Katarina Petrovic

Government Debt

Why Has the Government Debt Increased? An Analysis of What Factors Influence the Long-Term Interest Rate

A Panel Study of the 27 EU Member States for the Period 1995-2011

Economics
Master´s Thesis
Abstract
This paper analyzes what factors influence the long-term interest rate, in order to give an understanding of why the government debt has increased in EU member states. It is a statistical study of panel data analyzed by the fixed effect model. The research of the 27 EU member states is based on secondary data from the European Commission; Eurostat and EconStats. The results by the fixed effect model show that government debt, budget deficit and presidential system are significant and have a positive relationship with the long-term interest rate. The growth rate is significant, having a negative relationship with the long-term interest rate and the financial crisis did not increase the long-term interest rate. The results were not entirely consistent with theories and previous studies.

Keywords: European Union, Eurozone, government debt, bonds, long-term interest rate, panel data, fixed effect model
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1. Introduction

The issues of government debt\textsuperscript{1} and deficits in EU member states have in the most recent years become important and seriously discussed after the financial crisis in 2008 (Dinca et al. 2011). The European Union is in a position where the member states have to follow rules strictly\textsuperscript{2} regarding their budget deficit- and debt values since they have critical issues; how to decrease these values and find suitable financing on the financial markets (Europaportalen 2012a). Dinka et al. (2011) considers that the majority of the member states have complex financial problems; budget deficit combined with a current account deficit\textsuperscript{3}.

When expenditures in a country rise sharply, they are in a need of credits to meet the expenses and to avoid suspended payments. In the long run, the country is dependent of a well-functioning government finance and high growth. Countries have the opportunity to borrow as long as they are able to repay loans, although the problems arise when the confidence in a country's ability of paying back decreases (Ekonomifakta 2011). It is not necessary for the countries to pay off their debt as soon as possible, instead they need to sustain a low and stable interest rate. Neither Greece nor Italy has managed to meet the debt requirements in a single year since 1995 (Regeringen 2011). When confidence in a country’s economy decreases due to high debt levels, there will be a decline in the demand for domestic assets leading to higher interest rates which severely harms a country’s future development. The lack of confidence and higher interest rates lead to lower levels of investments and less debt reductions (Ball and Mankiw 1995).

1.1 Problem Discussion

The EU member states’ government debt has gained higher importance due to rapidly increased debt by numerous member states and many fear the possibility of EU collapsing. The fiscal sustainability\textsuperscript{4} in EU has worsened, the risk has increased, resulting in high deficit- and debt levels. To avoid such situations, the EU Stability -and Growth Pact (SGP) was

\textsuperscript{1}Also called public debt or national debt, it is the total amount of money owed by the government to creditors. It can be domestic creditors within the country; internal debt or international creditors; external debt. Government debt is normally presented as a percentage of gross domestic product.

\textsuperscript{2}Explanation of the rules will be later explained in the thesis.

\textsuperscript{3}The current account is divided into goods, services, income and current transfers; the value of exports and imports. A current account deficit is when import exceeds the export.

\textsuperscript{4}The state can maintain the debt through paying the interest and amortization; however the government debt-to-GDP ratio has to remain constant at any level.
introduced in 1997; the criteria of SGP should have constrained the deficit, helping the member states to accomplish sustainable government finances. The SGP instead failed to reduce the EU states’ budget deficits as a result of the criteria not being followed. There is political dissatisfaction, instability and protests in EU, many states still have deficit and debt above the threshold values.

In order to answer this paper’s purpose, I have chosen the following questions;

- What affects the changes in government debt?
- Do the explanatory variables; outstanding debt, current account balance, inflation, budget deficit, growth rate, Eurozone and political system, influence the long-term interest rate in EU member states?
- Has the financial crisis in 2008 increased the long-term interest rate?
- Why are the threshold values of deficit and government debt not being followed by all EU member states?
- Are the research results consistent with the theoretical framework?

1.2 Purpose

This paper analyzes what factors influence the long-term interest rate, in order to give an understanding of why the government debt has increased in EU member states.

1.3 Method

This paper is a quantitative statistical study, based on secondary data of the 27 EU member states. It is a multivariate regression analysis of panel data since different states are analyzed within a selected time period. The calculations are done in Excel and the fixed effect regression model is estimated in STATA. Data is obtained from; European Commission’s studies, the statistical database Eurostat, and EconStats.

To determine if the long-term interest rate increased during the financial crisis I have added a dummy variable when the financial crisis was assumed to be started in 2008 and went on until the end of 2011. The results of the regression analysis will be interpreted and confirm if the
hypothetical statements are correct. The results are also going to be compared with the theoretical framework and previous studies, and then a conclusion can be reached.

1.4 Limitations

The time period in the paper is analyzed between the years 1995-2011, because data for earlier years and 2012 is not available for some member states. Theories and previous studies found some relevant variables for this research which I decided to implement. Other excluded variables that were not examined may affect the long-term interest rate, however due to the limited time and limitations in access to data these variables are not investigated.

1.5 Disposition

This paper is structured as follows: Chapter 2 explains the European Union’s background. The theoretical framework and previous studies is discussed in Chapter 3 covering a brief discussion of the government debt and gives a broader description of the debt equation and its components. Chapter 4 presents the hypotheses, data and methodology explaining data and variables, the fixed effect model and deficiencies in data. Analysis and results are shown in Chapter 5, consisting of government debt calculations, hypothetical cases and estimations by the fixed effect model. The paper is concluded with a discussion and conclusions in Chapter 6.
2. Background

2.1 History Behind the European Union

The European Union is a unique political and economic partnership between 27 European member states (Appendix 1). It all started in the 1950s with the European Coal and Steel Community to make peace and tie the European states economically and politically closer together. In the 1960s the European economies experienced rapid growth. During 1973 there was an energy crisis and economic problems in Europe and three more states joined. The EU grew to ten member states between the years 1981 and 1986. In 1993 a single market with the four freedoms of movement: goods, services, money and people, was implemented. The Treaty of Maastricht was introduced in 1993 (European Union, the History). It contained strict rules in order to guide the national budgetary policies. The member states were according to the Treaty not allowed to lend money to each other if they had financial difficulties, they should turn to the market instead. It also implied no lending by the European Central Bank (ECB) to the member states. These rules were designed to avoid so called moral hazard (De Grauve 2009, 230).

The main goals of the Treaty were to:

- Improve effectiveness -and democracy in the institutions
- Form an economic -and monetary union
- Develop the community social dimension
- Create a common foreign -and security policy (Europa, Summaries of EU legislation 2010).

During 1995 the EU had three more new members. In 1999 the common currency, euro was introduced in eleven European member states and the ECB took over the control from the

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5 Belgium, France, Germany, Italy, Luxembourg and the Netherlands.
6 Denmark, Ireland and United Kingdom.
7 Greece, Spain and Portugal.
8 Today the Treaty has convergence criteria for member states to join the Eurozone; Inflation rate can at most be 1.5% higher than the average of the three lowest inflation rates in the EU. The long-term interest rate cannot be more than 2% higher the average of the three lowest ones. Not had a devaluation during the previous 2 years it joined the EU. The budget deficit cannot be higher than 3% if so, it has to decline or be temporary and becoming closer the threshold value. Government debt should be equal or below 60%, if not it has to be diminishing.
9 The member state does not care in the same extent how to solve the government debt problem if it can get help from the ECB.
10 Austria, Finland and Sweden.
11 Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain.
national central banks. Bulgaria and Romania also joined in 2007. In 2011 the EU had gradually grown to seventeen Eurozone member states (European Union, the History).

The general government sector in the EU includes all public firms that are no-market producers, and cannot cover at least 50 percent of costs through sales. General government gross debt refers to the short-and long-term debt of all institutions in the general government sector. This is the “Maastricht debt” and can be grouped into: currency and deposits, securities other than shares, excluding financial derivatives and loans (European Commission 2012).

2.2 The Eurozone

The Eurozone includes the member states that have the euro as currency, meaning they have a common monetary policy with the same interest-and exchange rate. The rationale behind the euro was to simplify trade and communication between the member states, and preventing individual countries to use monetary policy to gain advantages, at the expense of other states, by undervaluation of their exchange rates. The expectations were that the monetary union would increase the social welfare to the citizens. The member states had different economic structures which could lead to problems with a common currency, although joining the Eurozone seemed to provide benefits even if the states had to abandon their own central bank.

Member states in South Europe saw the membership as a good opportunity to lower inflation and reduce the high nominal -and real interest rates they had before joining the euro. Governments may use expansionary monetary policies to gain short term political favors. However, this often leads to higher expected inflation, as well as a higher volatility of the nominal interest rates, resulting in higher inflation risk premiums and higher average real interest rates. A higher real interest rate has a negative impact on investments since the cost of capital increases. Becoming a member in the Eurozone would make the real interest rate fall

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12 The central bank for the Europe’s currency euro handles the monetary policy. Their main point is to maintain the euro's purchasing power and sustain price stability in the Eurozone- ECB has an inflation target at 2 percent. The banking system in EU involves the European Central Bank (ECB) and National Central Banks (NCB) of all the union members. Combining these it is called the European System of Central Banks (ESCB), it consists of all the EU member states whether they have adopted the euro or not while the Eurozone consists of the ECB and the NCBs of those states that have adopted the euro.

13 The sector can be divided in four subsectors; central government, state government, local government and social security funds which provides social benefits, it can be in local, state or central level. The central government is the administrative departments of the state and other central agencies which cover the economic spectrum of a country. The state government is a separate institutional unit that handles government tasks below the central government. The local government makes decisions in the local territory.
and the loss of control of monetary policy could be more than compensated by a gain of credibility. However, this will only be the case if governments do not use the lower real interest rate to run higher deficits and therefore accumulate higher debt (Persson 2012, 9-16).

The EU introduced the Stability-and Growth Pact\textsuperscript{14} in 1997 (SGP) to maintain fiscal discipline. The budget deficits of a member state should not exceed three percent of gross domestic product (GDP) and the government debt should not be higher than 60 percent of GDP. The rules of SGP are intended to limit the incentive to borrow too much and limit the contribution of inflationary pressures in the European economy. Germany and France were the main generators of the agreement and even they exceeded the three percent threshold value. The states that exceed this threshold have to go through several steps to get their budget deficit under control. The states that are not members in the Eurozone are still restricted to follow the SGP (European Commission 2013).

2.3 The Global Economic Crisis

Government bonds\textsuperscript{15} are central to finance the national debt in the long run. The state gets the money and the buyer receives the bond with interest rate, becoming a bondholder. The interest rate is reflecting the risk taken by the bondholder. If there is uncertainty about a state’s ability to pay back the money when the bond matures, the bondholder could require a higher interest rate, though a higher interest rate will generate higher costs to a state (Ekonomifakta 2010). In 2008 the worst world financial crisis since World War II erupted. The member states of the EU were affected differently by the global economic crisis; some more severely whereas others managed to recover quickly. Firms and households financed their expenditures by issuing large amount of debts. At the end of 2008 the bank sector was lending too much money and the states increased their budget deficits; increasing the risk premium on the government bonds as the financial markets began to doubt if EU would stick together. In the Eurozone, German long-term bond rates declined most between 2007 and 2008, as well as the Finnish, Dutch and French bonds, but to a lesser extent. The states with constant bond rates were Spain, Belgium Portugal, Italy and Austria. Due to high debt Greece

\textsuperscript{14}Consists of two parts, surveillance- prevent states to produce more budget deficit, focusing on public finance to balance the budget. Dissuasive- when the first part does not work as expected or the deficit are unexpected. A deficit above three percent is acceptable if it is out of the member’s states control, as natural disaster or an economic downturn. If there is excessive deficit the member states gets orders to in four months correct it. If it fails it gets two months more in addition, if the actions aren’t efficient then there will be sanctions.

\textsuperscript{15}An individual invests money in a government which is promising to pay back their money with interest. Government bonds are usually safe investments.
and Ireland’s bond rates increased since the market assumed it was a high credit risk to buy these bonds (De Grauwe 2009, 242).

At the end of 2008 and through 2009 the economic problems did not disappear and for some states in Europe the situation became even worse. Even in 2011 the economy had not completely recovered from the crisis. The government’s budget deficits were large due to increased fiscal stimulus packages, for example rising unemployment benefit payments. The United Kingdom and Greece had the highest deficit followed by Spain and France. The deficits made the governments’ debt ratio, as percentages of GDP, to rise and it reached high levels in Italy, Belgium and Greece. Europe, though, as whole had a reasonable budget deficit and total debt, although the spread around the mean value was high. Imbalances within the EU member states have contributed towards the global crisis but affecting most severely the states with the euro as currency. In 2010 Greece had higher budget deficit and government debt than their recorded official numbers. The states which had budget surpluses were lending money and the ECB bought their domestic bonds making the interest rate fall, this resulted in cheaper borrowing on the market (Persson 2012, 23-30). The increased government debt was not only in member states such as Belgium and Greece, with a history of debt problems, but also in states where it was relatively low before the crisis, as in United Kingdom, France, Portugal and Ireland. The government debt in Greece, Portugal, Spain and Italy is predicted to increase in 2014 whereas the forecast in Estonia is a low debt (Global finance 2012).
3. Theoretical Framework and Previous Studies

3.1 Theoretical Framework

A country can run a budget deficit\textsuperscript{16} either by cutting taxes or raising government spending, inducing a lower national saving\textsuperscript{17}. The sum of all investments and net export is defined as national saving. A decrease in national saving reduces either investments, net exports or both these factors (Ball and Mankiw 1995).

Interest rates for loans are determined by the market where savers lend money to households and firms who want to invest. When national saving declines in a country it reduces the supply of loans available to private borrowers which increases interest rate. Households and firms therefore will reduce their investments. Higher interest rates pay higher returns on domestic assets since they are more attractive to investors. This will appreciate the domestic currency since its demand increases on the foreign exchange market. In turn an appreciated currency makes the domestic goods more expensive for foreigners, exports fall and imports rise (Ball and Mankiw 1995).

3.1.1 Are Budget Deficits a Problem?

The stock of the government debt is becoming greater when the deficit increases, signifying higher interest payments. The deficit measures the year to year shortfall of revenues relative to the expenditures whereas the debt is the accumulation of the past deficits over time. Each year’s deficit flows is added to the previous year’s debt stock (Gruber 2011, 13, 93).

When a government runs deficits for a long time period it builds up a stock of debt affecting the economy’s output and wealth which is determined by its stock of capital, since deficits reduce investments it will generate a more slow growth of capital stock. The economy’s capacity to produce goods and services will therefore be reduced (Ball and Mankiw 1995).

\textsuperscript{16} A government has cash in- and outflows. Expenditures are outflows while revenues are inflows. The most common revenues are taxes from households and businesses. If the expenditures exceed the revenues in any given year there is a budget deficit. When instead revenues exceed expenditures the government has a budget surplus.

\textsuperscript{17} Sum of private saving (household saving after tax income) and government saving (savings of the tax revenues). \( Y = C+I+NX \), \( S = Y-C-G \), \( S = I+NX \)
Budget deficits also affect wages and profits (the return to the owners of capital). The real wage is determined by the marginal product of labor, whereas the rate of profit is determined by the marginal product of capital. When deficits reduce the capital stock, the marginal product of labor falls since each worker has less capital to work with although the marginal product of capital rises, since the scarcity of capital makes the marginal unit of capital more valuable. Budget deficits therefore lead to lower real wages and higher rates of profit (Ball and Mankiw 1995).

Governments may never need to raise taxes or cut spending to reduce the deficit; they can pay off interest and maturing debt by issuing new debt. This can only occur if the economy is able to grow its way out of the debt by a higher growth rate of GDP than the interest rate, making the debt-to-GDP ratio fall over time. With the debt shrinking relative to the size of the economy, the government can roll over the debt forever. For example in the US from 1871 to 1992 the average growth was 5.9 percent and the average interest rate on debt was 4 percent. A depression can make the growth rate to drop below the interest rate for a sustained period. In this case the debt will rise faster than national income. Eventually the debt can become so large forcing a tax increase or spending cut. These adjustments are painful and they usually come when the economy is already suffering from a problem that has caused the debt-to-GDP ratio to rise. By raising taxes or cutting spending at an earlier stage it can reduce the risk of difficult fiscal adjustments in the future (Ball and Mankiw 1995).

The deficit can be affected by short- and long run factors. When a country is in a recession the tax revenues fall as households and firms have lower income. This in turn causes higher expenditures as the government has to support the unemployed and firms by increasing their benefits. The deficit increases in the short run, however, in the long run, during periods with economic growth, the revenues increases while the expenditures will decrease (Gruber 2011, 99). The government’s annual budget contains government consumption, interest payments, transfer payments\(^\text{18}\) and subsidies to firms. To be able to meet these expenditures the government raise funds, by printing money or borrowing from the private sector by issuing bonds, leading to future repayments with interest. Inflation\(^\text{19}\) has beneficial effects for the government as a debt holder, the deficit and debt are in nominal values and when inflation increases the national debt will therefore decrease since the interest paid is worth less in real terms at a higher price due to falling real deficit (Auerbach and Kotlikoff 1998, 143).

\(^{18}\) Benefits given to individuals by the government; unemployment, welfare and social security benefit.

\(^{19}\) Fischer equation: Inflation = Nominal interest rate - Real interest rate
3.1.2 The Components of Government Debt

The relationship between the initial stock of debt, the budget deficit and the nominal interest can be expressed as the government debt equation:

\[ D_{t+1} = D_t + G_t - Z_t + i_t D_t \]  \[3.1.2.1\]

- \( D_t \) = outstanding government debt
- \( G_t \) = expenditures
- \( Z_t \) = net tax\(^{20}\)
- \( i_tD_t \) = interest payments\(^{21}\)

Equation [3.1.2.1] shows that if a government purchases more in the first period without raising net taxes it then has to reduce purchases, or increase the net tax payments, in the future with an equal present value. According to Auer!ach and Kotlikoff (1998) actions today commit compensation in the future, keeping the intertemporal budget in balance.

The debt equation is suitable in order to understand how different factors influence the government debt. A country that has a budget deficit can handle negative shocks by borrowing but the burden of the additional debt can become unsustainable if the interest rate payments are too high.

The primary government surplus is,

\[ T - G \]  \[3.1.2.2\]

The government budget constraint is,

\[ G - T + iD = \Delta D + \Delta M \]  \[3.1.2.3\]

\( G = \) government expenditures (excluding interest payments on debt)
\( T = \) total tax revenue
\( i = \) nominal interest rate on debt

\(^{20}\) Tax revenues, excluding the transfer payments.
\(^{21}\) The interest rate times the outstanding government debt.
D= debt
M= monetary base

The left side in equation [3.1.2.3] represents the budget deficit. This can be financed through issuing more debt or printing money. When a country faces a high debt it can take the easy way out by printing money, causing inflation; the currency depreciates. However the member states in Eurozone cannot independently develop currency risk since they have given up their own monetary policy. Money creation is therefore not an option to finance budget deficit. The member states therefore have a harder budget constraint than countries maintaining their own currency. This creates incentives of larger budget deficits compared to other governments who are able to use the inflation mechanism in difficult times (De Grauwe 2009, 226-227).

Deriving the government budget constraint\(^{22}\) the debt equation is presented (Appendix 3). It describes the change in the government debt, as percentages of GDP.

\[
\Delta \frac{D}{Y} = \frac{G - T}{Y} + (i - x) \frac{D}{Y}
\]  

[3.1.2.4]

\(x = \text{growth rate of GDP}\)

\(\frac{D}{Y} = \text{government debt-to-GDP ratio}\)

\(\frac{G - T}{Y} = \text{budget deficit as a share of GDP}\)

The solvency equation:

\[
\frac{T - G}{Y} = (i - x) \frac{D}{Y}
\]  

[3.1.2.5]

De Grauwe (2009) shows that if the interest rate exceeds the growth rate in the economy the government should have a primary budget surplus otherwise the debt will increase without limit and stop the payments on the outstanding debt; default. The change in the government debt ratio also develops differently depending on the outstanding debt level.

\(^{22}\) It is not usual to print money (M) and can be ignored in this equation.

The fisher equation can explain the combination between the real interest rate (r), nominal interest rate (i) and the inflation (π). The nominal interest rate is according to the fisher equation, \(i = r + \pi\)
Dinca et al. (2011) explains that countries can have higher budget deficits if they have high a growth rate that stabilizes the government debt to GDP ratio. Economic growth is promoted when taxes are decreased encouraging more investors. Reducing the budget expenditures can keep the deficit at an appropriate level but is damaging if public investment, which promotes growth, decreases at the same rate as the expenditures.

3.1.3 Debt-to-GDP Ratio

The US and many European countries have had large increases in government debt during wars and depressions. The primary cause of increases in the US debt-to-GDP ratio has been wars which increased the federal indebtedness. An important reason why government debt dropped between 1945 and 1975 was that the growth rate exceeded the interest rate on government debt most of the period (Elmendorf and Mankiw 1998).

After 1975 there were larger deficits and a less favorable relationship between the interest rate and the growth rate in many countries, which caused the debt-to-GDP ratio to rise. The highest ratios were in Italy and Belgium, their high debt service payments led to large budget deficits despite primary budget surpluses (Elmendorf and Mankiw 1998).

3.1.4 Monetary Policy and Current Account Balance

Member states outside the Eurozone can create inflation by reducing the real value of the debt as their currency will depreciate. Member states in Eurozone do not have the opportunity to use such “surprise inflation” since they do not have their own central bank. When a country issues debt in their domestic currency the interest it pays reflects the risk premium; the risk and depreciation of the currency in the future. If a government cannot pay its outstanding debt the other members in the Eurozone may want to bail out this government through buying their bonds. This is to avoid negative spillover to the rest of the financial system, although this act is going against the Treaty of Maastricht and can make countries to issue unsustainable debt; the moral hazard problem (De Grauwe 2009, 235-239). For investment in these risky bonds there has to be an extra risk premium. According to De Grauwe (2009), a state with high budget deficit will have higher risk premium on its bonds. The entire union is reflecting different risk premiums on their government debt, there are different interest rates depending on the riskiness (Marrewijk 2012, 664-666; De Grauwe 2009, 147).
The current account balance measures the change in claims on the outside world, it shows the trade position of a country, but it also measures the difference between national savings and investments. The sum of governments, households and businesses financial savings sum up to national net savings\(^{23}\), which equals the current account balance, if it is negative the country as whole will increase its net foreign indebtedness. If the business and household sectors do not save enough to finance the government’s deficit, the country has to borrow abroad implying a current account deficit. This is the situation in the US, while Japanese households and business save so much that the country runs a current account surplus, although the government have a large budget deficit. High current accounts deficit are often associated with a high risk of a balance of payment crisis. The current account deficit is balanced out by the financial account surplus which is borrowing and selling assets. A current account and budget deficit can be avoided by increasing the supply of domestic currency which will depreciate the currency compared with other currencies (Zanghieri 2004).

3.1.5 Political System

When it is time for new elections there are fluctuations in fiscal policies because politicians want to please their voters. The Stability- and Growth Pact in EU were intended to restrict this behavior. In the Eurozone the fiscal policy is the only instrument to influence the voters before an election. The deviation of a government debt does not have to be caused by business cycles; it can be political tensions as well (Efthyvoulou 2010). Gwosc and Vandebeek (2003) claim that politician’s think of their self-interest, and want to maximize their utility by re-election. They are concentrating on a few groups of voters and want to satisfy them, providing desired goods for these groups; expanding the budget through borrowing. This debt affects the future generations, however politicians generally neglects this problem since future elections are held in member states, generating competition between the parties. Fiscal deficit often have political explanations and can be explained by politicians voting interests, conflicts about preferences between the politicians’ preferences and conflicts of interest between different social groups or regions (Eslava 2011). Active use of fiscal policy to gain political

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\(^{23}\) Government saving is the difference between expenditure and tax revenue.  
Business savings = cash flow and investment.  
Household saving = consumption - income.  
advantages varies from one election to another, it depends on the probability of re-election. The more competition, the higher should the benefits be of winning additional votes by using fiscal policy (Efthyvoulou 2010).

3.2 Previous Studies

Persson and Tabellini (2002, 2003) argue that the political system affects fiscal policy. The representatives’ inducement to stick together and vote along party lines is weaker in presidential systems than in parliamentary systems; there is larger spending and broader programs in parliamentary regimes. Nordhaus (1975) and Lindbeck (1976) consider that according to the political business cycle model, policy makers stimulate the economy before an election, increase inflation and inflationary expectations. The connection between elections and monetary policy is strong and it can result in monetary expansions, however this is only when the exchange rate is floating and the central bank is not independent (Efthyvoulou 2010).

Research by Efthyvoulou (2010) involving all member states during the period 1997–2008 shows that fiscal deficits are significantly higher in election years. The twelve new members in 2004 and 2007 had to adjust their fiscal policies and follow SGP rules to join EU, resulting in less fiscal manipulation. On average the estimations showed that expenditure of GDP increased during an election year while revenue decreased. There was more fiscal use in the parliamentary regimes although these results are weak due to low number of presidential countries in the sample. For members of the Eurozone, expenditures rise before an election while member states outside the Eurozone do not have a significant increase. Not having the same currency and ability to use a combination for desired fiscal and monetary policy outcomes is a possible explanation. Politicians’ incentive to manipulate fiscal policy varies over time and across countries depending on the political pressures at the time of elections. Evidence confirms that the SGP cannot prevent governments from overspending when there is an election year. If the probability of re-election is sensitive to economic stimulation

27 Cyprus, Lithuania and Poland had only presidential systems in the research sample.
governments will manipulate fiscal policy to win and correct the budget in another period. If the chances for election cannot be improved, governments will not manipulate the fiscal policy. Mink and de Haan (2006) conducted a study when the EU consisted of 14 member states; back then there was not enough discipline to follow the SGP and the member states were more tempted to run politically motivated fiscal policies. This behavior is fairly unexplored when the additional member states were included.

Hall and Sargent’s (2010) study shows that the US reduced the debt-to-GDP ratio by 85 percent after the World War II (1947-1974). This reduction was by a mixture of primary surpluses, negative real returns on its bonds and growing real income. 20 percent of the decline in the debt-to-GDP ratios was by using inflation to bring negative returns to bondholders. The remaining percent of the decline came equally from increased growth in GDP and running primary surpluses (T-G). The US continued to inflate away part of the debt during the 1970s, although the debt-to-GDP ratio continued to grow during the 1970s in spite of the inflation, because the real GDP growth was low and there were primary deficits. In 1981-1992 during the Reagan-Bush years the debt-to-GDP ratio increased with 25.4 percentage points. About half of this increase was due to primary deficits. Even if the growth was high the debt-to-GDP ratio grew more than the deficits due to large real returns paid to bondholders, it was Federal Reserve chairman Paul Volcker in the early 80s that brought inflation down, by decreasing the rate of money growth, which in turn increased the real interest rate. In the Clinton years 1993-2000 there were surpluses reducing the debt-to-GDP ratio. When Bush was president in 2001-2008 there were more deficits, which largely increased the growth in debt-to-GDP ratio.

3.3 A Current Debate: Is There a Low Growth Threshold?

Economists have difficulties to know when a country needs to worry about its debt. “Growth in a Time of Debt” is a paper by Carmen Reinhart and Kenneth Rogoff (2010), there they show that debt-to-GDP ratios over 90 percent are associated with lower growth; the government debt has little effect on growth rates until debt reaches 90 percent of GDP then growth rates drop sharply. In a post-war sample the average growth dropped from about 3 percent to -0.1 percent (Irons and Bivens 2010).

“The relationship between government debt and real GDP growth is weak for debt/GDP ratios below a threshold of 90 percent of GDP. Above 90 percent, median growth rates fall by one percent, and average growth falls considerably more.”

This conclusion has been criticized by others, notably by, Paul Krugman. Krugman refers to a paper by Irons and Bivens (2010) saying that if there are no differences in growth rates when a nation’s debt rises from 0 percent to 30 percent, to 60 percent, of GDP, then it is odd to see a sharp drop in the growth rate when the debt-to-GDP ratio rises from 89 percent to 91 percent. Irons and Bivens (2010) saw clearly that there is no trend when it comes to high debt and lower growth. Lower growth can increase the debt-to-GDP ratio due to lower GDP not higher debt. It should be deficits rather than the stock of the debt decreasing the GDP, by crowding out private sector borrowing. They also argue that the causation of debt and growth is difficult to determine when studying these variables; correlation does not have to be causation. Causality is more likely to run from slow growth to high debt levels. Studies show, when the growth rate is negative or slow the debt will increase since there is less revenues and higher automatic stabilization spending, which leads to higher deficit. Krugman argues that the growth rates during the post-wars years in the US and Britain, studied by Reinhart and Rogoff (2010) were extremely low and the war spending high resulting in increased debt levels. A conclusion only based on their results would therefore be a mistake and theory and data rest on shaky foundations²⁹. The studied period in the paper by Reinhart and Rogoff (2010) is not relevant today since the US has very limited experience with debt levels above 90 percent (The Economist 2010, 2013; Irons and Bivens 2010).

²⁹ Some errors in the study by Reinhart and Rogoff (2010) are spreadsheet errors, omission of available data, weighting, and transcription which reduced the measured average GDP growth of countries in the high public debt category.
4. Hypotheses, Data and Method

4.1 Hypotheses and Explanations of Variables

Based on the theories discussed, and previous studies reviewed, the variables: outstanding debt, budget deficit and inflation should have positive correlation with the long-term interest rate\(^{30}\). When debt increases the investors believe that governments’ bonds are risky and of low quality. A state with high budget deficit will have higher risk premium on its bonds. Inflation is associated with problems within an economy and when the inflation rises, as well as its variability, it should generate higher real interest rates.

The variables: current account balance, growth rate, Eurozone and presidential system should have negative relationship with the long-term interest rate. The dependent variable will decrease if the values on these explanatory variables increase. Growth should make revenues rise and expenditures decline; decreasing the risk premiums and therefore the real interest rate. Increased current account balance decreases the interest rate due to higher saving, export, and low unemployment. The ECB has control over the monetary policy in the Eurozone with an inflation target at two percent, gaining higher credibility on the financial market and the politicians in a presidential system are spending less money than in a parliamentary system.

Table 1: Description of the dependent-and explanatory variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent variable</strong></td>
<td>Nominal interest rate ([i])</td>
</tr>
<tr>
<td></td>
<td>Long-term government bond in percent. Ten years maturity. Assuming it reflects the market assessment of how risky it is to lend to the state. The higher long-term interest the lower credibility the state has to repay the debt.</td>
</tr>
<tr>
<td><strong>Explanatory variables</strong></td>
<td>Outstanding debt ([d])</td>
</tr>
<tr>
<td></td>
<td>General debt percentage of GDP at the end of the year, in nominal values.</td>
</tr>
</tbody>
</table>

\(^{30}\)The long-term interest rate is the financial market’s assessment of the state’s economic sustainability, ECB (2009).
---|---
Inflation [$\pi$] | Harmonized Indices of Consumer Prices (HICP), used by the European Central Bank for monitoring inflation. Annual average rate of change in percent.
Budget deficit [Bd] | When expenditures exceed the revenues there is a budget deficit, reverse it is a budget surplus, percentage of GDP.
Growth rate [$x$] | Growth rate, percentage change previous year, the GDP at current prices are valued in the prices of the previous year and the volume changes are imposed on the level of a reference year, the price movements will not inflate the growth rate.
Eurozone [Ez] | Dummy variable"0" explains if the state has an independent monetary policy, not member in Eurozone. “1” explains if it has a dependent monetary system; member in Eurozone.
Political system [Ps] | Dummy variable”0” explains if the state’s political system is parliamentary.”1” is a presidential system.

**Table 2: An overview of the variables in the regression model; mean value, standard deviation, minimum - and maximum values in percent**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Std dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>5,33</td>
<td>1,95</td>
<td>2,41</td>
<td>15,75</td>
</tr>
<tr>
<td>d</td>
<td>57,04</td>
<td>27,67</td>
<td>3,70</td>
<td>170,3</td>
</tr>
<tr>
<td>Ca</td>
<td>-1,69</td>
<td>5,95</td>
<td>-25,2</td>
<td>11,95</td>
</tr>
<tr>
<td>$\pi$</td>
<td>2,93</td>
<td>2,51</td>
<td>-1,7</td>
<td>28,3</td>
</tr>
<tr>
<td>Bd</td>
<td>2,74</td>
<td>4,21</td>
<td>-31,8</td>
<td>30,9</td>
</tr>
<tr>
<td>x</td>
<td>2,66</td>
<td>3,36</td>
<td>-17,7</td>
<td>11,5</td>
</tr>
<tr>
<td>Ez</td>
<td>0,63</td>
<td>0,48</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Ps</td>
<td>0,11</td>
<td>0,26</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

*Source: Secondary data processed in STATA*

Comment: d: Outstanding debt, Ca: Current account balance, $\pi$: Inflation, Bd: Budget deficit, x: Growth rate, Ez: Eurozone and Ps: Political system
Table 2 has 375 observations for the variables outstanding debt, current account balance, inflation, budget deficit and growth rate. The variables Eurozone and political system have 374 observations due to the dummy variable trap\textsuperscript{31}.

4.2 Econometric Method

4.2.1 Random or Fixed Effect Model?

The recommendation about applying the random -or the fixed effect model is hard to determine when deciding the most appropriate model for the specified data. Both models have a series of assumptions that can be violated. Random effects models can be biased but reduces the coefficients’ variance whereas the fixed effects estimates can be unbiased but may imply high variance; it is a clear tradeoff between bias and variance. If the error term in a random effect model is correlated with the explanatory variables the coefficient estimations are biased. The Hausman test should tell how the parameter estimations differ between the two models. However according to Clark and Linzer (2013) this test is not necessary or sufficient to decide between the models. Greene (2008)\textsuperscript{32} considers that the quality of inferences about either model can be compared based upon the size and characteristics of the researcher's dataset. With larger amounts of data and observations it is no obvious difference between the two estimators. The interest rate can change over time; some unexplained variation due to period specific events. Time dummies take into account the specific effects that may influence states in a given year to the same amount, if these effects exist, then it is wise to add them in, introducing time dummies – one dummy for each year (Gujarati and Porter 2009, 602-603). There are 16-time dummies in the model to avoid the dummy variable trap and to correct for annual differences in the data that cannot be modeled otherwise.

4.2.2 Regression Model

The fixed effect regression model is applied to estimate how the explanatory variables affect the dependent variable, long-term interest rate.

\[ i = \alpha + \gamma_i + \beta_1 d_{it} + \beta_2 C_{ai} + \beta_3 \pi_{it} + \beta_4 B_{it} + \beta_5 x_{it} + \beta_6 E_{it} + \beta_7 P_{it} + u_{it} \]  

\[ i = \text{ member state} \]

\textsuperscript{31}To avoid the situation of perfect collinearity
\( t = \) time period

The intercept is \( \alpha \), the specific effect for each member state is \( \gamma_1 \) and the estimated coefficients is \( \beta \). The beta coefficients do not vary across the countries. The fixed effect model is a solution to get efficient estimations of the parameters. Ordinary Least Square (OLS) gives fixed effect estimators which are always consistent even if it is assumed the underlying model is random or pooled; it is designed to study the causes of changes within a member state. This model is suitable when there are no time- invariant variables as gender or ethnicity (Gujarati, Porter 2009, 606-607).

4.3 Panel Data and Estimation Problems

Panel data is a combination of time series and cross- sectional data, the same cross sectional subjects are followed over time. It is the best solution when the analysis cannot be done by pure cross -or time series data. In this research the panel data is collected for 27 member states in EU, the time period extends over 17 years, investigating time, as well the cross- sectional patterns (Gujarati and Porter 2009, 592-593).

The estimations in a panel data can be inefficient if the residuals variances are different from each other; heteroskedasticity. Another problem is autocorrelation; the panel will not produce consistent estimates of the standard errors. To know the existence of autocorrelation the Wooldridge test is applied and the robust Wald test for heteroskedacity (Drukker 2003). The results show there is autocorrelation and heteroskedacity (Appendix 5). Clustering the standard errors will make the estimations to be robust against these two problems.

The existence of linear relationships between two or more explanatory variables in a regression model is called multicollinearity implying large standard errors and uncertain estimations, it creates difficulties to determine how large individual effects of each explanatory variable has on the dependent variable. Multicollinearity can be noticed if there is a high coefficient of determination, \( (R^2) \) and not significant parameters. The easiest way to detect it is to calculate the values of tolerance by the variance inflation factor (VIF). If the tolerance values are 0.1 or below and the VIF is 10 or higher there is a problem with multicollinearity (Acock 2006, 228-229). The test showed the VIF values were within the limits of what is considered to be a problem (Appendix 5).
4.4 Deficiency in Data

Deficiency in data can lead to misleading results and problems may arise with the collection of secondary data, and it is therefore important to be careful and select reliable sources.

In this research there were missing values and outliers which may have influenced the results. The data is unbalanced\(^{33}\) which can lead to heterogeneity of variance across cells and may cause problems with the standard error estimations. The time period could also have been wider, gaining more information and better estimations.

The Hausman test was applied for helping to determine which model of fixed- or random effect to implement. However, the Hausman test did not generate a relevant result, when estimating the fixed and random effect models they showed similar results. Even if the test would recommend the random-effect model, it would not be possible to apply it since the member states are not drawn from a random sample.

Introducing too many dummy variables in the fixed effect model can create problems with the degrees of freedom. It can also be a multicollinearity problem making difficulties in the estimations.

\(^{33}\) Unequal numbers of observations
5. Analysis and Results

Figures 1-3 show how government debt as percentages of GDP has developed in different EU member states during the time period 1995-2011.

Figure 1: The general government gross debt, percentage of GDP in the Eurozone; Belgium, Cyprus, Estonia, Greece, Ireland, Finland and France, million Euros.

Source: Secondary data from the European Commission, Eurostat

Figure 1 shows that Greece almost never had a government debt below 100 percent during this time period and has not followed the SGP. Greece’s debt started to increase in 2005 and the financial crisis caused doubt in the bond market about its ability to pay back, leading to higher interest rates. The debt in Ireland started to increase sharply in 2007 and continued to increase whereas Estonia had a very low -and stable debt during this time period. France had a debt-to-GDP ratio close to 60 percent for most of the period, following the SGP, but it also started to increase following the onset of the financial crisis.
Italy deviates in Figure 2, it had a high and stable debt above the threshold value the entire time period and has, like Greece, not managed to follow the SGP due to high debt service payments leading to large total budget deficits. Germany had a quite stable debt-to-GDP ratio at 60 percent until 2009 whereas Spain and Portugal started to increase their debt in 2008. Luxembourg is most similar to Estonia, both having quite low debt levels.
Interesting result to emphasize in Figure 3, is that not a single EU member state outside the Eurozone have a government debt-to-GDP ratio that exceeds 85 percent. Bulgaria had a significant decrease in their debt from 1997 to 2008 (missing values before 1997). Latvia and United Kingdom increased their debt significantly after 2007. The United Kingdom and Hungary were the states in 2011 that had government debt above the threshold value of 60 percent.

5.1 Analysis of Government Debt

To provide a wider understanding of changes in government debt, Tables 3 to 5 show calculations of different states during the years 1995, 1998, 2001, 2006 and 2011. These years are selected to see if there have been large changes in debt and how various variables affect these changes. Germany is selected since it is a large economy and is the driving force in the EU whereas Greece and United Kingdom are interesting as they have been discussed quite much in the media.

The equation is:

$$\Delta \frac{D}{Y} = \frac{G-T}{Y} + (i-x) \times \frac{D}{Y}$$

[3.1.2.4]
Table 3: The change in government debt, Germany

<table>
<thead>
<tr>
<th>Year/ Variables</th>
<th>ΔY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>i</td>
</tr>
<tr>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>D_Y</td>
</tr>
<tr>
<td>1995</td>
<td>0,124</td>
</tr>
<tr>
<td>1998</td>
<td>0,039</td>
</tr>
<tr>
<td>2001</td>
<td>0,061</td>
</tr>
<tr>
<td>2006</td>
<td>0,034</td>
</tr>
<tr>
<td>2011</td>
<td>-0,011</td>
</tr>
</tbody>
</table>

Source: Secondary data, Eurostat, EconStats and own calculations

Table 3 shows that in 1995 (before the euro) the change in debt was highest 12.4 percent due to high deficit and interest rate. In 2001 the growth rate was negative, -0.4 percent, the interest rate was 4.8 percent whereas the deficit was 3.1 percent. This resulted in a 6.1 percent debt increase, when having a outstanding debt at approximately 60 percent. The change in government debt in 2006, was lower compared to 2001 due to a decreased interest rate at 3.7 percent and deficit 1.6 percent but also due to a higher growth, 1.1 percent. Even if the outstanding debt was highest in 2011 the debt decreased with 1.1 percent since the state had a budget surplus, decent growth and lower interest rate. The change in government debt in Germany was not high in 2011 compared to Greece and United Kingdom.

Table 4: The change in government debt, Greece

<table>
<thead>
<tr>
<th>Year/ Variables</th>
<th>ΔY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>i</td>
</tr>
<tr>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>D_Y</td>
</tr>
<tr>
<td>1995</td>
<td>0,239</td>
</tr>
<tr>
<td>1998</td>
<td>0,087</td>
</tr>
<tr>
<td>2001</td>
<td>0,056</td>
</tr>
<tr>
<td>2006</td>
<td>0,042</td>
</tr>
<tr>
<td>2011</td>
<td>0,485</td>
</tr>
</tbody>
</table>

Source: Secondary data, Eurostat, EconStats and own calculations

Table 4 shows that Greece increased their debt most in 1995, 1998 and 2011. In 2001 the budget deficit was 4.5 percent and the interest rate was 5.3 percent, these variables increased
the debt. In 2006 the budget deficit and growth was higher than in 2001, 5,7 percent respectively 5,5 percent whereas the interest rate decreased, the change in debt was 4,2 percent. The negative growth rate -7,1 percent and high interest rate, 15,8 percent in 2011 increased the government debt, due to the high debt payments as the debt-to-GDP ratio was 170 percent. From 1995 to 2011 the debt-to-GDP ratio increased with 73,6 percent. According to Reinhart and Rogoff (2010) the growth should decrease when a country has a debt-to-GDP ratio above 90 percent. Greece had in 1998, 2001 and 2006 higher growth rate than in 1995 even if the debt was above the threshold value 90 percent.

Table 5: The change in government debt, United Kingdom

<table>
<thead>
<tr>
<th>Year/ Variables</th>
<th>$\frac{\Delta D}{Y}$</th>
<th>$\frac{G - T}{Y}$</th>
<th>i</th>
<th>x</th>
<th>$\frac{D}{Y}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>0,085</td>
<td>0,059</td>
<td>0,083</td>
<td>0,032</td>
<td>0,512</td>
</tr>
<tr>
<td>1998</td>
<td>0,010</td>
<td>0,001</td>
<td>0,056</td>
<td>0,035</td>
<td>0,467</td>
</tr>
<tr>
<td>2001</td>
<td>-0,003</td>
<td>-0,005</td>
<td>0,051</td>
<td>0,029</td>
<td>0,377</td>
</tr>
<tr>
<td>2006</td>
<td>0,032</td>
<td>0,027</td>
<td>0,037</td>
<td>0,026</td>
<td>0,433</td>
</tr>
<tr>
<td>2011</td>
<td>0,095</td>
<td>0,078</td>
<td>0,029</td>
<td>0,009</td>
<td>0,850</td>
</tr>
</tbody>
</table>

*Source: Secondary data, Eurostat, EconStats and own calculations*

Table 5 shows that in 2001 United Kingdom had a budget surplus of 0,5 percent, however the interest rate was 5,1 percent and the growth rate was 2,9 percent, the debt ratio decreased due to a low outstanding debt and budget surplus. In 2006 the deficit and the debt was higher than in 2001 but the interest rate was lower 3,7 percent. In 2011 the debt was almost twice as high compared to 2006 and the budget deficit was 7,8 percent whereas the growth rate was almost 0 percent, this induced the debt to increase in the United Kingdom with 9,5 percent.

Tables 3-5 show that Germany, Greece and United Kingdom increased their debt in 1995 due to high interest rate and deficit whereas it was lower in 1998 when these values decreased. The size of the outstanding debt-to-GDP ratio, growth rate, budget deficit and the interest rate affect the continued development of the debt in a state and can explain why states have different debt-to-GDP ratios. A high debt generates more interest payments, making it harder to sustain the debt at a constant level or decreasing it. There is higher demand on growth and budget surpluses to avoid the debt to become greater.
5.2 Hypothetical Cases for Germany and Greece

Figures 4 to 5 shows some hypothetical cases for Germany and Greece. These cases show how the outstanding debt in 1995 continues to develop until 2012 given the historical mean values for the variables: the growth rate, the nominal interest rate and the budget deficit, calculated by the values in Table 3 and 4. 2011 is not included since the financial crisis can lead to deviations and misleading results (Appendix 4).

The interpretation is: Which value should the analyzing variable have each year when the other variables at the same time are kept constant each year?

The equation for the hypothetical cases is:

\[
\Delta \frac{D}{y} = \frac{G-T}{y} + (i - x) \times \frac{D}{y}
\]  [3.1.2.4]

5.2.1 Germany

The debt-to-GDP ratio in 1995 is 55,6 percent for all cases. Case 1 shows that if the constant values each year for budget deficit is 3 percent (the state should not exceed this threshold) and the growth rate is 1,1 percent then the average nominal interest rate each year should be -3,6 percent to have a debt-to-GDP ratio at 60 percent in 2012, not exceeding the debt threshold value. In reality this is unrealistic since it is far from Germanys historical nominal mean value at 5,0 percent.
Figure 4: Hypothetical cases for Germany, with the historical mean values; growth rate: 1.1, nominal interest rate: 5.0, and budget deficit: 2.3 percent.

Case 2 shows that having a constant budget deficit of 3 percent, a nominal interest rate of 5.0 percent each year, implies that holding the debt-to-GDP ratio at 60 percent in 2012 requires a growth rate at 9.7 percent each year, clearly this is a very high value since the historical growth mean value is 1.1 percent (it is a stable country with no catch up growth).

Case 3 and 4 assume that the government has the political responsibility to keep its budget in balance, 0 percent. In Case 3 the nominal interest rate should each year be 1.5 percent with a constant growth rate at 1.1 percent and a budget balance. In Case 4 the growth rate should be 4.6 percent each year when the constant nominal interest rate is 5.0 percent each year.

5.2.2 Greece

Greece always had high debt-to-GDP values and has never followed the SGP. They want to keep their debt within the limits, not increasing it. Case 1 shows if the debt-to-GDP ratio is 97 percent in 1995 and the constant budget deficit each year until 2012 is 5.8 percent whereas the growth rate is 3.8 percent then the nominal interest rate should on average each year be -2.2 percent to keep the debt-to-GDP ratio at 97 percent in 2012.
Figure 5: Hypothetical cases for Greece, with the historical mean values; growth rate: 3.8 nominal interest rate: 8.8 and budget deficit: 5.8 percent

<table>
<thead>
<tr>
<th>Percent</th>
<th>Greece</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>-5</td>
<td></td>
</tr>
<tr>
<td>-10</td>
<td></td>
</tr>
<tr>
<td>Case 1</td>
<td>3.8</td>
</tr>
<tr>
<td>Case 2</td>
<td>5.8</td>
</tr>
<tr>
<td>Case 3</td>
<td>14.8</td>
</tr>
<tr>
<td>Case 4</td>
<td>8.8</td>
</tr>
<tr>
<td>Case 5</td>
<td>3.8</td>
</tr>
<tr>
<td>Case 6</td>
<td>3</td>
</tr>
<tr>
<td>Case 7</td>
<td>3.8</td>
</tr>
<tr>
<td>Case 8</td>
<td>5.8</td>
</tr>
</tbody>
</table>

Source: Secondary data, Eurostat, EconStats and own calculations

This result shows why they cannot keep their debt level constant since the historical mean interest rate is higher, 8.8 percent. If instead analyzing the growth rate in Case 2, it should be 14.8 percent each year when the constant nominal interest rate is 8.8 percent and the budget deficit is 5.8 percent, this is far from the historical mean value 3.8 percent each year but not impossible if they have a catch up growth. Case 3 show if they could have a constant budget deficit at 3 percent and a growth rate at 3.8 percent the nominal interest rate should be 0.7 percent each year keeping the outstanding debt level 97 percent. Case 4 shows that the nominal interest rate has to be -7.0 percent if Greece would have the debt threshold value at 60 percent in 2012 when the outstanding debt in 1995 is 97 percent, the constant growth rate is 3.8 percent and the budget deficit is 5.8 percent each year. Case 4 shows a very low nominal interest rate and why they have never reached the threshold value.

These hypothetical scenarios (Appendix 4) show that the nominal interest rate has an important impact for the continued development of the outstanding debt since there will be higher debt if the nominal interest rate increases. As Elmendorf and Mankiw (1998) argue, if the interest rate on government debt exceeds the growth rate for most of the periods, the government cannot collect taxes to finance the interest payments on the outstanding debt making it to grow faster than the economy. These hypothetical cases show why member states
have difficulties following the debt threshold value, therefore I want to analyze what factors influence the long-term interest rate.

5.3 Correlation Analysis

To measure the degree of association between the variables a correlation analysis is performed in Table 6.

<table>
<thead>
<tr>
<th>Variables</th>
<th>d</th>
<th>Ca</th>
<th>π</th>
<th>Bd</th>
<th>x</th>
<th>Ez</th>
<th>Ps</th>
</tr>
</thead>
<tbody>
<tr>
<td>d</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ca</td>
<td>-0.016</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>π</td>
<td>-0.109</td>
<td>-0.284</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bd</td>
<td>0.343</td>
<td>-0.246</td>
<td>0.067</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>x</td>
<td>-0.295</td>
<td>-0.040</td>
<td>0.169</td>
<td>-0.382</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ez</td>
<td>0.354</td>
<td>0.037</td>
<td>-0.107</td>
<td>0.075</td>
<td>-0.054</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Ps</td>
<td>-0.132</td>
<td>-0.219</td>
<td>0.103</td>
<td>0.062</td>
<td>0.070</td>
<td>-0.017</td>
<td>1</td>
</tr>
</tbody>
</table>

*Source: Secondary data processed in STATA*

Comment: i: Interest rate, d: Outstanding debt, Ca: Current account balance, π: Inflation, Bd: Budget deficit, x: Growth rate, Ez: Eurozone and Ps: Political system

The correlations values are ranged from -1 to 1, if the value is 1 there is a perfect, positive, correlation between the variables. A correlation of 0.80 is considered to be relatively high. If the relationship is negative it implies; when a variable increases then the other variable will decrease. A correlation says nothing about causation or causality (Agresti and Franklin 2009). The variables with the strongest positive correlation are outstanding debt and Eurozone; an independent monetary policy implies that a state has to adjust to ECB. Growth and budget deficit has a negative correlation; it can probably be explained by the higher growth the less expenditure is needed for example unemployment benefits. Debt and budget deficit have a positive correlation, when budget deficit increases there will be more debt accumulation. However, the other variables have no significant impact on the results since values below 0.30 indicates a little association between the variables.
5.4 Regression Analysis

The statistical results\textsuperscript{34} from the fixed effect model are presented in Table 7 and 8.

Table 7: Panel data regression results show beta coefficients, standard errors and p-value for the explanatory variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.034***</td>
<td>-0.035</td>
<td>0.048**</td>
<td>0.069**</td>
</tr>
<tr>
<td></td>
<td>(0.011)</td>
<td>(0.082)</td>
<td>(0.023)</td>
<td>(0.026)</td>
</tr>
<tr>
<td></td>
<td>-0.220**</td>
<td>-0.299***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.094)</td>
<td>(0.070)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.708*</td>
<td></td>
<td>1.880*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.971)</td>
<td></td>
<td>(0.964)</td>
<td></td>
</tr>
<tr>
<td>(R^2(\text{within}))\textsuperscript{35}</td>
<td>0.64</td>
<td>0.64</td>
<td>0.55</td>
<td>0.48</td>
</tr>
</tbody>
</table>

Time dummies | Yes | Yes | Yes | Yes |

Source: Secondary data processed in STATA

Comment: The dependent variable is government debt. The beta coefficients and the standard errors below are presented within parentheses. The significance levels are noted as: \(*P < 0.1; **P < 0.05; ***P < 0.01\)

The interpretation is: \textit{How an increase of a single beta coefficient affects the long-term interest rate when the values of the other variables at the same time are kept constant.}

\textit{Model 1} includes the explanatory variables; inflation, growth and presidential system. In the estimated model growth and presidential system are significant but they have different significance levels and relationship with the dependent variable. The growth rate is significant at a five percent level and has a negative relationship. The presidential system is significant at a ten percent level having a positive relationship with the interest rate. If a state has presidential system the interest rate will rise with 1.7 percent. The inflation is not significant.

\textsuperscript{34} I tested the variables that were not significant alone with the dependent model to be sure that there is no multicollinearity; however the models in table 7 and 8 are the best estimations.

\textsuperscript{35} In the fixed effect model the within \(R^2\) is used when interpreting the model.
The coefficient of determination tells that the explanatory variables can explain the interest rate by 64 percent.

*Model 2* consists of the variables debt, budget deficit and growth rate. The debt is significant at one percent level, when it increases with one percentage the dependent variable decreases with 0.034 percent. Growth is once again significant although now at a one percent level. The growth rate should increase the GDP, implying a decreased debt-to-GDP ratio, the state gains more credibility. The budget deficit is not significant. The coefficient of determination, $R^2$ tells that the explanatory variables can explain the long-term interest rate by 64 percent.

*Model 3* shows that political system is once again significant but now the budget deficit is also significant at a five percentage level which shows there is some problem with one of these models, therefore in *Model 4* I only analyze the budget deficit. I want to be sure how its relationship is with interest rate, since it was not significant in *Model 2* but it was significant and had positive value in *Model 3*. This can be due the correlation with debt and growth (when the growth rate is negative or slow there is less revenues leading to higher deficit). The budget deficit is positive and significant at five percent level, this confirms that the result in *Model 3* should be more correct.
Table 8: Panel data regression results show beta coefficients, standard errors and p-value for the explanatory variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 5</th>
<th>Model 6</th>
<th>Model 7</th>
<th>Model 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>d</td>
<td>0.048*** (0.012)</td>
<td></td>
<td>0.042*** (0.011)</td>
<td>0.030*** (0.009)</td>
</tr>
<tr>
<td>Ca</td>
<td>0.015 (0.015)</td>
<td>0.004 (0.016)</td>
<td>0.009 (0.016)</td>
<td></td>
</tr>
<tr>
<td>π</td>
<td>0.012 (0.137)</td>
<td></td>
<td>0.002 (0.025)</td>
<td></td>
</tr>
<tr>
<td>Bd</td>
<td></td>
<td></td>
<td></td>
<td>0.002 (0.025)</td>
</tr>
<tr>
<td>x</td>
<td>-0.309*** (0.080)</td>
<td></td>
<td>-0.286*** (0.067)</td>
<td></td>
</tr>
<tr>
<td>Ez</td>
<td>-0.346 (0.659)</td>
<td></td>
<td></td>
<td>1.762* (0.856)</td>
</tr>
<tr>
<td>Ps</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R²(within)</td>
<td>0.53</td>
<td>0.61</td>
<td>0.61</td>
<td>0.64</td>
</tr>
<tr>
<td>Time dummies</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Source: Secondary data processed in STATA
Comment: The dependent variable is government debt. The beta coefficients and the standard errors below are presented within parentheses. The significance levels are noted as: *P < 0.1; **P < 0.05; ***P < 0.01

Debt, current account balance and inflation are the variables in Model 5. The debt is significant variable at a one percentage level. The current account balance and inflation are not significant. The R² shows that the explanatory variables can by 53 percent explain the debt level.

In Model 6 the growth rate is significant at a one percentage level. Current account balance, inflation and Eurozone are not significant. In Model 7 the debt and presidential system are significant; R² is the same in the both models, 61 percent. Model 8 includes the variables growth and debt as they had the highest significance level in the previous models, they are significant and its coefficient of determination is 64 percent. The results in Tables 7 and 8 show that the growth rate are significant and has negative relationship with the interest rate. Presidential system, budget deficit and debt have a positive relationship with the interest rate. Model 1, 2 and 8 should have best estimations since they have highest R².

36 In the fixed effect model the within R² is used when interpreting the model.
The relationship between the financial crisis and long-term interest rate should be positive since the states will have a more difficult financial situation. However, the results show that financial crisis was significant at a one percent level and the $R^2$ was 46 percent although the relationship was negative. The financial crisis decreased the long-term interest with 2.84 percent.
6. Discussion and Conclusion

The fixed effect model results show how the long-term interest rate is influenced by the explanatory variables. The interest rate in this paper is assumed to be dependent upon market expectations; the more financial problems a state has the lower is their credibility and the risk value of their bonds increases. The results show that the government debt-to-GDP ratio is significant and has a positive relationship with long-term interest rate, as expected.

In the EU 63 percent of the member states have euro as currency, being part of the Eurozone. They have a common monetary policy ruled by the ECB with an inflation target at 2 percent which gains higher credibility on the market. This credibility lowers the interest rate since the euro has a lower currency risk but the results show that the variable Eurozone was not significant. An explanation can be that many state already had financial problems with high debt and bad reputations before they became members in Eurozone and the market already had this information, therefore solely becoming a member in Eurozone is not the right solution to gain credibility. For the member states to gain good economic reputations they need political discipline with long-term strategies and processes. Figures 1-3 show that generally member states outside the Eurozone have lower government debt. According to the theory, these are independent and can make decisions that suit them best, for example; an overheated economy can be solved by an increased nominal interest rate to encourage saving, although it’s challenging for ECB to reach united suitable decisions for all member states within the Eurozone, because these decisions can in some states cause the reverse reaction of increased debt and higher interest rate.

The theoretical framework shows that the budget deficit should be a good explanatory variable. Member states with high budget deficit should have higher long-term interest rate since they have more government expenditures. In a recession, for example the tax revenues diminish and there is more need of unemployment benefits, therefore the budget and the state’s fiscal credibility will decrease. The variable is significant and has a positive relationship with interest rate, as expected in this research. Many EU member states exceed the three percent threshold value due to high interest rate and low growth, although if the temporary high deficit depends upon investments; benefitting future growth, then there is a high possibility to pay off the investments in the future and the states should not have a problem. Therefore solely observing high deficit numbers and draw the conclusion that a state
does not have their budget under control is not sufficient, these states may actually have control, thinking of the future generations. There is a possibility that maybe the deficit threshold value at three percent is too low since states have difficulties following it and never in the history been implemented before, one can therefore ask the question if it really is a suitable threshold for EU? Only the future can tell and so far it seems not to be functioning as expected. One should have in mind that the stated deficit may not be true, or correct, since states can have incentives to decrease these numbers by not reporting their actual values, this is exactly what Greece has done and therefore hold a bad reputation with low credibility.

The growth rate should have a negative relationship with the long-term interest rate. Growth increases GDP implying a decreased debt-to-GDP ratio. With a higher growth rate the state would also gain a higher fiscal credibility by increased capacity to pay back. Table 4 showed that when Greece had debt values above the threshold value the growth did not decrease. The causation of debt and growth is difficult to determine since correlation does not have to be causation. Studies show that when the growth rate exceeded the interest rate on government debt for most of the period the government can finance the interest payments on the outstanding debt by issuing more debt, and the debt will still grow more slowly than the economy, for example Italy and Greece had high debt-to-GDP ratio when the growth was low.

The nominal interest rate is the same in the entire Eurozone although the inflation differs. When inflation increases the real interest rate decreases encouraging more investments and less saving. A high unexpected inflation created by the government makes the real value on bonds to be eroded, the bondholders lose and the government gains since the interest rate does not reflect the inflation, therefore the market requires an extra premium risk to invest in these bonds. Problem arises when the states have high debt-to-GDP ratio and they may want to create more inflation although only the member states outside the Eurozone have this option, the risk should then be higher in states outside the Eurozone. The inflation variable was not significant, maybe because this research is limited of analyzing the ten year long-term interest rate and the inflation may not have as strong impact on the long-term interest rate compared to short-run; that should increase the interest rate with one percent. Therefore the inflation expectations and risk may have decreased.

The current account balance should be significant and have a negative relationship with the long-term interest rate. A current account surplus implies more export than import and more
private saving which decreases the interest rate, the state gains more credibility and can easily loan from the citizens. The highest current account deficit was in Greece with 14.7 percent of GDP in 2008 whereas in Spain it was 10 percent of GDP in 2007, an explanation may be that these states have adopted a single currency and the option of devaluing a national currency is taken away to overcome a current account deficit. Although a current account deficit may not have a greater importance if a member state in EU has a significant political role and big economy; for example Germany or France. These states would with current-account deficit most likely have higher credibility than for example Bulgaria and Romania.

The political system affects the fiscal policy outcomes. The research hypothesis regarding the presidential system is a negative relationship with the long-term interest rate. There are higher expenditures in a parliamentary system than in a presidential system when there are national elections of parties. According to theory, fiscal deficits often have political explanations and a result of politicians voting interests and conflicts of preferences between the politicians. This variable was interesting to analyze since the study by Efthyvoulou (2010) showed that there is more fiscal use in parliamentary regimes although this is considered a weak results due to a low number of presidential countries in the sample. This is opposite to the results of this research where the presidential system instead shows increase of the interest rate and not according to the stated hypothesis. The explanation may be that the member states in this research have changed their political systems that differ from the point of time when the study by Efthyvoulou (2010) was conducted37. Politicians’ incentive to manipulate fiscal policy varies over time and across states from one election to the other depending on the probability of re-election. Only three states had presidential system which showed higher expenditures where maybe these politicians had high self-interest and large spending.

The negative relationship between the financial crisis and long-term interest rate was a surprising result since previous studies shows that the bank sector was lending too much money and the states increased their budget deficit; increasing the risk premium on government bonds, especially Greece and Ireland had high credit risk. However according to previous studies the initial stock of debt in member states was a crucial factor of how the crises affected future debt level and economic development.

37 Cyprus, France and Romania in this research have presidential systems while in Efthyvoulou’s research Cyprus, Poland and Lithuania had presidential systems.
Some problems in this paper is that the long-term interest rate can affect the explanatory variables, i.e. causality goes in the other direction, and there are probably other variables than those studied in this research that influences the long-term interest rate. It had also been useful having data for forecasted values for the explanatory variables since the interest rate depends on future expectations rather than actual values which would improve the reliability in the regressions. Another question is, does the market have full information of a member state’s financial situation and is the long-term interest rate correct?

This research paper analyzes what factors influence the long-term interest rate, in order to give an understanding of why the government debt has increased in EU member states. The conclusion has been achieved by analyzing previous empirical studies, erecting a theoretical framework derived from theoretical papers, and estimating a fixed effect model using a panel data for 27 EU member states between 1995 and 2011. The main results are that the variables: presidential system, outstanding debt, budget deficit and growth rate influence the long-term interest rate.
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Appendix 1

Table A1: The 27 member states in the European Union, member states in Eurozone*

<table>
<thead>
<tr>
<th>Year</th>
<th>Germany*</th>
<th>United Kingdom</th>
<th>Greece*</th>
<th>Spain*</th>
<th>Sweden</th>
<th>Estonia*</th>
<th>Bulgaria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1952</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1973</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1981</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1986</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Belgium* Ireland* Denmark Portugal* Finland* Austria* Latvia Lithuania Poland Czech Republic Cyprus* Hungary Slovakia* Slovenia* Malta*

Appendix 2

Figure A1: The mean value of the long-term interest rate in EU varied between 3.9 and 8.8 percent. The long-term interest rate was highest in 1995. It was lowest in 2005 whereas it increased again 2008 when the financial crisis occurred.

Source: Secondary data from the European Commission, Eurostat, EconStats and own calculations.
Appendix 3

Government budget constraint
\[ G - T + i * D = \Delta D \]

Instead of absolute amounts all the variables are ratios to national income (Y)
\[ \frac{\Delta D}{Y} = \frac{G - T}{Y} + \frac{i * D}{Y} \]

Deriving by the quotient rule
\[ \frac{\Delta D}{Y} = \frac{\Delta D * Y - D * \Delta Y}{Y^2} \]
\[ \Rightarrow \frac{\Delta D}{Y} - \frac{D * \Delta Y}{Y^2} \]
\[ \Rightarrow \Delta D = \frac{\Delta D * Y}{Y} + \frac{D * \Delta Y}{Y} \]

Substituting into the budget constraint
\[ \frac{G - T}{Y} + \frac{i * D}{Y} = \frac{\Delta D}{Y} + \frac{D * \Delta Y}{Y} \]
\[ \Rightarrow \frac{G - T}{Y} + \frac{i * D}{Y} = \frac{\Delta D + D * \Delta Y}{Y} \]
\[ x = \frac{\Delta Y}{Y} \]
\[ \Rightarrow \Delta D = \frac{(G - T) + (i - x) * D}{Y} \]
Appendix 4

Historical mean values, Germany

Growth: \((0,017+0,019+0,004+0,011)/4= 1.1\) percent

Nominal interest rate: \((0,069+0,046+0,048+0,037)/4= 5.0\) percent

Budget deficit: \((0,023+0,031+0,016)/3= 2.3\) percent, 1995 is not included since the value would give misleading results.

Table A2: Hypothetical cases for Germany with the historical mean values, growth rate: 1.1, nominal interest rate: 5.0 and budget deficit: 2.3 percent.

<table>
<thead>
<tr>
<th>Hypothetical cases/Variables</th>
<th>D/Y 1995</th>
<th>Growth rate</th>
<th>Nominal-interest rate</th>
<th>Budget deficit</th>
<th>D/Y 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>0.556</td>
<td>0.011</td>
<td>-0.036</td>
<td>0.03</td>
<td>0.60</td>
</tr>
<tr>
<td>Case 2</td>
<td>0.556</td>
<td>0.097</td>
<td>0.050</td>
<td>0.03</td>
<td>0.60</td>
</tr>
<tr>
<td>Case 3</td>
<td>0.556</td>
<td>0.011</td>
<td>0.015</td>
<td>0</td>
<td>0.60</td>
</tr>
<tr>
<td>Case 4</td>
<td>0.556</td>
<td>0.046</td>
<td>0.050</td>
<td>0</td>
<td>0.60</td>
</tr>
</tbody>
</table>

Historical mean values, Greece

Growth: \((0,021+0,034+0,042+0,055)/4= 3.8\) percent

Nominal interest rate: \((0,173+0,085+0,053+0,041)/4= 8.8\) percent

Budget deficit: \((0,092+0,039+0,045+0,057)/4= 5.8\) percent

Table A3: Hypothetical cases for Greece with the historical mean values, growth rate: 3.8 nominal interest rate: 8.8 – and budget deficit: 5.8 percent

<table>
<thead>
<tr>
<th>Hypothetical cases/Variables</th>
<th>D/Y 1995</th>
<th>Growth rate</th>
<th>Nominal-interest rate</th>
<th>Budget deficit</th>
<th>D/Y 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>0.97</td>
<td>0.038</td>
<td>-0.022</td>
<td>0.058</td>
<td>0.97</td>
</tr>
<tr>
<td>Case 2</td>
<td>0.97</td>
<td>0.148</td>
<td>0.088</td>
<td>0.058</td>
<td>0.97</td>
</tr>
<tr>
<td>Case 3</td>
<td>0.97</td>
<td>0.038</td>
<td>0.007</td>
<td>0.030</td>
<td>0.97</td>
</tr>
<tr>
<td>Case 4</td>
<td>0.97</td>
<td>0.038</td>
<td>-0.070</td>
<td>0.058</td>
<td>0.60</td>
</tr>
</tbody>
</table>
Appendix 5

Stata output

Correlation analysis data

```
. corr longterminter Debt_GDP Caccount inflation Budgetdeficit growth emu ps
(obs=349)

longterminter     Debt_GDP      Caccount    inflation   Budgetdeficit    growth     emu     ps
      longterminter     1.0000     0.2073     -0.2155     0.3515   -0.1322   -0.1433
      Debt_GDP          0.2073      1.0000     -0.0156     1.0000   -0.3430   -0.2590
      Caccount         -0.2155     -0.0156      1.0000     0.3129    0.3541   -0.1794
      inflation         0.3515     -0.1094     0.2837      1.0000    0.0670   -0.0402
      Budgetdeficit     -0.1322    -0.3430     -0.2590     0.0670      1.0000    0.1071
      growth            -0.1433    -0.2590     -0.0402     0.1071   -0.1794    1.0000
      emu               -0.2186     0.3541     -0.1794    -0.1071    0.1071    0.0670
      ps                -0.0169   -0.1322   -0.3430     -0.2590   -0.1794    1.0000

(obs=349)
```

Descriptive statistics

```
. summarize longterminter

Variable | Obs | Mean | Std. Dev. | Min | Max
---------|-----|------|-----------|-----|-----
longterminter | 375 | 5.330613 | 1.95123 | 2.41 | 15.75
```

Diagnostic tests

Multicollinearity test

```
Collinearity Diagnostics

<table>
<thead>
<tr>
<th>Variable</th>
<th>VIF</th>
<th>SORT VIF</th>
<th>Tolerance</th>
<th>R-Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt_GDP</td>
<td>1.38</td>
<td>1.70</td>
<td>0.7257</td>
<td>0.2743</td>
</tr>
<tr>
<td>Caccount</td>
<td>1.21</td>
<td>1.10</td>
<td>0.8299</td>
<td>0.1701</td>
</tr>
<tr>
<td>inflation</td>
<td>1.14</td>
<td>1.07</td>
<td>0.8775</td>
<td>0.1227</td>
</tr>
<tr>
<td>Budgetdeficit</td>
<td>1.39</td>
<td>1.18</td>
<td>0.7211</td>
<td>0.2789</td>
</tr>
<tr>
<td>growth</td>
<td>1.28</td>
<td>1.13</td>
<td>0.7837</td>
<td>0.2163</td>
</tr>
<tr>
<td>emu</td>
<td>1.16</td>
<td>1.08</td>
<td>0.8633</td>
<td>0.1367</td>
</tr>
<tr>
<td>ps</td>
<td>1.08</td>
<td>1.04</td>
<td>0.9260</td>
<td>0.0740</td>
</tr>
</tbody>
</table>

Mean VIF 1.23
```

Eigenvalues & Cond Index computed from scaled raw sscp (w/ intercept)
```
1 | 4.4011 | 1.0000 |
2 | 1.0811 | 2.0377 |
3 | 0.9302 | 2.1951 |
4 | 0.7064 | 2.4960 |
5 | 0.3886 | 3.4553 |
6 | 0.2980 | 3.8430 |
7 | 0.1520 | 5.3804 |
8 | 0.0625 | 8.3938 |

Condition Number 8.3938
```

Det(correlation matrix) 0.4708
The Wooldridge’s test for autocorrelation shows there is Autocorrelation

. xtserial longterminter Debt_GDP Caccount inflation Budgetdeficit growth emu ps, output
Linear regression
Number of obs = 322
F(  7,   24) = 4.56
Prob > F = 0.0024
R-squared = 0.1906
Root MSE = .98699
(Std. Err. adjusted for 25 clusters in country)

<table>
<thead>
<tr>
<th></th>
<th>Robust</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D.</td>
<td>Conf.</td>
<td>Std. Err.</td>
<td>t</td>
<td>P&gt;</td>
</tr>
<tr>
<td></td>
<td>longtermin-r</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Debt_GDP</td>
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<td>.022827</td>
<td>2.76</td>
<td>0.011</td>
<td>.015575</td>
</tr>
<tr>
<td>Caccount</td>
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Wooldridge test for autocorrelation in panel data
F(  1,   24) = 71.955
Prob > F = 0.0000

Robust Wald test shows there is Heteroskedasticity

. xttest3

Modified Wald test for groupwise heteroskedasticity in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (27) = 2309.38
Prob>chi2 = 0.0000