
		Without Trend		With Trend		Without Trend		With Trend	
		Chi sq.	P-Value	Chi sq.	P-Value	Zt-bar	P-Value	Zt-bar	P-Value
RGDP	0	216.094	0.000*	15.816	0.000*	-9.488	0.000*	-7.680	0.000*
	1	163.757	0.000*	31.942	0.000*	-7.758	0.000*	-6.351	0.000*
DEBT	0	38.908	0.082	10.469	0.239	1.554	0.940	0.404	0.657
	1	35.565	0.154	31.492	0.053	0.788	0.785	-1.109	0.134
GCF	0	233.940	0.000*	18.877	0.000*	-11.762	0.000*	-10.366	0.000*
	1	183.813	0.000*	41.045	0.000*	-7.972	0.000*	-5.993	0.000*
∆DEBT	0	189.6930	0.000*	152.0359	0.000*	-10.234	0.000*	-9.403	0.000*
	1	125.3095	0.000*	88.7068	0.000*	-6.358	0.000*	-4.945	0.000*

(*) The significance is measured by 5% probability level which shows stationary series.

Table 3.5 represents the results of Maddala and Wu and Pesaran (2007) tests. Consideration of Maddala and Wu unit root test result, RGDP and GCF has no unit root for no lags and one lags condition and with or without trend option. The reason is that p-values of these variables are smaller than 5% and then, Ho is rejected, there is no unit root in series which are stationary. Also, there is a unit root for DEBT for both lag structure and trend options. DEBT is not stationary at its level. Additional to Maddala and Wu, estimation results of CIPS tests that are more important, represent exactly the same conclusion in terms of the unit root structure. For the with or without trend option and zero and no lags conditions RGDP and GCF are stationary, no unit root, since p-values of them are smaller than 0.05. Similar to MW, the Pesaran CIPS test also concluded that DEBT is not stationary and/or there is the unit root (it means p-value more than 0.05) for both with and without trend options. Since the DEBT has unit root for all options and both test results, the variable needs for differentiation. In conjunction with taking the first difference, the variable becomes ∆DEBT and stationary for MW and CIPS tests with conditions of various trends and lag structures.

The Pescadf is the last applied panel unit root test in this study. The test is also known as the Pesaran CADF test. The CADF test is developed by Pesaran in 2007 on the purpose of considering the existence of cross-sectional dependency. In this context, CADF is the abbreviation of a Cross-sectionally Augmented Dickey-Fuller test (Costantini & Lupi, 2011). Thus, the test allows checking cross-sectional dependence

between the variables. The Pescadf test is analyzed for no and one lag which as shown in Table 3.6.

Table 3.6. *Estimation results of Pescadf test*

Variables	Lags	T-bar	Z[T-bar]	P-value
RGDP	0	-4.154	-9.488	0.000*
	1	-3.719	-7.758	0.000*
DEBT	0	-1.380	1.554	0.940
	1	-1.572	0.788	0.785
GCF	0	-4.725	-11.762	0.000*
	1	-3.773	-7.972	0.000*
∆DEBT	0	-4.341	-10.234	0.000*
	1	-3.367	6.358	0.000*

(*) The significance is measured by 5% probability level which shows stationary series.

Depending on the estimation results of the Pescadf test, RGDP and GCF are stationary for both zero and one lags since p-values are lower than 5%. There are no unit-roots for these variables at their level. However, like all unit root test results, DEBT has a unit root at its level and so it requires to take first differences. The first difference of the variable is ΔDEBT and it is stationary for zero and one lag structure.

The general results of all panel unit root tests are demonstrated in Table 3.7. Panel unit root tests consist of Breitung, Multipurt (MW and CIPS), and PesCADF tests.

Table 3.7. *General results of panel unit root tests*

Variables	Lags	Breitung	Multipurt	PesCADF
RGDP	(0) - (1)	I (0)	I (0)	I (0)
DEBT	(0) - (1)	I (1)	I (1)	I (1)
GCF	(0) - (1)	I (0)	I (0)	I (0)

Table 3.7 represent which level of all variables are stationary via zero and one lags structure for Breitung, Multipurt, and PesCADF tests. I (0) show that variables are stationary at their level while I (1) indicate variables become stationary when taking its first difference.

Thirdly, after performing panel unit root tests, to analyze the cointegration relationship between the data, the study uses Westerlund (2007) and the Pedroni panel cointegration test. The Westerlund test makes cointegration analysis by testing whether

the whole or each member of panel data has error correction. The Westerlund test is the best option to make a cointegration analysis with two reasons in this study. The first of two reasons is the existence of heterogeneity between the slope coefficients of variables and the second one is the presence of cross-sectional dependency. Since the Westerlund allows for large degree heterogeneity between variables and cross-sectional dependency, it is the optimal test for cointegration analysis in the study. (Persyn & Westerlund, "Error-Correction–Based Cointegration Tests for Panel Data", 2008). Also, the hypothesis of both Westerlund and Pedroni tests can be written as in Equation 3.4.

$$H_0: \text{Absence of cointegration,}$$

$$H_1: \text{Existence of cointegration} \qquad (3.4)$$

The null hypothesis, H_0, is no cointegration between variables while the alternative hypothesis, H_1, is the existence of cointegration relationships. The estimation results of the Westerlund cointegration test are shown in Table 3.8.

Table 3.8. *Estimation results of Westerlund cointegration test*

Statistics	Value	Z-value	P-Value	Robust P-Value
$\mathbf{G_t}$	-4.578	-9.119	0.000	0.000*
$\mathbf{G_a}$	-17.155	-1.798	0.036	0.004*
$\mathbf{P_t}$	-14.994	-7.133	0.000	0.000*
$\mathbf{P_a}$	-16.837	-3.515	0.000	0.000*

The significance is measured by 5% (*) probability level.

The existence of heterogeneity and cross-sectional dependency in the study causes to apply Westerlund (2007) cointegration test in the analysis. The bootstrap option possessed by the Westerlund test uses for the presence of these situations. The bootstrap options consist of multi-repetitions of significant cointegration tests. Therefore, these options decrease the effects of cross-sectional dependency (Persyn & Westerlund, 2008 & Burret, Feld, & Köhler, 2014).

In Table 3.8, the statistics of Gt and Ga represents group-mean tests statistics while Pt and Pa show panel test statistics. The estimation of the Westerlund test is analyzed considering optimum options about constant, trend, lags, leads, and bootstrap. According to test results, both group-mean (G_t, G_a) and panel test statistics (P_t, P_a) are significant to explain the cointegration relationship between variables since statistics are meaningful at a 5% significance level for p-value and especially robust p-value.

The second, panel cointegration test used in the study is Pedroni (1999) which consists of seven test statistics. Four of them are panel statistics while three of them are group statistics. The Pedroni panel cointegration test is suitable in terms of heterogeneity between variables. Likely Westerlund test, the null hypothesis of the Pedroni test also shows no cointegration (Pedroni, 1999). The situation is exactly the same as in Equation 3.4. The estimation results of Pedroni is in Table 3.9.

Table 3.9. *Estimation results of Pedroni cointegration test*

Test Statistics	Panel Statistics	Probability	Group Statistics	Probability
v	2.008366	0.0223**	-	-
rho	-7.300300	0.0000*	-5.652861	0.0000*
PP	-8.508548	0.0000*	-10.30467	0.0000*
ADF	-7.156499	0.0000*	-8.135041	0.0000*

Number of Observations: 532

All test statistics are distributed N (0,1), under a null of no cointegration, and diverge to negative infinity (save for panel v).

The null hypothesis is rejected at 1% (*) significance level and only panel v is rejected at 5% (**).

Pedroni panel cointegration test represents a rejection of the null hypothesis for six of seven tests at 0.01 significance level and panel v statistics at 0.05. Test results indicate the existence of cointegration relationships between dependent and explanatory variables for all seven test statistics in the long run.

The general findings of analysis lay stress on that the effect of DEBT, debt-to-GDP ratio, on RGDP, economic growth is valid or significant for both Westerlund and Pedroni cointegration tests. In other words, according to the results of panel analyses, the relationship between the debt-to-GDP ratio on economic growth is meaningful in the long run for 14 European countries for the period of 1980-2017.

Associated with the existence of a cointegration relationship of variables, explanations of long-term relationships should need to arise in terms of form and degree of relationships. In this context, Mean Group (MG) and Pooled Mean Group (PMG) are the most preferred estimators for panel ARDL analyses. PMG estimator gives a chance for the short-run and the long run are analyzed separately while MG analyses only long-term relationships. According to the PMG estimator, the parameters of the countries that is existed in the panel data, are identical in the long run. However, these parameters can be different for each country in the short run of each panel unit which property is the same

with MG long-term estimation. Briefly, the PMG estimator allows homogeneity between panel members in the long run while allowing heterogeneity between groups in the short run. Additionally, the MG estimator allows heterogeneous slope coefficients between each unit of the panel member, only in the long run. (Bangake & Eggoh, "Pooled Mean Group Estimation on International Capital Mobility in African Countries", 2012). In this respect, the mean group estimator is more meaningful rather than pooled group estimators since the existence of slope heterogeneity between the coefficient of variables shown with the delta test of Pesaran in Table 3.1. However, both estimation methods do not resist in terms of cross-sectional dependency despite allowing it. In this context, instead of using these estimators, the study uses an augmented mean group estimator as the main estimator and fully modified ordinary least squares as an auxiliary estimator to estimate panel analysis of the relationship between debt-to-GDP ratio and economic growth.

A type and improved version of mean group estimators, Augmented Mean Group (AMG) estimator is developed by Eberhardt and Teal in 2010. Like other types of mean group estimators, AMG estimator permits of estimation of group-specific regression for each unit of the panel. In addition, the otherness of AMG is having an option that imposing a common dynamic process to analyze. However, this option cannot be included in this analysis (Eberhardt & Bond, 2009).

Additional to the AMG estimator, Fully Modified Ordinary Least Square (FMOLS) is preferred as an auxiliary estimator to estimate the coefficient of long-term relationships and support the conclusion of the analysis. Pedroni developed FMOLS estimator because of the inability of OLS analysis for panel application. Thus, FMOLS provides more consistent and unbiased conclusions. Moreover, FMOLS allows for heterogeneity between panel units and solve problems such as serial correlation and heteroskedasticity (Dritsaki & Dritsaki, 2014).

Table 3.10 represents ultimate long-term coefficients via fully modified OLS and augmented mean group estimators to determine the effect of the debt-to-GDP ratio on economic growth.

Table 3.10. *Estimation results of AMG and FMOLS*

Augmented Mean Group (AMG)				
Variables	Coefficient	Standard Error	z	(P>|z|)
DEBT	-.0269518	.0022074	-12.21	0.000*
GCF	.1203738	.009884	12.18	0.000*
AMG Diagnostic Test Results:				
Wald chi2(2) = 297.39				
Prob > chi2 = 0.000				
Fully Modified OLS (FMOLS)				
Variables	Coefficient	Standard Error	Probability	
DEBT	-0.026165	0.010696	0.0148**	
GCF	0.080172	0.043284	0.0646***	

Dependent variable: RGDP

Explanatory variables: DEBT and GCF

*%1, 5% and 10% significance levels are represented by *, **, *** respectively.*

The results of augmented mean group estimators are significant at 1% level for both DEBT and GDP variables. Considering the coefficients of variables, DEBT has a negative impact on RGDP about 0.03% while GCF has a positive effect on RGDP by nearly 0.13%. The conclusions of fully modified OLS estimators are significant at 5% for DEBT and a 10% significance level for GCF. Also, findings of FMOLS show similarity with AMG because the effect of DEBT is about minus 0.03% and the impact of GCF is about plus 0.09%. In conclusion, an increase in 1% of debt-to-GDP ratio diminish economic growth by about 0.03% and a rise in 1% of the gross fixed capital formation increases economic growth by nearly 0.09% for the long-term. Simply, there is an inverse relationship between public debt and economic growth while economic growth and gross fixed capital formation have positive relationships in the long run. The additional option of AMG analysis is group-specific coefficients that show coefficients of each member of the panel. By this means, coefficients of fourteen European countries are represented to understand the effects of variables on a country basis in Table 3.11.

Table 3.11. *Results of AMG group-specific coefficients*

Group-specific coefficients (AMG)						
	DEBT			GCF		
Countries	Coefficients	Standard Error	z (P>|z|)	Coefficients	Standard Error	z (P>|z|)
Austria	-.0490323	.0218536	-2.24** (0.025)	.070996	.0171269	4.15* (0.000)
Belgium	-.0287903	.0109992	-2.62* (0.009)	.0991466	.0125201	7.92 * (0.000)
Denmark	.0200207	.0102057	1.96** (0.050)	.1014765	.0121952	8.32* (0.000)
Finland	-.0285143	.0152282	-1.87*** (0.061)	.1712	.0154506	11.08* (0.000)
France	-.0235149	.0059353	-3.96* (0.000)	.0920679	.0116997	7.87* (0.000)
Germany	-.0295689	.0174506	-1.69*** (0.090)	.1375489	.0175802	7.82* (0.000)
Greece	-.0223546	.0068077	-3.28* (0.001)	.164913	.0204652	8.06* (0.000)
Italy	-.0303203	.0071282	-4.25* (0.000)	.1141321	.0122466	9.32* (0.000)
Luxembourg	-.1933697	.0651785	-2.97* (0.003)	.1254816	.0192744	6.51* (0.000)
Norway	.1164701	.0399286	2.92* (0.004)	.0705878	.0222518	3.17* (0.002)
Portugal	-.0237474	.0075558	-3.14* (0.002)	.147939	.0160102	9.24* (0.000)
Spain	-.0202475	.0075351	-2.69* (0.007)	.133074	.0102445	12.99* (0.000)
Sweden	.0073896	.0180965	0.41 (0.683)	.0994772	.0165135	6.02* (0.000)
Turkey	-.0785798	.0365525	-2.15** (0.032)	.1577783	.0176948	8.92* (0.000)

Dependent variable: RGDP

Explanatory variables: DEBT and GCF

*1%, 5% and 10% significance levels are represented by *, **, ** respectively.*

Group-specific coefficient results of AMG indicates that all variables are statistically significant from different level for two independent variables except only DEBT variables of Sweden. Firstly, the debt-to-GDP ratio (DEBT) which is the main variable of the study considered. Belgium, France, Greece, Italy, Luxembourg, Norway, Portugal, and Spain are significant at 1% level; Austria, Denmark, and Turkey are significant for 5% level; and Finland and Germany are significant at 10% level while Sweden is not statistically significant for any level and DEBT variables. The long-term relationship of DEBT results shows that except Denmark and Norway that are positively related, eleven European countries are negatively related to RGDP. A 1% increase in

debt-to-GDP ratio diminishes economic growth by about 0.03% for Belgium, Finland, France, Germany, Greece, Italy, Portugal, and Spain; and it decreases RGDP approximately 0.05% for Austria; 0.08% for Turkey; and 0.20% for Luxembourg. Additional to this, a 1% increase in DEBT rises economic growth by about 0.11% for Norway and 0.02% for Denmark, but there is no statistically significant relationship between DEBT and RGDP for Sweden. Secondly, the effect of GCF to RGDP is statistically significant at 1% for all variables and fourteen European countries. Moreover, a 1% increase in gross fixed capital formation affects economic growth positively for all European countries. The lowest rise is about 0.08% for Norway and Austria and the highest raise is approximately 0.18% for Finland and Greece. The condition of other countries is between these intervals.

3.3. Estimation Results of Third Chapter

The third chapter of the study that the relationship between public debt and economic growth consists of panel analysis of selected European countries between the years of 1980 and 2017. The selected 14 European countries include Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Luxembourg, Norway, Portugal, Spain, Sweden, and Turkey. Panel analyses are considered respectively. In the first place, according to the slope homogeneity test, slope coefficients of variables are heterogeneous. Then, the cross-sectional dependency test implies the presence of cross-sectional dependency between variables. Thirdly, three panel unit root test is applied, and the results of these test show that RGDP and GCF are stationary at their level while DEBT becomes stationary after taking its first differences (ΔDEBT). After completion of the unit root testing process, two panel cointegration tests are estimated and cointegration relationships between explanatory and dependent variables are found. Finally, the coefficients of long-term relationships are determined.

The panel analysis emphasized that there is a strong relationship between independent (DEBT and GCF) and dependent (RGDP) variables. As a result, any increase in gross fixed capital formation, GCF, rises economic growth, Especially, the effect of any increase in debt-to-GDP ratio (DEBT) that is the main variable of the study, diminish economic growth. Statistically, a 1% increase in GCF, rises RGDP about 0.13%. However, a 1% increase in the debt-to-GDP ratio, decreases economic growth by approximately 0.03%.

3.4. CONCLUDING REMARKS

Public debt, one of the most preferred methods to inject funds in the economy, is an overemphasized issue lately. The reason is that public debt can cause differential effects on the economy. The impacts of public debt matter for all economies since policymakers want to know how public debt impresses economic growth as a result of the fund-raising method. In this context, the study analyses the effects of public debt on economic growth for Turkey and selected European countries.

First of all, time series analysis is made for understanding public debt's effect in Turkey. The ARDL analysis is done for short-term and long-term effects between the period 2003 and 2018. According to the findings of time series analysis, public debt affects economic growth in two ways which are positive for the short-term and negatively for the long-term in Turkey. A 1% increase in public debt rises economic growth by about 0.54 % in the short run while it decreases the growth of 0.01% in the long run.

On the other hand, panel analysis is made for the spanning period of 1980-2017 and selected fourteen European countries. Estimation results of panel analysis show that there is an inverse relationship between public debt and economic growth except for Denmark, Norway which are positively related, and Sweden that is not statistically significant. The percentage of effects of public debt makes differences for each European country. An increase in 1% of public debt pointed out that the lowest impact is about 0.03% in Spain while the highest diminish is about 0.20 % in Luxembourg.

As a consequence of time series and panel analysis, the existence of public debt creates a negative impact on economic growth in the long-term exactly. Policymakers should consider this adverse effect of public debt when deciding to use it in the economy. The general effect of debt represents that size of the effect is about thousand which means it is not excessive. Correspondingly public debt can be a feasible method for economies. At this point, how public debt is injected into the economy is important. When public debt is used to improve and strengthen the economy, the repayment of debt becomes easier. Especially, the situation of Turkey is more favorable since the impact of public debt rises economic growth in the short-term. Indeed, the adverse impact of public debt on the economy, in the long run, is an undeniable fact.

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APPENDICES I

Year	*Debt-to-GDP Ratio*	*Public Net Debt Stock*	*Year*	*Debt-to-GDP Ratio*	*Public Net Debt Stock*
2000 Q4	*41,48743742*	*70,80524652*	***2009 Q4***	*30,92255627*	*308,9756614*
2001 Q1	*44,47298462*	*81,01446228*	***2010 Q1***	*30,59423358*	*314,5727122*
2001 Q2	*63,53968385*	*126,6507071*	***2010 Q2***	*29,30627596*	*312,2983467*
2001 Q3	*69,01218859*	*152,8452605*	***2010 Q3***	*27,76786377*	*308,9253462*
2001 Q4	*64,76500574*	*158,9519502*	***2010 Q4***	*27,36793681*	*317,4718925*
2002 Q1	*60,6123391*	*163,5026218*	***2011 Q1***	*26,39869038*	*319,5169179*
2002 Q2	*63,87445599*	*188,9604569*	***2011 Q2***	*23,69483675*	*300,4357644*
2002 Q3	*63,59553985*	*208,1529465*	***2011 Q3***	*21,99134619*	*292,7275729*
2002 Q4	*59,89986222*	*215,2554689*	***2011 Q4***	*20,76773018*	*289,6012551*
2003 Q1	*60,22535767*	*232,7948663*	***2012 Q1***	*20,09908042*	*288,8299923*
2003 Q2	*55,80167951*	*231,1904757*	***2012 Q2***	*18,5094554*	*274,4705582*
2003 Q3	*52,78817246*	*233,6550121*	***2012 Q3***	*16,46736485*	*251,2382278*
2003 Q4	*53,58405581*	*250,7814972*	***2012 Q4***	*15,31941471*	*240,4645809*
2004 Q1	*51,410125*	*251,9098313*	***2013 Q1***	*14,02350515*	*227,5079171*
2004 Q2	*51,34097911*	*265,0417151*	***2013 Q2***	*13,14585792*	*221,0873401*
2004 Q3	*50,12988154*	*273,767862*	***2013 Q3***	*11,3049313*	*197,6509758*
2004 Q4	*47,57416968*	*274,5141377*	***2013 Q4***	*10,89938803*	*197,2476516*
2005 Q1	*46,16632077*	*276,9018233*	***2014 Q1***	*10,53667589*	*197,5792817*
2005 Q2	*42,89760226*	*267,7223616*	***2014 Q2***	*9,69971323*	*186,3090996*
2005 Q3	*41,51273504*	*269,5186174*	***2014 Q3***	*8,990751131*	*177,8488527*
2005 Q4	*40,09533981*	*270,1234842*	***2014 Q4***	*9,137422306*	*186,811481*
2006 Q1	*38,68554931*	*268,3989376*	***2015 Q1***	*7,86589936*	*164,4668103*
2006 Q2	*36,77863524*	*266,6472662*	***2015 Q2***	*7,172914026*	*155,414125*
2006 Q3	*35,09007893*	*265,6401275*	***2015 Q3***	*6,469419729*	*145,5339285*
2006 Q4	*32,67903351*	*257,9119372*	***2015 Q4***	*6,883866911*	*160,989381*
2007 Q1	*32,15434711*	*262,9212637*	***2016 Q1***	*6,767120547*	*162,7391697*
2007 Q2	*29,82223328*	*249,6625794*	***2016 Q2***	*5,969069641*	*147,6232087*
2007 Q3	*29,52896259*	*253,2076624*	***2016 Q3***	*7,060780854*	*177,0702658*
2007 Q4	*28,16045339*	*247,9417755*	***2016 Q4***	*8,402567646*	*219,1831407*
2008 Q1	*27,08796907*	*246,1797171*	***2017 Q1***	*8,636868524*	*232,6832622*
2008 Q2	*24,81198789*	*234,6552069*	***2017 Q2***	*8,467855717*	*236,9405615*
2008 Q3	*24,6913056*	*241,2588772*	***2017 Q3***	*7,753826262*	*229,9511869*
2008 Q4	*26,84662336*	*267,0656073*	***2017 Q4***	*8,430315399*	*262,237619*
2009 Q1	*29,01121893*	*286,6570065*	***2018 Q1***	*8,140424985*	*264,6719667*
2009 Q2	*28,95225187*	*283,6821544*	***2018 Q2***	*8,692145867*	*296,0965591*
2009 Q3	*30,73389978*	*302,0963629*	***2018 Q3***	*13,39372188*	*482,0971332*
2009 Q4	*30,92255627*	*308,9756614*	***2018 Q4***	*13,61728248*	*507,1604259*

APPENDICES II

Year	*Countries*	*RGDP*	*DEBT*	*GCF*	*Countries*	*RGDP*	*DEBT*	*GCF*
1980	*Austria*	*2.3*	*24.981397*	*-37.76133*	*Belgium*	*4.4*	*52.153131*	*11.129663*
1981	*Austria*	*-.1*	*26.530158*	*-13.722545*	*Belgium*	*-.3*	*61.741184*	*-28.275444*
1982	*Austria*	*1.9*	*28.591034*	*-9.4873394*	*Belgium*	*.6*	*72.168405*	*-17.213767*
1983	*Austria*	*2.8*	*32.690148*	*-2.377278*	*Belgium*	*.3*	*81.990377*	*-12.679919*
1984	*Austria*	*.3*	*35.149281*	*-7.7138301*	*Belgium*	*2.5*	*87.375127*	*-6.2043032*
1985	*Austria*	*2.2*	*37.312904*	*4.8305531*	*Belgium*	*1.7*	*94.526271*	*6.0655425*
1986	*Austria*	*2.3*	*41.662632*	*41.480845*	*Belgium*	*1.8*	*99.538304*	*37.967113*
1987	*Austria*	*1.7*	*45.37284*	*28.384776*	*Belgium*	*2.3*	*103.62001*	*27.430614*
1988	*Austria*	*1*	*45.361026*	*10.700088*	*Belgium*	*4.7*	*105.06708*	*19.821029*
1989	*Austria*	*3.9*	*45.444219*	*.84800744*	*Belgium*	*3.5*	*103.22843*	*9.6383587*
1990	*Austria*	*4.3*	*45.530671*	*26.039468*	*Belgium*	*3.1*	*103.68116*	*31.296374*
1991	*Austria*	*3.4*	*46.221884*	*8.8274146*	*Belgium*	*1.8*	*106.22149*	*-4.2697059*
1992	*Austria*	*2.1*	*46.282669*	*10.499989*	*Belgium*	*1.5*	*108.38833*	*10.067351*
1993	*Austria*	*.5*	*50.044093*	*-4.330903*	*Belgium*	*-1*	*114.88016*	*-7.6634985*
1994	*Austria*	*2.4*	*52.726249*	*9.6052798*	*Belgium*	*3.2*	*112.0985*	*6.3160367*
1995	*Austria*	*2.7*	*55.248052*	*14.521828*	*Belgium*	*2.4*	*115.98878*	*20.0672*
1996	*Austria*	*2.4*	*55.611616*	*.34598156*	*Belgium*	*1.6*	*113.17667*	*-2.9891044*
1997	*Austria*	*2.1*	*56.834379*	*-11.605129*	*Belgium*	*3.7*	*110.44855*	*-6.6618317*
1998	*Austria*	*3.6*	*56.839821*	*2.775406*	*Belgium*	*2*	*106.01691*	*2.2038241*
1999	*Austria*	*3.6*	*57.872775*	*-2.4884251*	*Belgium*	*3.6*	*103.05782*	*1.3268708*
2000	*Austria*	*3.4*	*56.508085*	*-7.0177843*	*Belgium*	*3.6*	*98.225558*	*-7.6304105*
2001	*Austria*	*1.3*	*55.056318*	*-2.9176487*	*Belgium*	*.8*	*97.619531*	*-.35875668*
2002	*Austria*	*1.7*	*54.668618*	*2.6073925*	*Belgium*	*1.8*	*94.669279*	*.32229278*
2003	*Austria*	*.9*	*54.721248*	*25.65459*	*Belgium*	*.8*	*88.879729*	*21.908751*
2004	*Austria*	*2.7*	*55.931896*	*12.518519*	*Belgium*	*3.6*	*84.549615*	*21.453884*
2005	*Austria*	*2.2*	*55.624892*	*2.60741*	*Belgium*	*2.1*	*83.467317*	*8.3840353*
2006	*Austria*	*3.5*	*54.238877*	*4.2551845*	*Belgium*	*2.5*	*80.491822*	*6.6906101*
2007	*Austria*	*3.7*	*51.896996*	*17.301319*	*Belgium*	*3.4*	*76.959027*	*19.716384*
2008	*Austria*	*1.5*	*55.13683*	*12.439614*	*Belgium*	*.8*	*82.19541*	*13.418459*
2009	*Austria*	*-3.8*	*58.572669*	*-10.450213*	*Belgium*	*-2.3*	*85.921538*	*-11.976092*
2010	*Austria*	*1.8*	*59.740463*	*-5.6356557*	*Belgium*	*2.7*	*85.306217*	*-3.6023132*
2011	*Austria*	*2.9*	*59.064511*	*14.466818*	*Belgium*	*1.8*	*87.730904*	*12.7991*
2012	*Austria*	*.7*	*59.484769*	*-4.2817958*	*Belgium*	*.2*	*88.659097*	*-5.3461181*
2013	*Austria*	*0*	*59.875237*	*6.854987*	*Belgium*	*.2*	*89.728068*	*2.4790003*
2014	*Austria*	*.7*	*58.911148*	*1.0799258*	*Belgium*	*1.3*	*90.131931*	*5.920859*
2015	*Austria*	*1.1*	*57.798819*	*-13.482335*	*Belgium*	*1.7*	*89.66219*	*-13.818906*
2016	*Austria*	*2*	*58.803516*	*5.5994496*	*Belgium*	*1.5*	*90.026427*	*4.0852739*
2017	*Austria*	*2.6*	*57.151407*	*7.5792634*	*Belgium*	*1.7*	*88.084738*	*6.0277166*

Year	*Countries*	*RGDP*	*DEBT*	*GCF*	*Countries*	*RGDP*	*DEBT*	*GCF*
1980	*Denmark*	*-.5*	*33.952409*	*-7.4411223*	*Finland*	*5.7*	*8.2566356*	*30.709728*
1981	*Denmark*	*-.7*	*43.762347*	*-26.748095*	*Finland*	*1.3*	*8.7914107*	*-2.9342807*
1982	*Denmark*	*3.7*	*56.245214*	*1.3757342*	*Finland*	*3.1*	*10.788915*	*1.7536096*
1983	*Denmark*	*2.6*	*67.617685*	*1.7658961*	*Finland*	*3.1*	*12.24524*	*-2.126173*
1984	*Denmark*	*4.2*	*70.167349*	*2.2054737*	*Finland*	*3.2*	*12.054656*	*-1.7414754*
1985	*Denmark*	*4*	*68.315221*	*15.258029*	*Finland*	*3.5*	*12.576135*	*6.9748103*
1986	*Denmark*	*4.9*	*65.951843*	*53.599723*	*Finland*	*2.7*	*12.982149*	*29.034799*
1987	*Denmark*	*.3*	*63.144078*	*23.092943*	*Finland*	*3.6*	*13.866954*	*28.298789*
1988	*Denmark*	*0*	*61.417831*	*-1.6277658*	*Finland*	*5.2*	*12.428017*	*24.623627*
1989	*Denmark*	*.6*	*59.82124*	*-3.0793625*	*Finland*	*5.1*	*10.138603*	*18.35927*
1990	*Denmark*	*1.5*	*61.433663*	*20.903369*	*Finland*	*.7*	*9.9725305*	*15.424851*
1991	*Denmark*	*1.4*	*62.287281*	*-3.4407512*	*Finland*	*-5.9*	*16.452014*	*-21.239432*
1992	*Denmark*	*2*	*66.748644*	*4.8358477*	*Finland*	*-3.3*	*33.195446*	*-24.352105*
1993	*Denmark*	*0*	*78.387362*	*-9.4919125*	*Finland*	*-.7*	*48.218034*	*-31.692417*
1994	*Denmark*	*5.3*	*75.53708*	*10.515547*	*Finland*	*3.9*	*51.255949*	*12.775301*
1995	*Denmark*	*3*	*74.289689*	*26.068998*	*Finland*	*4.2*	*51.251065*	*34.266677*
1996	*Denmark*	*2.9*	*72.480019*	*2.0966132*	*Finland*	*3.7*	*51.918479*	*4.7233509*
1997	*Denmark*	*3.3*	*67.819591*	*-1.8026395*	*Finland*	*6.3*	*49.335368*	*.07475823*
1998	*Denmark*	*2.2*	*62.791582*	*5.6705818*	*Finland*	*5.4*	*44.130352*	*9.8106138*
1999	*Denmark*	*2.9*	*59.491543*	*-2.4628278*	*Finland*	*4.4*	*41.577177*	*1.9408007*
2000	*Denmark*	*3.7*	*53.598169*	*-5.1669474*	*Finland*	*5.6*	*39.97402*	*-4.4924833*
2001	*Denmark*	*.8*	*50.658901*	*-.56797638*	*Finland*	*2.6*	*38.477675*	*2.1387372*
2002	*Denmark*	*.5*	*50.245626*	*5.0199583*	*Finland*	*1.7*	*37.398593*	*1.9588013*
2003	*Denmark*	*.4*	*48.36607*	*22.447899*	*Finland*	*2*	*39.396578*	*23.600814*
2004	*Denmark*	*2.7*	*45.717071*	*15.053389*	*Finland*	*3.9*	*38.91795*	*17.599335*
2005	*Denmark*	*2.3*	*38.282882*	*7.8093771*	*Finland*	*2.8*	*35.626296*	*6.9821787*
2006	*Denmark*	*3.9*	*31.757338*	*17.569769*	*Finland*	*4.1*	*33.563326*	*5.141696*
2007	*Denmark*	*.9*	*27.068642*	*14.084136*	*Finland*	*5.2*	*29.508425*	*25.103787*
2008	*Denmark*	*-.5*	*31.230107*	*7.9453432*	*Finland*	*.7*	*28.160507*	*12.0986*
2009	*Denmark*	*-4.9*	*36.437683*	*-20.085265*	*Finland*	*-8.3*	*36.187572*	*-17.315831*
2010	*Denmark*	*1.9*	*38.165226*	*-9.9792768*	*Finland*	*3*	*41.460716*	*-5.25584*
2011	*Denmark*	*1.3*	*41.028961*	*7.0977066*	*Finland*	*2.6*	*42.698952*	*12.259124*
2012	*Denmark*	*.2*	*39.974839*	*-1.6550407*	*Finland*	*-1.4*	*46.435561*	*-5.8183389*
2013	*Denmark*	*.9*	*38.35388*	*6.5602553*	*Finland*	*-.8*	*48.197091*	*-.20003277*
2014	*Denmark*	*1.6*	*38.221198*	*3.3385291*	*Finland*	*-.6*	*50.944645*	*-2.0426313*
2015	*Denmark*	*2.3*	*33.520151*	*-11.181603*	*Finland*	*.5*	*53.507567*	*-15.460145*
2016	*Denmark*	*2.4*	*31.299366*	*8.4945568*	*Finland*	*2.8*	*53.169899*	*9.3832679*
2017	*Denmark*	*2.3*	*29.87882*	*7.3590293*	*Finland*	*3*	*51.511104*	*8.8145764*

Year	*Countries*	*RGDP*	*DEBT*	*GCF*	*Countries*	*RGDP*	*DEBT*	*GCF*
1980	*France*	*1.8*	*12.838391*	*18.299464*	*Germany*	*1.3*	*15.26401*	*10.811141*
1981	*France*	*1.1*	*13.882761*	*-14.056578*	*Germany*	*.1*	*17.244051*	*-19.553735*
1982	*France*	*2.5*	*16.979841*	*-7.6583367*	*Germany*	*-.8*	*18.76908*	*-8.4674208*
1983	*France*	*1.2*	*17.97046*	*-9.6475328*	*Germany*	*1.6*	*19.772628*	*.22206316*
1984	*France*	*1.5*	*19.772853*	*-8.0049577*	*Germany*	*2.8*	*20.292882*	*-7.7387931*
1985	*France*	*1.6*	*20.932071*	*3.6759878*	*Germany*	*2.2*	*20.746344*	*-1.2045397*
1986	*France*	*2.3*	*22.047739*	*39.769466*	*Germany*	*2.4*	*20.737969*	*42.05282*
1987	*France*	*2.6*	*23.692059*	*24.678835*	*Germany*	*1.5*	*21.250353*	*24.941387*
1988	*France*	*4.7*	*23.875532*	*12.876307*	*Germany*	*3.7*	*21.753682*	*9.1427412*
1989	*France*	*4.3*	*24.991952*	*3.0519103*	*Germany*	*3.9*	*21.153929*	*2.8019155*
1990	*France*	*2.9*	*26.159275*	*24.960568*	*Germany*	*5.7*	*23.339193*	*30.993774*
1991	*France*	*1*	*26.683033*	*-.86583172*	*Germany*	*5*	*22.859518*	*7.5132591*
1992	*France*	*1.6*	*29.726353*	*5.1861817*	*Germany*	*1.9*	*24.946274*	*14.984713*
1993	*France*	*-.6*	*35.005109*	*-11.487695*	*Germany*	*-1*	*27.106145*	*-6.938432*
1994	*France*	*2.4*	*38.792508*	*3.9413502*	*Germany*	*2.4*	*28.804135*	*6.8596098*
1995	*France*	*2.1*	*44.119832*	*12.892051*	*Germany*	*1.5*	*35.386192*	*14.414794*
1996	*France*	*1.4*	*47.585737*	*-.78340437*	*Germany*	*.8*	*37.179874*	*-5.6099455*
1997	*France*	*2.3*	*48.825126*	*-11.067904*	*Germany*	*1.8*	*37.633545*	*-12.687739*
1998	*France*	*3.6*	*49.929876*	*5.4799852*	*Germany*	*2*	*38.189404*	*1.6720524*
1999	*France*	*3.4*	*49.685974*	*3.8358735*	*Germany*	*1.9*	*38.713291*	*-.7043331*
2000	*France*	*3.9*	*48.58023*	*-5.6438627*	*Germany*	*2.9*	*37.82195*	*-11.016232*
2001	*France*	*2*	*48.465739*	*1.0390833*	*Germany*	*1.7*	*36.041654*	*-5.6750985*
2002	*France*	*1.1*	*50.616282*	*5.7338483*	*Germany*	*-.2*	*36.585147*	*-1.4615232*
2003	*France*	*.8*	*53.757177*	*23.646639*	*Germany*	*-.7*	*38.512261*	*17.327577*
2004	*France*	*2.8*	*53.667242*	*16.758158*	*Germany*	*1.2*	*39.408047*	*10.482173*
2005	*France*	*1.7*	*54.295106*	*5.9021826*	*Germany*	*.7*	*40.887277*	*1.0341703*
2006	*France*	*2.4*	*51.418959*	*8.740676*	*Germany*	*3.8*	*40.868819*	*9.0654929*
2007	*France*	*2.4*	*51.185767*	*18.340959*	*Germany*	*3*	*39.162989*	*16.277896*
2008	*France*	*.3*	*55.250504*	*11.787132*	*Germany*	*1*	*39.674752*	*10.241748*
2009	*France*	*-2.9*	*67.046336*	*-13.789576*	*Germany*	*-5.7*	*44.00491*	*-14.148378*
2010	*France*	*1.9*	*68.250765*	*-1.6010691*	*Germany*	*4.2*	*51.705038*	*1.4044185*
2011	*France*	*2.2*	*69.642518*	*9.8395217*	*Germany*	*3.9*	*49.723357*	*14.667751*
2012	*France*	*.3*	*72.026863*	*-6.0629025*	*Germany*	*.4*	*50.316395*	*-6.4043935*
2013	*France*	*.6*	*74.750058*	*2.8001431*	*Germany*	*.4*	*49.19752*	*3.7108733*
2014	*France*	*1*	*76.026915*	*.43913476*	*Germany*	*2.2*	*47.522655*	*5.4515226*
2015	*France*	*1.1*	*76.609147*	*-15.769303*	*Germany*	*1.7*	*45.020959*	*-13.850819*
2016	*France*	*1.1*	*77.511658*	*2.8465144*	*Germany*	*2.2*	*43.258074*	*4.4346944*
2017	*France*	*2.3*	*78.142693*	*7.8412896*	*Germany*	*2.5*	*41.231303*	*6.9672746*

Year	*Countries*	*RGDP*	*DEBT*	*GCF*	*Countries*	*RGDP*	*DEBT*	*GCF*
1980	*Greece*	*.7*	*24.592685*	*-9.6963589*	*Italy*	*3.1*	*49.871502*	*28.481415*
1981	*Greece*	*-1.6*	*28.773888*	*-15.974501*	*Italy*	*.6*	*52.73988*	*-9.3421179*
1982	*Greece*	*-1.1*	*29.634242*	*-5.5540913*	*Italy*	*.2*	*57.058256*	*-6.5306645*
1983	*Greece*	*-1.1*	*33.959588*	*-3.0211066*	*Italy*	*.9*	*63.02048*	*-2.0758345*
1984	*Greece*	*2*	*40.503248*	*-21.425532*	*Italy*	*3*	*67.780081*	*-1.8698102*
1985	*Greece*	*2.5*	*48.245323*	*6.9730449*	*Italy*	*2.6*	*74.220824*	*1.3713289*
1986	*Greece*	*.5*	*48.866468*	*22.580384*	*Italy*	*2.7*	*78.640316*	*36.686268*
1987	*Greece*	*-2.3*	*54.340439*	*10.147806*	*Italy*	*3.1*	*82.725624*	*25.830762*
1988	*Greece*	*4.3*	*59.055919*	*15.757854*	*Italy*	*4*	*84.812367*	*12.685768*
1989	*Greece*	*3.8*	*61.988015*	*8.6974125*	*Italy*	*3.3*	*87.254179*	*4.3757038*
1990	*Greece*	*0*	*75.831416*	*26.717368*	*Italy*	*2*	*90.917105*	*28.74029*
1991	*Greece*	*3.1*	*77.108717*	*4.8742575*	*Italy*	*1.4*	*93.400778*	*3.596364*
1992	*Greece*	*.7*	*82.783492*	*4.3564038*	*Italy*	*.7*	*100.01359*	*3.2263991*
1993	*Greece*	*-1.6*	*93.745283*	*-10.942239*	*Italy*	*-.8*	*109.5431*	*-27.754323*
1994	*Greece*	*2*	*99.242434*	*-1.3822425*	*Italy*	*2.1*	*116.47564*	*1.6321196*
1995	*Greece*	*2.1*	*100.80814*	*17.131116*	*Italy*	*2.7*	*115.24376*	*10.062035*
1996	*Greece*	*2.9*	*103.22954*	*11.0201*	*Italy*	*1.3*	*114.84862*	*10.668433*
1997	*Greece*	*4.5*	*99.876909*	*-4.6767432*	*Italy*	*1.8*	*112.02988*	*-5.6090877*
1998	*Greece*	*3.9*	*97.349393*	*18.483075*	*Italy*	*1.6*	*108.9467*	*3.9583793*
1999	*Greece*	*3.1*	*96.546061*	*1.9637115*	*Italy*	*1.6*	*107.01927*	*.63163345*
2000	*Greece*	*3.9*	*98.539551*	*-8.183992*	*Italy*	*3.7*	*102.02545*	*-4.692614*
2001	*Greece*	*4.1*	*95.757605*	*5.0607588*	*Italy*	*1.8*	*101.43317*	*2.1078731*
2002	*Greece*	*3.9*	*101.62491*	*7.7726909*	*Italy*	*.2*	*98.707515*	*12.741989*
2003	*Greece*	*5.8*	*99.389117*	*40.841985*	*Italy*	*.2*	*96.199593*	*21.106851*
2004	*Greece*	*5.1*	*103.88613*	*14.741589*	*Italy*	*1.6*	*95.632987*	*15.21081*
2005	*Greece*	*.6*	*108.11764*	*-12.040197*	*Italy*	*.9*	*96.904169*	*4.6123373*
2006	*Greece*	*5.7*	*103.83527*	*25.434885*	*Italy*	*2*	*96.571125*	*6.4945484*
2007	*Greece*	*3.3*	*102.99247*	*27.973671*	*Italy*	*1.5*	*93.704574*	*13.835046*
2008	*Greece*	*-.3*	*108.29817*	*1.8867734*	*Italy*	*-1.1*	*96.649466*	*6.8668205*
2009	*Greece*	*-4.3*	*125.67641*	*-18.716203*	*Italy*	*-5.5*	*105.73215*	*-13.999271*
2010	*Greece*	*-5.5*	*150.54846*	*-23.370493*	*Italy*	*1.7*	*108.67016*	*-2.9570081*
2011	*Greece*	*-9.1*	*177.74225*	*-16.431298*	*Italy*	*.6*	*109.98658*	*5.5633611*
2012	*Greece*	*-7.3*	*159.79652*	*-29.408187*	*Italy*	*-2.8*	*116.8784*	*-14.945242*
2013	*Greece*	*-3.2*	*177.95231*	*-5.9825207*	*Italy*	*-1.7*	*122.98426*	*-3.4660165*
2014	*Greece*	*.7*	*181.42569*	*-6.1655424*	*Italy*	*.1*	*126.35605*	*-1.936436*
2015	*Greece*	*-.4*	*182.25201*	*-16.949522*	*Italy*	*.9*	*126.41089*	*-13.893729*
2016	*Greece*	*-.2*	*187.34788*	*3.6021277*	*Italy*	*1.1*	*127.25967*	*3.4655079*
2017	*Greece*	*1.5*	*184.94041*	*11.249531*	*Italy*	*1.7*	*127.30611*	*6.6528667*

Year	Countries	RGDP	DEBT	GCF	Countries	RGDP	DEBT	GCF
1980	Luxembourg	3.2	4.3946784	21.334116	Norway	4.5	33.587933	10.975529
1981	Luxembourg	.8	4.6375097	-21.27355	Norway	1.6	29.494292	-.33472007
1982	Luxembourg	1	5.1790959	-10.496181	Norway	.2	25.671428	-.92709221
1983	Luxembourg	1.9	5.5767193	-16.447566	Norway	4	20.54984	.33006215
1984	Luxembourg	4.7	5.8073719	-7.3971604	Norway	6.1	22.863811	-4.1034613
1985	Luxembourg	5.6	5.5034381	-9.0887972	Norway	5.6	25.318189	-.47661693
1986	Luxembourg	10	5.7806213	85.426738	Norway	4	33.387121	33.387287
1987	Luxembourg	4	4.8435405	43.530458	Norway	1.8	26.028116	21.038479
1988	Luxembourg	8.5	3.5692074	13.584567	Norway	-.3	25.067424	10.200534
1989	Luxembourg	9.8	2.6457745	4.1698092	Norway	1	24.896562	-8.866271
1990	Luxembourg	5.3	1.8233464	29.026504	Norway	1.9	21.986341	-.74039808
1991	Luxembourg	8.6	1.284928	16.580376	Norway	3.1	22.5242	-3.0977971
1992	Luxembourg	1.8	1.5278953	-4.9947834	Norway	3.6	26.69101	3.0501771
1993	Luxembourg	4.2	1.9282427	13.806326	Norway	2.8	34.646324	-5.9711223
1994	Luxembourg	3.8	1.9114378	4.936758	Norway	5.1	32.343599	7.036675
1995	Luxembourg	1.4	2.617362	13.452609	Norway	4.2	30.187629	18.557589
1996	Luxembourg	1.5	3.4208266	-7.6394186	Norway	5	27.007195	9.4812326
1997	Luxembourg	5.9	3.7326006	-5.5893986	Norway	5.3	24.198145	6.4932382
1998	Luxembourg	6.5	4.0620949	9.0336998	Norway	2.6	21.809746	7.567564
1999	Luxembourg	8.4	3.5147637	13.564786	Norway	2	20.445982	-6.8369964
2000	Luxembourg	8.4	3.0217292	-14.87602	Norway	3.2	18.960862	-10.856828
2001	Luxembourg	2.5	2.9332829	6.4474122	Norway	2.1	17.811816	.08070537
2002	Luxembourg	3.8	2.5599133	8.162869	Norway	1.4	18.653413	11.804405
2003	Luxembourg	1.6	1.6629881	21.661604	Norway	.9	20.982296	13.626096
2004	Luxembourg	3.6	1.4035904	17.165315	Norway	4	17.999855	20.033138
2005	Luxembourg	3.2	.82781126	1.106338	Norway	2.6	16.799493	21.174936
2006	Luxembourg	5.2	1.4623541	4.6980677	Norway	2.4	12.15914	15.145945
2007	Luxembourg	8.4	1.4309192	25.46318	Norway	3	11.286477	30.612268
2008	Luxembourg	-1.3	8.4765766	20.780683	Norway	.5	13.415126	10.483301
2009	Luxembourg	-4.4	8.7406867	-16.470912	Norway	-1.7	25.817107	-13.89006
2010	Luxembourg	4.9	13.022117	-.90157047	Norway	.7	25.185533	-.97970561
2011	Luxembourg	2.5	12.121016	22.822604	Norway	1	19.937806	20.504488
2012	Luxembourg	-.4	14.127675	-.69650589	Norway	2.7	20.794857	6.7019817
2013	Luxembourg	3.7	15.660383	5.4168168	Norway	1	19.640061	7.7588158
2014	Luxembourg	4.3	14.966125	9.5634448	Norway	2	15.42754	-3.4938759
2015	Luxembourg	3.9	14.360321	-21.702243	Norway	2	15.484254	-22.696326
2016	Luxembourg	2.4	13.586505	6.2317742	Norway	1.1	16.541917	2.3329023
2017	Luxembourg	1.5	16.629046	7.3614048	Norway	2.3	15.824377	5.9520974

Year	*Countries*	*RGDP*	*DEBT*	*GCF*	*Countries*	*RGDP*	*DEBT*	*GCF*
1980	*Portugal*	*6.7*	*29.093433*	*32.846174*	*Spain*	*1.2*	*9.7553538*	*10.935891*
1981	*Portugal*	*3.5*	*35.833152*	*4.9453257*	*Spain*	*-.4*	*10.399658*	*-13.334114*
1982	*Portugal*	*2.2*	*39.185045*	*-3.8596249*	*Spain*	*1.2*	*11.583411*	*-4.3347118*
1983	*Portugal*	*1*	*42.516638*	*-16.193187*	*Spain*	*1.7*	*12.99764*	*-15.162086*
1984	*Portugal*	*-1*	*47.143501*	*-25.202506*	*Spain*	*1.7*	*17.734361*	*-7.7323009*
1985	*Portugal*	*1.6*	*50.749945*	*-.5867785*	*Spain*	*2.4*	*30.388137*	*7.8784696*
1986	*Portugal*	*3.3*	*50.65189*	*44.918772*	*Spain*	*3.4*	*35.235125*	*42.701895*
1987	*Portugal*	*7.6*	*56.615515*	*37.63595*	*Spain*	*5.7*	*36.250367*	*34.250984*
1988	*Portugal*	*5.3*	*56.032702*	*24.659207*	*Spain*	*5.3*	*36.683699*	*27.650874*
1989	*Portugal*	*6.6*	*54.630054*	*4.5199926*	*Spain*	*5*	*33.067137*	*16.584267*
1990	*Portugal*	*7.9*	*50.649055*	*28.022475*	*Spain*	*3.8*	*34.481664*	*30.636669*
1991	*Portugal*	*3.4*	*51.679023*	*7.822379*	*Spain*	*2.5*	*35.98972*	*4.4997285*
1992	*Portugal*	*3.1*	*49.6511*	*14.638321*	*Spain*	*.9*	*36.114649*	*.62720102*
1993	*Portugal*	*-.7*	*55.411459*	*-17.202127*	*Spain*	*-1.3*	*39.405957*	*-23.489511*
1994	*Portugal*	*1.5*	*57.382017*	*5.033102*	*Spain*	*2.3*	*49.151699*	*.3253128*
1995	*Portugal*	*2.3*	*56.1598*	*21.55442*	*Spain*	*4.1*	*51.584538*	*20.662205*
1996	*Portugal*	*3.5*	*57.437653*	*6.1585571*	*Spain*	*2.4*	*55.122816*	*3.5633796*
1997	*Portugal*	*4.4*	*53.445298*	*4.2198221*	*Spain*	*3.9*	*53.988733*	*-6.2553753*
1998	*Portugal*	*4.8*	*50.928759*	*11.428958*	*Spain*	*4.5*	*52.354391*	*10.199476*
1999	*Portugal*	*3.9*	*50.950775*	*3.7309967*	*Spain*	*4.7*	*51.015086*	*9.0659908*
2000	*Portugal*	*3.8*	*49.84276*	*-5.7559761*	*Spain*	*5.1*	*48.713936*	*-1.167882*
2001	*Portugal*	*1.9*	*52.315429*	*.40398697*	*Spain*	*4*	*45.10041*	*5.4854339*
2002	*Portugal*	*.8*	*54.8345*	*4.2835293*	*Spain*	*2.9*	*42.917401*	*14.331975*
2003	*Portugal*	*-.9*	*57.178532*	*12.921767*	*Spain*	*3.2*	*39.889816*	*33.584272*
2004	*Portugal*	*1.8*	*60.410706*	*12.988284*	*Spain*	*3.2*	*38.533954*	*21.647999*
2005	*Portugal*	*.8*	*65.220929*	*2.9684964*	*Spain*	*3.7*	*35.655348*	*13.390925*
2006	*Portugal*	*1.6*	*66.961606*	*2.9774199*	*Spain*	*4.2*	*32.378701*	*13.514703*
2007	*Portugal*	*2.5*	*66.235457*	*15.051757*	*Spain*	*3.8*	*29.50287*	*16.960795*
2008	*Portugal*	*.3*	*69.587925*	*10.822963*	*Spain*	*1.1*	*33.045298*	*3.990289*
2009	*Portugal*	*-3.1*	*81.00123*	*-13.845931*	*Spain*	*-3.6*	*45.194255*	*-23.644054*
2010	*Portugal*	*1.7*	*93.604672*	*-5.102336*	*Spain*	*0*	*51.025884*	*-9.5750967*
2011	*Portugal*	*-1.7*	*109.12596*	*-7.7857367*	*Spain*	*-1*	*58.315515*	*-3.0915915*
2012	*Portugal*	*-4.1*	*125.4885*	*-24.034522*	*Spain*	*-2.9*	*73.268412*	*-17.240306*
2013	*Portugal*	*-.9*	*128.79907*	*-2.6680264*	*Spain*	*-1.7*	*82.888098*	*-3.4241311*
2014	*Portugal*	*.8*	*131.17426*	*3.3890049*	*Spain*	*1.4*	*86.959415*	*4.0245873*
2015	*Portugal*	*1.8*	*129.61203*	*-10.453903*	*Spain*	*3.6*	*87.078825*	*-10.366639*
2016	*Portugal*	*2*	*131.34333*	*3.2677474*	*Spain*	*3.2*	*86.683782*	*3.6373012*
2017	*Portugal*	*3.5*	*128.34538*	*14.103825*	*Spain*	*3*	*86.861646*	*9.0982795*

Year	*Countries*	*RGDP*	*DEBT*	*GCF*	*Countries*	*RGDP*	*DEBT*	*GCF*
1980	*Sweden*	*4.6*	*39.285403*	*17.375865*	*Turkey*	*-.8*	*24.797395*	*-21.4424*
1981	*Sweden*	*4.5*	*46.284726*	*-14.137031*	*Turkey*	*4.4*	*25.736872*	*-1.7269176*
1982	*Sweden*	*1.4*	*53.906514*	*-12.429115*	*Turkey*	*3.4*	*29.466751*	*-9.2252667*
1983	*Sweden*	*2.1*	*58.636801*	*-6.7733687*	*Turkey*	*4.8*	*29.252852*	*-6.7358882*
1984	*Sweden*	*4.3*	*60.616515*	*5.701612*	*Turkey*	*6.8*	*36.908581*	*-5.1022643*
1985	*Sweden*	*2.3*	*62.06984*	*9.6287005*	*Turkey*	*4.3*	*38.380723*	*18.830212*
1986	*Sweden*	*2.9*	*60.115573*	*26.046511*	*Turkey*	*6.9*	*32.931308*	*26.459239*
1987	*Sweden*	*3.3*	*54.805966*	*26.631321*	*Turkey*	*10*	*37.685367*	*66.231133*
1988	*Sweden*	*2.5*	*49.133213*	*18.062588*	*Turkey*	*2.1*	*38.58673*	*9.9545513*
1989	*Sweden*	*2.5*	*43.686364*	*15.196504*	*Turkey*	*.3*	*30.435408*	*3.0028654*
1990	*Sweden*	*.8*	*40.833574*	*18.67008*	*Turkey*	*9.3*	*24.679378*	*41.042201*
1991	*Sweden*	*-1*	*42.657787*	*-6.0340147*	*Turkey*	*.9*	*27.25194*	*3.1387074*
1992	*Sweden*	*-1*	*54.133999*	*-8.7338211*	*Turkey*	*6*	*29.081496*	*2.5293657*
1993	*Sweden*	*-1.3*	*69.211239*	*-36.765198*	*Turkey*	*8*	*29.795005*	*26.201903*
1994	*Sweden*	*4*	*73.671685*	*7.8257063*	*Turkey*	*-5.5*	*39.328845*	*-30.490922*
1995	*Sweden*	*4*	*76.255696*	*18.234739*	*Turkey*	*7.2*	*31.70504*	*26.378823*
1996	*Sweden*	*1.6*	*78.691238*	*12.043708*	*Turkey*	*7*	*32.746841*	*12.711755*
1997	*Sweden*	*3.1*	*80.1392*	*-9.4437803*	*Turkey*	*7.5*	*32.208491*	*10.147877*
1998	*Sweden*	*4.3*	*79.239891*	*5.3768005*	*Turkey*	*3.1*	*30.334205*	*28.959231*
1999	*Sweden*	*4.3*	*73.910692*	*5.119287*	*Turkey*	*-3.4*	*38.925233*	*-21.244833*
2000	*Sweden*	*4.9*	*65.459808*	*-.79107301*	*Turkey*	*6.6*	*37.363539*	*19.533387*
2001	*Sweden*	*1.5*	*57.743614*	*-6.0543951*	*Turkey*	*-6*	*72.599291*	*-40.559496*
2002	*Sweden*	*2.2*	*54.920183*	*6.0840025*	*Turkey*	*6.4*	*67.651373*	*29.196849*
2003	*Sweden*	*2.2*	*53.295711*	*23.077011*	*Turkey*	*5.6*	*60.518137*	*39.033625*
2004	*Sweden*	*4.3*	*51.865882*	*16.924433*	*Turkey*	*9.6*	*54.932322*	*58.25433*
2005	*Sweden*	*2.9*	*51.998723*	*4.4974317*	*Turkey*	*9*	*49.270806*	*29.889487*
2006	*Sweden*	*4.6*	*47.082796*	*12.181567*	*Turkey*	*7.1*	*43.777219*	*18.607307*
2007	*Sweden*	*3.4*	*41.611059*	*20.59315*	*Turkey*	*5*	*37.918999*	*19.804526*
2008	*Sweden*	*-.2*	*39.564629*	*7.2585846*	*Turkey*	*.8*	*38.282687*	*8.0685698*
2009	*Sweden*	*-4.2*	*43.508903*	*-23.302064*	*Turkey*	*-4.7*	*44.240641*	*-29.711957*
2010	*Sweden*	*6.2*	*40.036875*	*13.355042*	*Turkey*	*8.5*	*40.874151*	*33.085462*
2011	*Sweden*	*3.1*	*38.981132*	*17.630605*	*Turkey*	*11.1*	*37.223248*	*21.72575*
2012	*Sweden*	*-.6*	*39.608921*	*-3.6892416*	*Turkey*	*4.8*	*33.949826*	*2.1863881*
2013	*Sweden*	*1.1*	*42.205929*	*4.9910064*	*Turkey*	*8.5*	*32.391436*	*13.559694*
2014	*Sweden*	*2.7*	*44.881265*	*2.2775554*	*Turkey*	*5.2*	*29.959725*	*-.44873505*
2015	*Sweden*	*4.4*	*43.676668*	*-11.532957*	*Turkey*	*6.1*	*29.001593*	*-5.3695166*
2016	*Sweden*	*2.4*	*41.634004*	*4.3168498*	*Turkey*	*3.2*	*29.133335*	*-.879078*
2017	*Sweden*	*2.4*	*39.688449*	*9.002748*	*Turkey*	*7.5*	*28.214475*	*.88820318*