DETERMINANTS OF REAL LONG-TERM INTEREST RATES IN EUROPE: “IS IT A FISCAL PHENOMENA?”

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By

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ABSTRACT

Several studies investigate the relationship between government debt/deficit ratios and the real long-term interest rates, but the empirical evidence is not conclusive enough for consensus building. Evidence for statistically weak or mixed association is as much as the evidence for a strong positive relationship, which means rising debt/deficit ratios are estimated to increase real yields. My research extends the existing literature by using a large panel of European countries covering the years 1990 and 2012. I find a very strong positive relationship between the debt to GDP ratio and real long-term interest rates in linear specifications. Quadratic specifications yield a U-curve structure in explaining the association between debt ratios and the real long-term yields, supporting evidence for a positive association once the debt ratio surpasses a threshold in the range of 49-54%.

Key Words: General government debt, deficit, real long-term interest rates
The research and writing of this thesis is dedicated to my thesis advisor Dr. William Encinosa, my beloved wife and daughter, and all my friends who helped a lot along the way.

Many thanks

Fatih Kaya
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INTRODUCTION AND MOTIVATION

It is widely believed that irresponsible fiscal policies and fiscal profligacy would cause high interest rates due to the associated sustainability risks. Although theory does not give a simple answer, and empirical evidence is quite divided as regards to the presence and the magnitude of the relationship between fiscal policy variables and interest rates, among the other usual suspects fiscal problems have always been taken into consideration first in understanding the interest rate dynamics. It is quite easy to find a report or a policy paper that recommends fiscal austerity to bring down interest rates in a certain country.

The global financial crisis that broke out in 2007 hit Europe hard, even harder than its epicenter, the US. It led to a prolonged recession, which might potentially continue on a downward path for some time to come as already proven by the recent developments. Crisis in Europe brought government deficits and debt to the forefront of the public debate again. Greece, Ireland, Portugal and Spain have all suffered from fiscal sustainability problems, and they all sought external financial support or debt consolidation. During this process, interest rates played a primary role in reflecting market perceptions and alarming levels of risk accumulation. After the so-called Greek failure, an above-7 percent real long-term interest rate in any individual European country caused it to be regarded as next in line after Greece, such as Portugal, Spain, and Italy. Fiscal profligacy is blamed as a root cause and austerity is strictly recommended to reduce interest rates and make Europe return to its ordinary growth trajectory. Although there might be growth pay-offs, those countries seem to
be committed to a debt reduction agenda in order to return an ordinary public finance trajectory in the future.

Before the global financial crisis less effort was devoted to understanding the real long-term interest rate dynamics as compared to the early 1980s. Low real yields in the late 1990s and 2000s might have an effect on keeping intellectual attention away from understanding real interest rate dynamics. Yet we should be aware of the fact that long-term real yields, as the key determinant of saving-investment dynamics, are highly critical for the sustainability of investments, thus sustainable growth in the long run. A high level of real interest rates caused by excessive government deficits or debt may reduce investments, and may hinder durable consumption expenditures, which are sensitive to interest rates\(^1\). Moreover, long-term interest rates also reflect the risk perceptions in an economy. Relatively higher long-term interest rates in an economy is a clear indication of a sustainability bias, which might trigger a sudden capital outflow after a certain threshold, as happened in the case of Greece. Even more, chronically high real interest rate returns in a country may distort the operation of financial markets as speculative activities attract more and more resources. When governments have to pay relatively high real interest rates for a certain period of time, private capital might move away from job-creating activities to financial investments since the corporate sector would also have to pay high real borrowing costs, as banks demand higher real rates on their loans as well. In this context, sustainability of investments, and thus sustainability of growth in an economy, will be affected by long-term interest rates\(^2\).

\(^1\) Engen and Hubbard, 2004  
\(^2\) Elmendorf and Mankiw, 1999
In this context, I examine the relationship between real long-term interest rates and various fiscal variables in Europe while controlling for other relevant economic and institutional factors. After analyzing the presence and the magnitude of the above-mentioned relationship, research proceeds by highlighting the role of other usual suspects that are included in the study.

Contrary to the US, the relationship between real yields and fiscal parameters has not drawn satisfactory intellectual attention, specifically after the establishment of the Monetary Union (EMU). The EMU is believed to bring about a conversion of real yields across Europe. Yet recent global financial crises have shown that there are still dramatic differences among European countries, and it still begs for an explanation.

Covering a time period between 1990 and 2012, a comprehensive panel of 31 countries will be used in this study in order to analyze the hypothesized relationship. This panel includes data from all the EU member states, which also encompass the subset of Eurozone members, in addition to the non-EU countries that are geographically located in the region.

In the first chapter, I will develop the theoretical framework. The market for loanable funds, where saving and desired investment schedules reach equilibrium via real interest rates is the starting point of the research. National accounting identities are the building blocks of this analysis. In this chapter, I will also emphasize the role of fiscal parameters, and the Ricardian equivalence proposition in understanding the effect of governments.

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3 Faini, 2005
As mentioned before, there is no clear-cut answer in the literature to my research question. Therefore, in the second chapter, I categorize the research into three main groups, research with no significance, with mixed results, and lastly research with strong significant relationships. Then I elaborate on empirical methods by delving into the scope, selected controls, time frame, and model structures.

In the third and fourth chapters, I will develop the methodological approach and the description of data. In these chapters, the underlying conceptual model of the research, estimation strategy, handling of econometric issues and problems, and the structure of panel data are highlighted.

Key finding in this research can be summarized as follows. First using a non-linear specification, the effect of government debt on real long-term interest rates is positive, and highly statistically significant. I find that real long-term yields rise by about 2.8 to 6.8 basis points for a one-percentage point increase in the debt to GDP ratio depending on the model specification. Second, in all quadratic specifications, the coefficient on the debt to GDP ratio has a negative sign and the coefficient on its square has a positive sign, and both coefficients are statistically significant, which indicates a U-shaped curve structure in explaining the association between debt ratios and real yields. Threshold levels of debt to GDP ratio, the bending points, range between 49 to 54 percent. If we consider the fact that the mean of the debt stock to GDP ratio in the EU is now above that thresholds, we can say that debt stocks are currently affecting real long-term yields positively.
1. DETERMINANTS OF LONG-TERM INTEREST RATES

In this chapter, I briefly mention the theoretical framework in explaining the determinants of long-term interest rates in an open-market economy. In the first part, I will explain the making of market equilibrium in the financial markets where interest rates are the key in adjusting supply of savings, the amount of total loanable funds in the financial market, and the demand for investments in the economy. In the second part, I explain the role of various factors in determining the level of interest rates in the economy. These factors might well be a reason in understanding why some countries generally pay more for borrowing costs as compared to others or vice versa. In the third part of this chapter, I emphasize the role of fiscal policies under the Ricardian equivalence proposition, that offers long-sighted and rational economic agents adjust themselves changing policy environments very quickly and wisely, in offsetting presumed effects of the government decisions on interest rates. In the fourth and the last part of this chapter, I discuss the role of global interlinkages in the context of an open economy.

1.1. The Market for Loanable Funds and Equilibrium

Just like individuals, an economy on an aggregate level either consumes or saves the income that is generated within a certain period of time. Although my aim here is neither explaining the dynamics behind consumption and saving behaviors nor is an attempt to interpret the reasons why some countries save more than others, in order to understand saving-investment equilibrium in the financial markets and the

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4 Seater, 1993 and Elmendorf and Mankiw, 1999:32
5 Mankiw, 2003: 560
role played by the interest rates, it would be very helpful to inform the reader on the
generation of the GDP, thus income, and savings in the economy.

GDP, as an aggregate economic identity, represents both total income and
expenditures in an economy. In an open-economy GDP, shown as $Y$, is the sum of
four different expenditure categories: consumption ($C$), investment ($I$), government
purchases ($G$), and the difference between exports and imports ($NX$), which is also
known as net exports. We write

$$Y = C + I + G + NX$$

With an aim to show generation of savings in an economy we can rearrange
above-mentioned equation as follows:

$$Y - C - G - NX = I$$

We also know that individuals pay taxes to their government and they receive
transfers. In this context, aggregate income minus taxes plus transfers gives us a new
definition of disposable income, which is the income that households have left after
the involvement of the government into the economy.

$$Y_d = Y - T + TR$$

Since they cancel each other, adding ($-T + TR$) together with ($T-TR$) will not
make any change in our original income equation quantitatively. However, as we can
see below it will give us important insight about saving-investment balance in the
economy.

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6 Mankiw, 2003: 499
7 Mankiw, 2003: 499
8 Mankiw, 2003: 498
\[ Y - T + TR + T - TR - C - G - NX = I \]

\[ [(Y - T - TR) - C] + (T - TR - G) - (X - M) = I \]

\[ (Y_d - C) + (T - TR - G) - (X - M) = I \]

As mentioned before generated income in the economy is either consumed or saved. Households consume their disposable income, which is the total amount fund that is left after paying taxes and receiving government transfers. The residual left after consumption represents the total amount of domestic saving in the economy, which is shown as \((Y_d - C)\) above. This amount could also be called as private saving in the economy\(^9\). In the government’s side, the total amount of tax money that is left after the government spending on purchase of goods and services and transfers determines the budget surplus in the economy. If the government’s tax receipts are not meeting government’s expenditures then there is a negative budget surplus or budget deficit. Therefore, \((T - TR - G)\), represents government’s budget surplus or public savings in the economy. Moreover, an open economy is also interlinked with the rest of the world. As mentioned in explaining generation of income, \(NX\) or \((X-M)\), net export is the difference between exports and imports in the economy\(^{10}\). That could also be called as the trade surplus of the economy. In order to simplify we can call trade surplus as current account surplus of the economy. Then \(-(X-M)\) in the equation above becomes current account deficit of the economy by definition. We also know that, on aggregate level, current account deficits of individual countries are financed by current account surpluses, thus savings, of others. With this logic –

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\(^9\) See Mankiw, 2003: 562
\(^{10}\) Mankiw, 2003: 499
(X-M) in the equation above can be called as the foreign savings that flow into the economy from the rest of the world.

\[ S_p + S_g + S_f = I \]

\[ S_p + S_g = S_d \]

\[ S_d + S_f = I \]

\[ S = I \]

We can see that there are three different types of savings in the right-hand side of the equation above as regards to their source. First one is the private savings, which comprises of the household and the firm savings in the economy. Second is the government savings, which denotes the government’s budget surplus. The third and the last is the foreign saving, which represents savings of others that pours into the economy from the rest of the world. Moreover, the sum of the private and government savings may also be classified as the domestic or the national savings of the economy. After a step-by-step rearranging of basic macroeconomic equations, we can now reach the conclusion that saving always equals investment. The hypothetical market that brings savers and borrowers together is called the market for loanable funds. The loanable funds market is a market where savers supply and investors demand funds. In this market interest rate adjust to ensure that desired saving equals desired investments.

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11 See Mankiw, 2003: 562
12 Mankiw, 2003: 564
13 Mankiw, 1997: 63
Graph 1.1. Market Equilibrium

The interest rate is the key for reaching the market equilibrium. Under the condition that the interest rate is too low for the market equilibrium, investors will demand more funds than households are willing to supply for this rate of return. That will result in an increase in the interest rates. With the same logic, if the real interest rate is too high for a possible market equilibrium, then investors will demand fewer funds because of the high real cost of borrowing. That will lead to a decrease in the interest rates. The equilibrium interest rate is set when these two curves cross each other. At the equilibrium interest rate, saving and the desired investment, thus the demand and supply for loanable funds should be equal.  

1.2. Determinants of Interest Rates

The real interest rate is the return for forgoing current consumption for the savers on one hand, and the real borrowing costs for the investors on the other. As discussed before, this level, the equilibrium level of interest, is determined by the

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14 Mankiw, 1997: 63
15 Howe and Pigott, 1992: 13
saving-investment dynamics in the economy. A number of factors might affect the
demand or supply side dynamics, or both.

On the demand side, investment decisions are dependent on the difference
between the marginal product of capital and the marginal cost\(^\text{16}\). If the marginal
product of capital exceeds the marginal cost of capital, it becomes profitable for
firms to add to their existing capital stock by investing\(^\text{17}\). If the marginal product of
capital is less than the cost of capital, then firms invest less, which may even let their
capital stock shrink\(^\text{18}\). In this setting, real interest rate, as a key variable, explains the
cost of capital\(^\text{19}\). Since real interest rate is taken as the variable on the vertical axis,
movements on the investment curve are dependent on the changes in this variable.
Increases in the real interest rate simultaneously decrease the level of desired
investment without shifting the desired investment schedule, and vice versa. Tax
incentives and government subsidies may stimulate investments, and shift the desired
investment curve outwards by reducing costs. Institutional structure, protection of
property rights, transparency, ease of doing business, and other transaction costs,
which determine the investment climate in a country, have an impact on investment
decisions.

On the other hand, change in the marginal product of capital, thus change in
productivity, explains the shifts in the investment curve similar to the changes in the
marginal cost structure as described above. Any increase in the marginal product of
the capital shifts the investment curve in the outward direction, and vice versa.

\(^{16}\) Blanchard, 1984: 15
\(^{17}\) Blanchard, 1984: 15
\(^{18}\) Mankiw, 1997: 457
\(^{19}\) Blanchard, 1984: 15
Technological progress and innovation is believed to be the foremost reason behind that. In addition to this, tax incentives and government subsidies may help stimulate investments.

**Graph 1.2. Shifts in the Investment Curve**

As shown in Graph 1.2, any increase or decrease in the investment demand is supposed to shift the curve in the right or left direction. At any given market interest rate the desired amount of investment is now greater or lower than the initial level. Therefore new equilibrium will shift from point A to point B, where the level of real interest rate is higher or lower.

On the supply side, real interest rate explains the rationale behind decisions on whether consuming today or saving for tomorrow. Positive slope of the saving curve implies that the increase in the interest rate induces households to consume less and save more, or vice versa. In addition to the real interest rates, a number of factors are very critical in understanding saving dynamics as well. Among them, increase in disposable income is the key in explaining shifts in the saving curve. In this context,
the more disposable income people have, the more financial resources would be available for saving after satisfying consumption needs. This proposition is strongly related to the cyclical developments and the performance of the economy. We know that economies operate through boom and bust cycles in which incomes and savings are higher during the good times as compared to the bad ones in the bad times.

**Graph 1.3. Shifts in the Saving Curve**

Lastly, it is also important to know that people save for precautionary causes. Savings help people smooth their consumption level, and alleviate negative effects of any economic downturn during their lifecycle. In this regard, expectations about the economy and risk perceptions are critical considerations, which may either stimulate or dissuade savings. Moreover, saving tendencies would be different across different countries depending on age structure, demographic characteristics, and availability of social security and safety net.
1.3. Budget Deficits and Ricardian Equivalence

According to the national accounting identities of an economy, which have been covered in the first part of this chapter, a country’s total national savings is the sum of private and public savings. In this setting, decisions on budgetary policies are supposed to create a two-fold effect on national savings. By definition, any increase in budget deficit, which means that the government is either spending more on purchases and/or transfers or collecting less in taxes, leads to an equivalent decrease in public savings. Yet private parties are now receiving more in transfers or being burdened less by taxes. So an increase in the budget deficit gives more fiscal room to private households for both consumption and saving.

The critical question here is how much of the additional amount of funds will be consumed and saved. If marginal propensity to save would be the same after the increase in the budget deficit, some portion of this additional amount will be spent, and some will be saved. Although private savings increase in this scenario, that does not match the decrease in public savings. Consequently, the national saving curve shifts to the left, and the new equilibrium will be the point at which the new saving schedule crosses the investment curve. The equilibrium interest rate is now higher, and investments are lower, which is known as the crowding-out effect.

So far, explanations on saving and investment dynamics, and the effects of government decisions are based on conventional approach for government debt and deficits. Yet there is also another way to analyze the issue, which is known as

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20 Mankiw, 2003: 562
21 See Mankiw, 1997: 64
Ricardian equivalence, named after the well-known 19th century economist David Ricardo. Ricardian equivalence proposition states that forward-looking economic agents will adjust themselves to the changing policy environments very rationally in a way to offset the presumed effects of government decisions\textsuperscript{22}.

As mentioned before, conventional analysis concludes that any increase in the budget deficits will increase equilibrium interest rate and reduce national saving and investment. By contrast, Ricardian equivalence proposition asserts that government decisions will not make any change in the aforementioned variables. This proposition is based on the insight that budget deficits of today are just an implication of higher taxes of tomorrow\textsuperscript{23}. In that sense, people are well aware that an increase in budget deficit, even though that enables more fiscal space for current consumption, could only be a postponement of future tax burden\textsuperscript{24}.

Knowing the fact that that total tax burden will be the same intertemporally, households would not increase their consumption spending due to the governments’ decisions on taxes or transfers\textsuperscript{25}. Instead, they tend to save any additional financial space that is generated by government budget deficits in order to meet any future tax liabilities\textsuperscript{26}. For this reason, national savings could not be affected by budgetary decisions. Any increase/decrease in the government budget deficits will always be associated with the same amount of increase/decrease in private savings\textsuperscript{27}.

\textsuperscript{22} Elmendorf and Mankiw, 1999: 32
\textsuperscript{23} Elmendorf and Mankiw, 1999: 32
\textsuperscript{24} Elmendorf and Mankiw, 1999: 33
\textsuperscript{25} Elmendorf and Mankiw, 1999: 33
\textsuperscript{26} Elmendorf and Mankiw, 1999: 33
\textsuperscript{27} Elmendorf and Mankiw, 1999: 33
Ricardian equivalence proposition is very critical for my study, if equivalence conditions hold, for sure, then there would be no reason for searching a relationship between real interest rates and fiscal policy variables. Many economists are skeptical of Ricardian equivalence proposition, although there is also no strong consensus on why and how government debt matters. In this regard, I may at least briefly mention several reasons why Ricardian equivalence proposition might not be the case.

Intergenerational Redistribution\textsuperscript{28}: Budgetary outcomes might matter, since it is a redistribution of economic resources across different generations of taxpayers\textsuperscript{29}. This proposition basically argues that the future generation, who will shoulder the burden of tax increases due to the past budget deficits, might not be the same with the one, who benefits from the government budget deficits, thus the fiscal largesse, today. In an overlapping-generational setting, fiscal deficits might not lead to a same amount of increase in savings.

Capital Market Imperfections\textsuperscript{30}: Simply explaining the failure of Ricardian equivalence, this proposition hinges on existing borrowing constraints, lack of access to capital and information asymmetries. For households who are expecting raising future incomes, the optimal path for consumption might be spending more than their income/salary when they are young, and less when they are old\textsuperscript{31}. Yet probability of borrowing is limited during they are young due to the risk of default or other market frictions. In such a case, the optimal strategy could well be to consume whatever you

\textsuperscript{28} For detailed discussions of the role of intergenerational structure, see Blanchard (1985), Kotlikoff (1988), and Modigliani (1988)
\textsuperscript{29} Elmendorf and Mankiw, 1999: 33
\textsuperscript{30} Elmendorf and Mankiw, 1999: 46
\textsuperscript{31} Elmendorf and Mankiw, 1999: 46
have in your hand and save nothing. Debt-augmenting government transfers or tax cuts enables young people to get the funds they wanted but they could not obtain from financial markets. Therefore, increased budget deficits, even though they imply higher future tax burden, may lead households spend more\textsuperscript{32}.

The Degree of Substitutability\textsuperscript{33}: The degree of substitutability between private and publicly provided goods is very critical in understanding the impact of increasing government spending. If private and publicly provided goods are perfect substitutes, any increase in public spending, thus any increase in publicly provided goods, will be fully offset by an equivalent amount of fall in private consumption, leaving interest rates unchanged\textsuperscript{34}. Yet private and public goods are not perfect substitutes at best. If those are in fact less than perfect substitutes, even in a Ricardian setting, any increase in public spending will not associate with an equal amount of spending cut on private goods, thus an equal amount of increase in private saving\textsuperscript{35}.

Permanent Postponement of the Tax Burden\textsuperscript{36}: This proposition is based on the fact that governments never have to pay off its debt obligations. In the modern world, there is almost no government without debt. What matters is the debt sustainability. Governments could postpone the tax burden as long as they can roll over the debt. If governments are able to run budget deficit without getting into Ponzi

\textsuperscript{32} Elmendorf and Mankiw, 1999: 46
\textsuperscript{33} Faini, 2005: 4
\textsuperscript{34} Faini, 2005: 4
\textsuperscript{35} Faini, 2005: 4
\textsuperscript{36} Elmendorf and Mankiw, 1999: 52
scheme, which refers to the dramatic situation that governments finance interest payments by issuing new debt, they can postpone tax increases infinitely\textsuperscript{37}.

Myopia\textsuperscript{38}: Ricardian equivalence is based on a behavioral model, which takes human as ultra rational, optimizing and forward-looking creatures. Rational human beings assumption makes life easier for economist since myopia, which could be a possible alternative, is hard to be modeled. Yet myopia is still the case in the real world.

1.4. Global Interlinkages and Spill-Over Effects

Global interlinkages and spillover effects are very critical in understanding the making of the real interest rates around the world. Theory suggests that the real interest rate in a small open economy equals to the world interest rate, prevailing in the global financial markets\textsuperscript{39}. In a closed economy, the real interest rate adjust to equilibrate saving and investment. In the open economy setting, small economies are price takers, so the real world interest rates are determined abroad, depending on the equilibrium level of world savings and investments. Hence, the difference between saving and investment at the world real interest rates determines trade deficit/surplus of those economies.

In such an integrated structure, fiscal policy might seem totally ineffective in having an effect on the level of domestic interest rates, with any change in domestic savings being offset by the same amount of change in international capital flows\textsuperscript{40}.

\textsuperscript{37} Elmendorf and Mankiw, 1999: 52
\textsuperscript{38} See Elmendorf and Mankiw, 1999: 52
\textsuperscript{39} Mankiw, 1997: 188
\textsuperscript{40} Faini, 2005: 4
Increasing global integration, however, does not eliminate sovereign default risks, which is highly affected by fiscal policies. In addition to that, only a small portion of saving changes is offset by capital flows. Supporting that, Feldstein and Horioka found that domestic investment and savings are strongly correlated in the OECD economies\textsuperscript{41}, which is also known as Feldstein-Horioka puzzle.

Taking all those into account, we still have many reasons to believe that fiscal policy is important in affecting the level of real interest rates even in the context of an open economy.

\textsuperscript{41} For further information see Feldstein and Horioka, 1985, and Summers, 1985
2. LITERATURE REVIEW

Academic opinions are quite divided in suggesting an exact relationship between real interest rates and fiscal policy variables, including various government deficit and debt indicators such as overall fiscal balance, primary balance, cyclically adjusted balance, and gross or net government debt. Some studies in the empirical literature, such as Evans (1985), and Barro and Sala-i-Martin (1990) fail to establish a significant link between interest rates and fiscal variables. Some research, such as Bernoth et al. (2003), Codogno et al. (2003), Engen and Hubbard (2004), and Afonso and Strauch (2005) assign a statistically significant but economically (practically) small role to the fiscal variables in determining the magnitude of the interest rates. On the other hand, numerous others come up with a statistically and economically significant relationship between long term interest rates and fiscal variables, such as Feldstein (1983), Gale and Orszag (2004), Laubach (2003), Faini (2005), Laubach (2007), and Alper and Forni (2010).

The reason behind the division among scholars might well emanated from the theory, since theory, as well, does not offer a clear-cut explanation in establishing the aforementioned linkage, as mentioned in the previous chapter. Theory emphasizes the role of different factors in determining the real interest rates. Many variables are interrelated with each other in the economy. Hence, it would not be surprising to see that empirical results are highly dependent on the scope, specification, and selected controls of the research.
Table 2.1. Summary Literature Review as Regards to Results

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<td>Cebula and Koch (1994)</td>
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<td>Cebula (2000)</td>
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<td>Faini (2005)</td>
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Source: Gale and Orszag, 2004, and author’s contributions
In this chapter, I elaborate the research by highlighting the time-period covered, the scope of the study, model specification and controls variables included. In doing this, various research are classified by the offered relationship between fiscal policy variables and real interest rates. Empirical research with no statistically significant linkage, research with statistically significant but economically weak link, and research with both statistically and economically significant link will be covered in the first, second and third sections of this chapter consecutively.

2.1. Empirical Research With No Statistically Significant Linkage

*Barro and Sala-i-Martin (1990)* tries to explain why the real interest rates were so high in the 1980s in major industrialized economies. In order to address this challenge, researchers focused on the time period between 1959 and 1988 in nine major OECD economies, which were accounting 65 percent of the world’s real GDP at that time. They analyzed the behavior of short-term real interest rates rather than examining the trends in long-term real yields mainly due to the data shortages and hardships in calculating long-term expected inflation rates. Regression analysis for real short-term interest rates, as a dependent variable, were based on one-year lagged realization of control variables. They controlled for previous year’s; real rate of return in the stock market, oil prices, monetary expansion over M1, expected world inflation, expected real short-term yields, world real investment to GDP ratio, real central government debt as a ratio to real GDP, real budget deficit as a ratio to real GDP, and adjusted real deficits as a ratio to real GDP in explaining real short-term yields in the current year. According to the study key elements in determining high real interest rates in 1980s are found as “favorable stock market returns” (which
stimulated investments and thereby raised real interest rates), and “high oil prices” (which also raised interest rates but discouraged investments). Fiscal stance variables are all ended up with statistically insignificant coefficients at conventional significance levels. Deficit indicators do not show expected positive signs, and fiscal control variables are also jointly statistically insignificant at 5 percent significance level.

*Evans (1985)* questions the conventional economic wisdom that large budget deficits do produce high interest rates. Researcher analyzed the very long-term macroeconomic trends in the US history. Researcher focused on different time spans between 1858 and 1985 by running separate regressions for civil war period (1858-1870), World War I period (1912-1922), World War II period (1938-1950), and Post-War Era (1979-1985). Commercial paper rates, ratio of federal spending to trend real national income, ratio of the real deficit to trend real national income, real stock of paper money as a ratio to trend national income are selected as the right-hand side control variables. Depending on the availability of macro-fiscal data researcher used annual, quarterly or monthly realizations together with assigning time lags in running the regression analysis. In all those aforementioned time periods, research ended up with either unexpected negative signs or insignificant coefficient on deficit variable.

In conclusion, this paper highlights the fact that more than a century of US history, large federal budget deficits have never caused high interest rates. His contribution to the literature could also be taken as a support to the presence of Ricardian equivalence in the US economy.

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42 Evans, 1985: 13
2.2. Empirical Research With Significant but Economically Small Effect

Bernoth et al. (2004) analyzes the determinants and the developments of the EU government bond yield spreads over the period between 1991 and 2002 in 15 European countries. In this research, dependent variable is taken as the yield spread of a bond issue in EU country (i) over the benchmark currency. Benchmark currencies were taken as Mark before 1998, and Euro after 1998. Irregularity of time series as regards to bond yields made researchers use cross-sectional time series regression. They used fiscal control variables, including gross debt to GDP ratio, deficit to GDP ratio, and interest payments as a ratio to total revenues. Squared forms of these variables were also added to the regression in order to capture any possible non-linear effects. Moreover, all those controls are measured in relation to the benchmark country, Germany. In order to measure general perceptions for credit risk of investors, a measure of yield spread between low-grade corporate bonds and benchmark government bonds in the US, together with its interactions with fiscal controls are added in the right-hand side variables\textsuperscript{43}. Study also includes institutional dummies such as a dummy that represents being EMU member, and other controls, such as maturity and business cycle, which might affect the yields. Regression results in this research suggest that all three fiscal control variables have a positive (expected sign) and a significant effect on the yield spread of the issuer country versus Germany\textsuperscript{44}. Another important conclusion in the study is that the coefficients on the fiscal controls in the regression that control for time fixed effects are slightly

\textsuperscript{43} Bernoth et al., 2004: 4

\textsuperscript{44} Bernoth et al., 2004: 22
higher than those in the regression, when they use country fixed effects\textsuperscript{45}. This means that within the EU countries the fiscal performance has less influence on the yield level than between the EU countries\textsuperscript{46}. The coefficient estimates for fiscal control variables, however, have statistically significant but economically weak effect on interest rates with a one-percentage point increase in gross national debt, the interest rate level of that country increases by around 1.20 basis points. The magnitude of the effect is quantitatively small as compared to numerous other studies that suggest 10-50 basis point increases in the interest rates in response to one-percentage increase in fiscal deficits or gross national debt.

\textit{Codogno et al. (2003)} aims at explaining the movements in yield differentials between Eurozone government bonds. Researchers focused on the monthly data of ten EU countries between the years 1995 and 2002. In that sense, we can say that this study covers time periods before and after the establishment of the EMU. Relative yield differentials excluding any exchange rate effects in an individual country, by taking Germany as the reference category, are taken as the dependent variable of the study. Exogenous risk measures (spread between 10-year fixed interest rates on US swaps and the yield on 10-year government bonds, spread between the yield on Moody’s Seasoned AAA US corporate bonds and the yield on 10-year US government bonds), debt to GDP ratios in comparison to Germany (as an indicator of fiscal stance), and interactions of risk and fiscal stance variables are taken as the independent variables of the study in explaining the relative long-term yield differential. Study concludes that changes in the risk factors mostly explains the

\textsuperscript{45} Bernoth et al. 2004: 22
\textsuperscript{46} Bernoth et al. 2004: 23
variations in yield differentials on Eurozone government bonds (up to 20 basis points), fiscal stance is found statistically significant only in Austria, Italy and Spain with a small basis point impact.

**Engen and Hubbard (2004)** analyses the relationship between US federal government debt and interest rates over the time period between 1953 and 2003 based on either annual realizations or projections done by Congressional Budget Office (CBO). Similar to Gale and Orszag (2004), research uses current and five-year ahead real long-term government bond yields as the dependent variables in separate regressions. In the right-hand side of the equation, research controls for federal debt and deficit as a ratio to GDP, real GDP growth rate, real oil prices, equity premium, and Federal Reserve treasury holdings and purchases variables. Their empirical study suggests that others being equal, a one-percent increase in federal government debt, as a ratio to GDP, would be associated by about three basis points to increase in the long-term real rate\(^{47}\).

**Afonso and Strauch (2005)** assesses the importance of the credibility of the European Fiscal framework by means of evaluating to which extend relevant fiscal policy events taking place in 2002, (such as deficit forecast declarations by governments, policy advice/recommendations by European Council), produced a reaction in the long-term bond segment of European capital markets. Study covers 253 daily observations during the year 2002. After identifying relevant fiscal policy events, researchers estimated the impact of these events on interest rate swap spreads in 13 EU member states. Swap spread, which is defined as the difference between

\(^{47}\) Engen and Hubbard, 2004: 33
10-year rates reported for the inter-bank swap market and 10-year government bond yields, is taken as the dependent variable of the study. Interest rate swap spread in the US, bid-ask spread for the 10-year government bonds, volatility of Eurostoxx index, slope of the US yield curve, binomial proxies of for the fiscal policy events are also taken as independent variables in the right-hand side of the regression equation. According to the regression results of the study the reaction of swap spreads to the fiscal stance parameters, when significant, has found mostly five basis points or less.

2.3. Empirical Research Suggesting Strong Positive Linkages

Gale and Orszag (2004) examine the trends in real long-term government bond yields in the US economy during the time period between 1976 and 2004. Researchers studied annual data for the aforementioned period, which means they only had 29 observations (relatively small sample as compared to other studies). Current and five-year ahead real long-term government bond yields are taken as the dependent variables in separate regressions, and projected GDP growth (in \( t+5 \)), projected debt to GDP ratio (in \( t+5 \)), projected primary deficit as a ratio to GDP (in \( t+5 \)), defense spending as a ratio to GDP, oil prices, and equity premium are taken as the control variables of the study. Their analysis suggests that deficit matters. Reasonable rule of thumb based on their regression results are that one percentage point increase in current deficits reduces national saving by 0.5 to 0.8 percent of GDP, that each percent of GDP in anticipated future deficit raises forward long-term yields by around 25 to 35 basis points, and that each percent of GDP in projected primary budget deficits raise interest rates by around 40 to 70 basis points\(^{48}\).

\(^{48}\) Gale and Orszag, 2004: 23
Faini (2005) studies the making of real long-term rates and the spillover effects of fiscal profligacy in Europe by means of analyzing a sample data of 10 EMU member states that covers the time period between 1979 and 2002. Research takes real long-term rates as the dependent, and several fiscal stance indicators (cyclically-adjusted primary balance, gross general government debt and government consumption), short-term real rates, expected inflation, real stock market returns, output gap as the independent variables. Empirical evidence based on this study suggests that one percentage point increase in deficit to GDP ratio leads no more than 10 basis point increase in the real interest rates depending on various regression outcomes. According to this study, fiscal policy in one EMU member country will have a two-fold effect, first on its spreads (country based effects), and second on the overall level of EMU interest rates for the currency union as a whole. Paper suggests that the latter effect is more significant than the former, indicating that there are indeed substantial spillover effects among the EMU member countries.

Alper and Forni (2011) analyzed the relationship between public debt ratios and long-term real yields, and spillover effects in 53 countries, including 25 emerging market and 28 advanced economies. Research is based on a sample of annual data for those 53 countries covering the time period from 2002 to 2010. Researchers ran separate OLS and IV regressions for advanced and emerging market economies. Real long-term yields are taken as the dependent variable, and short-term real interest rates, one-year-ahead expected GDP growth, one-year-ahead expected inflation, one-year-ahead expected debt (together with its squared form), financial openness, financial development, current account as a ratio to GDP, foreign reserves as a ratio to GDP are taken as control variables. This paper concludes that the long-
term real interest rates rise by about 2.5 to 4 basis points for one percentage point increase in one-year-ahead expected debt to GDP ratio in emerging market economies. On the other hand, regression results show an impact ranging between 2.5 and 7 basis points for advanced economies.
3. METHODOLOGICAL APPROACH

In this chapter, methodological approach of this study is elaborated. In the first part, I mention the set-up of my panel data that is used in this study. In the second part, I explain the underlying conceptual model in estimating real interest rates, and the rationale behind including the right-hand side controls. In the third and final part, I discuss estimation strategy of my research by mentioned possible problems faced and solutions offered.

3.1. Methodological Approach

Covering the years between 1990 and 2012, a panel of 31 countries, which are geographically located in Europe, is used in this study. Panel data includes 17 EMU members, 10 EU member countries, which have not joined common currency, along with 4 other European countries that are not a part of the European Union treaty. This panel is produced by the author based on the data coming from different sources, which will be discussed in the next chapter.

Real long-term interest rate is the dependent variable of this study. As widely known, the real interest rate is the rate, which is calculated by subtracting inflation from nominal interest rates, and long-term refers to time frames that cover more than one year⁴⁹. In this regard, secondary market yields of government bond maturities of close to ten years are selected as the nominal long-term interest rate in this research. The EuroStat, which is the relevant statistical institution of the EU, regularly reports these figures. Nominal to real rate conversion, however, is somewhat dependent on

⁴⁹ stats.oecd.org/glossary
the approach selected by the author, since s/he should apply inflation expectations for the forthcoming ten-year period to deflate the nominal interest rate. Some researchers apply forecasts from an estimated ARIMA process of inflation in order to get long-term inflation expectations\textsuperscript{50}. Some others just use short-term real interest rates as the dependent variable in explaining long-term trends of real interest rates, assuming that short and long-term real interest rates follow similar movement patterns\textsuperscript{51}. In my research, I use a relatively meticulous approach by means of gathering national long-term inflation forecasts of individual countries. Knowing that national governments might report rosy inflation figures, I also compared national forecasts with the IMF’s World Economic Outlook projections. Some countries don’t report ten-year inflation forecasts. For those, available national forecast for the longest possible term is used.

Right-hand side variables include fiscal, economic, and institutional controls, which might affect saving-investment dynamics, and thus real interest rates, as mentioned in the first chapter. Fiscal controls are the government debt stock, as a ratio to GDP, and three different budget deficit categories including overall, primary, and structural deficit definitions, as a ratio to GDP. General government, which comprises central, state and local government agencies, and social security institutions, is selected as the scope of the government in line with the European System of Accounts (ESA-95)\textsuperscript{52}. This definition is the most comprehensive definition of government.

\textsuperscript{50} For detailed information see Blanchard and Summers, 1984, Faini, 2005
\textsuperscript{51} See Barro and Sala-i-Martin, 1990
\textsuperscript{52} See ESA-95 Manual, European Commission, 1995
Economic controls are the real short-term interest rates calculated by using the overnight interbank rate in the money markets, CPI-inflation, output gap as a ratio to potential GDP, current account balance as a ratio to GDP, real stock market returns, and the US real interest rate ratio. Lastly, individual country transparency scores, which are based on Transparency International’s corruption perception index, and membership to EMU, are taken as the institutional controls.

3.2. Underlying Conceptual Model

As mentioned above, real long-term interest rates will be the dependent variable of my research. Empirical studies estimating the impact of fiscal parameters on real interest rates use either government debt or budget deficit, or both. From a theoretical point of view, the level of long-term real interest rates should depend on the level of public debt, as it is the stock of debt that crowds out private capital in the portfolio of savers\textsuperscript{53}. The total stock of debt, however, is mainly determined by the annual flows of government deficits. Therefore in my research I prefer to use general government debt together with one of the deficit categories in the same regression.

The very basic specification of my model is summarized as follows:

\[ r_{it} = \beta_0 + \beta_1 Debt_{it} + \beta_2 (Debt_{it})^2 + \beta_3 Deficit_{it} + \beta_4 r_{i,t}^{\text{short}} + \beta_5 p_{it} + \beta_6 (y^d - y^p)_{it} + \beta_7 \pi_{it} + \beta_8 CAB_{it} + \beta_9EMU_{it} + \beta_{10} TransScore_{it} + \beta_{11} US_{it} + \epsilon_{it} \]

Where \( r_{it} \) denotes real long-term interest rates in the year \( t \). \( Debt_{it} \) is the general government gross debt stock as a ratio to GDP in the year \( t \), and \( (Debt_{it})^2 \) is its square. \( r_{i,t}^{\text{short}} \) is the short-term real rate in the money market in the associated year.

\textsuperscript{53} See Engen and Hubbard, 2004, Hubbard, 2011, and Alper and Forni, 2010
that aims at capturing the effect of monetary policy stance on long-term real yields since monetary policies followed by the central banks are key in determining short-term real yields. Moreover, investment profitability as a key variable in analyzing real long-term interest rates are controlled by real stock market returns, STOCKMARKET\textsubscript{t}. Stock market returns assumed to proxy high investment profitability in the economy. As we mentioned in the literature review chapter, high investment profitability might result in an increase investment demand, and thus an increase in the real interest rates, in the economy\textsuperscript{54}. The early eighties are associated with high world real interest rates. Analyzing this time period, both Blanchard and Summers (1984), and Barro and Sala-i-Martin (1990) conclude that future prospects of investment profitability is the key in explaining high real yields in the world at that time.

Other economic controls are inflation, current account balance, and the output gap, which are represented by \(\pi_{it}, \text{CAB}_t\) and \((y^a-y^p)\_t\) OUTPUTGAP\textsubscript{t} consecutively. Rather than using actual real growth rates I prefer to use output gap, which is the ratio of the difference between actual and trend growth rate to trend growth rate. Among these controls, inflation is included since it is an indication of ambiguities in the economy. In fact, the effect of inflation on real interest rates is somewhat blurry. High inflation may boost consumption spending, and deter savings in a way to increase real interest yields. Yet inflation may encourage precautionary saving as well. On the other hand, inflation might well cause entrepreneurs to postpone investment decisions due to the ambiguities in the economy. If so, inflation may

\textsuperscript{54} See Barro and Sala-i-Martin, 1990, and Blanchard and Summers 1984
decrease real yields as the demand for investment decreases. Current account balance is another economic control in the right-hand side of the regression. The model includes current account balance, as a ratio to GDP, since it is believed to capture the effect capital inflows in the economy along with reflecting the domestic saving performance of that country. Lastly, output gap is also an important variable in the model. If the output gap has a positive sign that reflects the economy’s actual GDP is higher than its potential, we can expect an increase in the desired investment, thus an increase in the real interest rates. Saving schedule, however, might be affected by the output gap as well. Booming periods in the economy may also boost savings. Therefore, the effect of the output gap is somewhat ambiguous similar the inflation. These economic controls also help me isolate the effect of fiscal variables from other business cycle related factors, which are probably affecting the interest rates.

TransScore\textsubscript{i,t} and EMU\textsubscript{i,t} are the institutional variables in the model that refers to the corruption perception index of an individual country, and the membership status to the EMU, consecutively. Corruption perception index scores are supposed to proxy transparency of a country, and there is believed to be a negative correlation between transparency scores and the real interest rates. The more transparent a country is, the lesser the real yields would be depending on the risk perceptions. EMU captures membership effects. There are now 17 member countries in the Eurozone of which most have become a member after 1998. One might expect a negative relationship between being a member to the Eurozone and the real interest rates since there would be better integrated and deepened financial markets, thus an increased saving pool, for the members. Membership effects, however, are still a controversial topic under debate, since Eurozone countries are also subject to the
common pool problems due to having one monetary authority, the European Central Bank (ECB). Therefore, membership to EMU also indicates that there are risks are to be shared as well as benefits.

With an aim to capture financial interlinkages and global liquidity conditions, the model also includes the US real interest rate ratio, US. It is for sure that financial ties are very strong between the both sides of the Atlantic.

3.3. Estimation Strategy

Most recent empirical studies Ardagana, Caselli and Lane (2007); Baldacci and Kumar (2010); Alper and Forni (2010) have considered a non-linear relationship between the initial level of government debt and real long-term interest rates. The standard hypothesis is that the relation between the level of debt and long-term rates has a U-shaped form. The basic rationale behind such a relationship depends on the fact that when the stock of government debt is limited, additional public borrowing can increase market liquidity and reduce volatility. Cautious deficit financing, if used in development projects that have higher growth returns, might affect savings positively due to the increasing incomes. At higher levels of debt, liquidity considerations start to play a smaller role, while the crowding out effect and sustainability concerns of debt start becoming more important. Additional public borrowing is more difficult when market participants have already been holding large amounts of public debt, and risk premium will increase in response to the sustainability bias of government debt\(^{55}\). Taking these countervailing effects into account, the quadratic form of government debt is also included in the model.

\(^{55}\) Alper and Forni, 2008: 8
A fixed effect model setting is applied in the estimation process and random effect model results are also reported along with the fixed effect estimates\textsuperscript{56}. Country and time fixed effects are controlled for, and robust standard errors are used due to the presence of heteroskedasticity\textsuperscript{57}. In addition to that, I also control for the first order autocorrelation in the error term\textsuperscript{58}.

Moreover, the level of government debt may well depend on the existing real long-term yields in the financial market. Abundant global liquidity and easy access to funds enable governments to pile up more debt, or to postpone fiscal adjustment. Therefore, there may be potential endogeneity risks between these two. An instrumental variable approach (IV) is applied to deal with this problem. As instruments for debt stock and its square, I used the three-year lagged debt stock and real GDP growth rate. In addition to that, it is possible to have endogeneity in some macroeconomic controls as well. Therefore, Arellano-Bond dynamic panel estimates with two-year lags are reported along with 2SLS estimates.

\textsuperscript{56} Hausman test yields a p-value of .005, which implies that the difference in coefficients is systematic under the conventional significance levels.

\textsuperscript{57} Modified Wald test is used for groupwise heteroskedasticity.

\textsuperscript{58} Lagram-Multiplier test yields presence of first-order autocorrelation at 10 percent significance level.
4. DESCRIPTION OF DATA

In this chapter, I will describe the data on the variable of interest and research controls. In the first part, I will mention the main sources of data, and in the second part I will elaborate key variables and descriptive statistics.

4.1. Sources of Data

Covering the years between 1990 and 2012, I produce my own panel of 31 countries, which are located in Europe. Since the model includes macroeconomic, fiscal and institutional variables, I need to combine the data coming from different data sources. Consolidation of data also requires me to devote special attention to the compatibility of data (as regards to definition, scope, sector, …,etc.) coming from different sources. Furthermore, in order to have a coherent dataset one simply needs to make a prioritization among different data sources since different sources may include different figures for a variable included in the conceptual model in a certain year. Main sources of my dataset are further elaborated below.

**Eurostat**

Eurostat is the primary official statistical agency of the EU whose task is to collect and disseminate data in the region. Since Eurostat is the only official central authority in producing/collecting and disseminating the data in the EU, data will be highly consistent and reliable. Therefore, it is my first priority to check the Eurostat for data availability for the variables included in my model. Unless otherwise specified, the realization of macro-fiscal figures, such as long-term and short-term

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59 For more information visit ec.europa.eu/eurostat
interest nominal rates, general government budget deficit, primary deficit, structural
deficit, general government debt, growth rates, output gap, CPI-inflation, current
account balance, and stock market returns will be taken from various Eurostat
databases (government finance statistics, national accounts, interest rates databases).
However, one major drawback of this data source is the unavailability of realization
figures before 1995, and projections for the aforementioned items after 2011.
Moreover, Eurostat also lacks institutional variables such as any transparency index
and other international figures/indicators such as the US nominal interest rates,
which are to be included in the model specification as well.

**IMF-World Economic Outlook Database (WEO)**

IMF regularly publishes economic data series that is used in the preparation
of the WEO reports in April and September/October each year. Data on national
accounts, CPI-inflation, current account balances, real GDP growth rates and output
gap, various fiscal data, trade for countries and country groups (aggregates), and
prices are available in this database from 1980 to the present. Moreover, projections
are also released for the medium-term (2012-2017) for selected indicators. The
IMF’s WEO database is the ideal substitute for Eurostat data to fill the gap as regards
to the time period covered and additional data included.

**Transparency International (Corruption Perceptions Index)**

Transparency International is a non-governmental civil society organization
that fights corruption. This organization publishes corruption perceptions index for
most of the countries annually. The index has been based on a survey, which records

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60 For more information visit www.imf.org/weo.
responses of inhabitants on their corruption perceptions for the government of the country in which they live\textsuperscript{61}. The aforementioned index takes values between zero and ten; zero represents the worst while ten represents the best.

4.2. Key Variables and Descriptive Statistics

\textit{Real Long-term Interest Rates (r_{i,t}) (dependent/endogenous variable)}

As discussed before, real long-term real interest rates will be the dependent variable of my research. Long-term interest rates refer to the nominal average interest rates for government borrowing with a maturity close to ten years in each country, and secondary market yields for those bonds are taken as the basis for those rates\textsuperscript{62}. Nominal rates are deflated by the expected inflation for the forthcoming ten years to get the real long-term interest rates.

As being a continuous variable, real long-term interest rates takes values between -2.18\% and 75.36\% according to the panel data. Moreover, real long-term interest rate has a mean value of 4.37\%, with a standard deviation of 5.95\%. Before the global financial crisis, real yields showed a declining trend both in the US and in the EU. Although, real interest rates increased during the crisis, it is still lower than the levels in the 1990s and early 2000s. Moreover, real yields follow similar movement patterns on both sides of the Atlantic. Therefore, I include real US interest rates in order to control for the effects of interlinkages.

\textsuperscript{61} For more information visit www.transparency.org.
\textsuperscript{62} stats.oecd.org/glossary/
Gross General Government Debt ($Debt_{i,t}$) (independent/exogenous variable)

Gross general government debt stock, as a ratio to GDP, is an independent variable of my research. The scope of general government refers to the consolidation of central (federal), state and local governments, and social security accounts in a country.\textsuperscript{63}

\textsuperscript{63} European System of Accounts (ESA-1995)
General government scope is the most comprehensive definition of the government sector. Gross general government debt is a continuous variable and it takes values between 3.69 and 170.73 percent, as a ratio to GDP. According to the raw data trends, as we can see in Graph 4.2, there seems to be a slight positive relationship between debt stock ratio and real yields. In addition to that, response of
real yields to the changes in the debt stock ratio also seems to be more pronounced in EMU member countries.

*Structural Balance (Deficit)*<sub>i,t</sub> (independent/exogenous variable)

Structural balance represents what general government deficit/surplus would be if output were at its potential level<sup>64</sup>. As a measure of deficit I rely on this variable in my research.

**Graph 4.3. Structural Deficits and Real Yields**

It has a clear advantage over other deficit definitions, such as overall balance or primary balance, since general government balance is adjusted over the business cycle in order to eliminate cyclical macroeconomic effects on government budget balances. General government structural balance, as a ratio to GDP, is a continuous variable taking values between -18.60 and 6.58.

<sup>64</sup> stats.oecd.org/glossary
Real Short-Term Interest Rates $r_{i,t}^\text{short}$ (independent/exogenous variable)

Short-term interest rates refer to money markets rates that have a maturity of less than a year. Typical standardized names for short-term interest rates are either money market rate or Treasury bill rate\(^{65}\). This variable will help control for the monetary policy stance. Yet in the EMU member countries nominal interest rates are determined by the ECB, not by the sovereign central banks. Therefore, nominal interest rates are the same for all. The only difference is the rate of inflation, which changes real rates in those countries. Overnight rates are used as a measure of short-term rates, and nominal to real conversion is made by CPI-inflation of the associated year.

Investment Profitability ($p_{i,t}$) (independent/exogenous variable)

Investment profitability has also been a key variable in explaining the making of real interest rates. In order to proxy investment profitability, I use nominal stock market returns, and then I deflate nominal rates by CPI inflation to get real returns.

Output Gap $(y^a - y^p)_{i,t}$ (independent/exogenous variable)

Output gap is also another continuous variable in the right hand side of the model. Output gap refers to the difference between actual and potential GDP as a percent of potential GDP\(^{66}\).

\(^{65}\) stats.oecd.org/glossary
\(^{66}\) stats.oecd.org/glossary
Inflation ($\pi_{i,t}$) (independent/exogenous variable)

Inflation is a measure of changes in the price level, which is calculated by the price changes in a typical basket of goods and services. Among different definitions, the annual average increase in the CPI index is taken as the basis of inflation.

Current Account Balance ($CAB_{i,t}$) (independent/exogenous variable)

The current account balance includes transactions that have a certain value, which occurs between resident and non-resident entities of the economy, excluding financial transactions\textsuperscript{67}.

Membership to EMU ($EMU_{i,t}$) (independent/exogenous variable)

Membership in the EMU is a binary control variable, which becomes one for EU countries after the year they joined the EMU. Although the establishment of the EMU comprises of three stages, the third and the last stage, which represents the introduction of the common currency, is taken as the basis for the establishment of the EMU.

At the beginning of 1999, the third and final stage of the of the Eurozone started with fixing of the exchange rates in 11 countries, and the sovereign monetary policies were left to the authority of the ECB. The number of member states has risen to 12 in 2001 with the Greece’s joining the club. Slovenia became the 13\textsuperscript{th} member of the Eurozone in 2007, followed one year later by Cyprus and Malta, by Slovakia

\textsuperscript{67} stats.oecd.org/glossary, and IMF’s manual on Balance of Payments
in 2009 and by Estonia in 2011. As those countries become a member to the EMU their sovereign central banks automatically became part of the Eurozone\(^{68}\).

*Transparency Score (TransScore\(_{i,t}\)) (independent/exogenous variable)*

Transparency scores are based on the corruption perceptions index that is published by the Transparency International. As we mentioned before respondents are surveyed as regards to their perceptions on government-induced corruption. Zero represents the worst and ten represents the best. According to my panel, transparency scores range between 2.6 and 10 with a mean value of 6.46. Standard deviation of this variable is 2.07.

**Table 4.1. Summary Descriptive Statistics of Controls**

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<thead>
<tr>
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<th>Explanation</th>
<th>Mean</th>
<th>Min.</th>
<th>Max.</th>
<th>Stan. Dev.</th>
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<tr>
<td>Debt</td>
<td>General government gross debt to GDP ratio</td>
<td>53.63</td>
<td>3.69</td>
<td>170.73</td>
<td>28.88</td>
</tr>
<tr>
<td>Structural Deficit</td>
<td>General government deficit to GDP ratio adjusted for the cyclical effects</td>
<td>-3.05</td>
<td>-18.60</td>
<td>6.58</td>
<td>3.35</td>
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<td>Real Short-Term Interest Rates</td>
<td>Annual average interest rates in the money markets, deflated by the CPI inflation rate</td>
<td>1.63</td>
<td>-13.77</td>
<td>23.11</td>
<td>3.44</td>
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<td>Investment Profitability</td>
<td>Annual average stock market returns deflated by the CPI inflation</td>
<td>6.20</td>
<td>-88.52</td>
<td>276.94</td>
<td>31.63</td>
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<tr>
<td>Output Gap</td>
<td>The difference between actual and potential GDP as a</td>
<td>-0.01</td>
<td>-9.8</td>
<td>11.88</td>
<td>2.67</td>
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</table>

\(^{68}\) For further information see [http://www.ecb.int/ecb/history/emu/](http://www.ecb.int/ecb/history/emu/).
<table>
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<tr>
<th>Explanation</th>
<th>Mean</th>
<th>Min.</th>
<th>Max.</th>
<th>Stan. Dev.</th>
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<tr>
<td>ratio to potential GDP</td>
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<td><strong>Inflation</strong></td>
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<tr>
<td>Annual average CPI inflation</td>
<td>11.19 %</td>
<td>-1.7 %</td>
<td>1061.21 %</td>
<td>52.10 %</td>
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<td><strong>CAB</strong></td>
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</tr>
<tr>
<td>Current account balance as a ratio to GDP</td>
<td>-1.22 %</td>
<td>-28.35 %</td>
<td>16.40 %</td>
<td>6.41 %</td>
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<tr>
<td>Scores calculated by Transparency International over Corruption Perceptions Index (10: best, 0: worst)</td>
<td>6.46</td>
<td>2.60</td>
<td>10.00</td>
<td>2.07</td>
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<td><strong>US Interest Rates</strong></td>
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<tr>
<td>Long-term interest rates in the US deflated by the CPI inflation</td>
<td>2.48 %</td>
<td>-0.36 %</td>
<td>4.48 %</td>
<td>1.36 %</td>
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</table>
5. RESULTS AND POLICY IMPLICATIONS

Model results will be described and policy implications will be mentioned in this chapter. In the first part, I will show model results in two different tables, where each column represents different specification. In the second part, I will mention the policy implications based on these model results.

5.1. Results

Table 5.1, shows regression results for different specifications. In this Table, random and fixed effect model coefficient estimates are reported for two different types of equations that measure linear and quadratic relationship between debt stock ratio and real long-term yields. General government debt stock ratio and its square are found statistically significant in each specification.

Two facts stand out. First, coefficient estimate on general government debt stock ratio has a positive sign in the linear setting, indicating, holding others constant, a rise in the debt stock to GDP ratio is associated with an increase in the long-term real yields. In such a relationship, the estimated effect of a one-percentage point increase in debt-to-GDP ratio increases interest rates by 3.6 basis points in the random effect model, and by 6.8 basis points in the fixed effect model. Second, regression results support a U-shaped relationship between debt stock and real long-term interest rates. In a quadratic setting, a rise in debt stock ratio yields an upward pressure on real long-term interest rates above a certain threshold level, although the initial direction of the effect in this relationship is downwards below that level. Threshold levels of the debt-to-GDP ratio are found to be 54.3 percent in the random effect model, and 49 percent in the fixed effect model.
Table 5.1. Baseline Estimates of the Impact of Debt on Interest Rates

<table>
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<tr>
<th>VARIABLES</th>
<th>(1) Random Effect</th>
<th>(2) Random Effect</th>
<th>(3) Fixed-Effect</th>
<th>(4) Fixed Effect</th>
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<td>Short-Term Rate</td>
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<td>2.584***</td>
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<td>20</td>
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</tr>
</tbody>
</table>

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Country and time fixed effects are used, and first order autocorrelation in the error term is controlled for.

Columns:
1. Random effect model without quadratic form of debt stock
2. Random effect model with quadratic form of debt stock
3. Fixed effect model without quadratic form of debt stock
4. Fixed effect model with quadratic form of debt stock

On the other hand, coefficient estimates on government structural deficit, as a ratio to GDP, is not found statistically significant. Although regressions results that are shown in Table 5.1 do not include other government deficit definitions, such as overall deficit or primary deficit, I tried running the same model specifications with the aforementioned government deficit variables as well. Yet this exercise found
insignificant coefficient estimates each time. As a result, the study also concludes that among various fiscal variables, debt stock to GDP ratio is the only one that matters.

In panel model regressions, macroeconomic controls may pose a potential problem if they have a trending pattern over time, which is known as a unit root. If that is the case, existence of a trending pattern, non-stationarity, may affect statistical inferences and may cast doubts on the validity of the suggested causal relationship between real yields and other controls of interest. In order to address possible concerns, I apply a Fisher-type unit root test, an augmented Dickey-Fuller test, with two-year time lags as a diagnostic tool. I find that all series for the macroeconomic controls are stationary at conventional significance levels. Although, non-stationarity is not a concern for my research, I prefer to also include a first-differenced regression model in my research as a robustness check. First differencing is regarded as an option to solve any unit root problems as well as being an appropriate approach to address time constant omitted variable bias. Results are shown in the first column of Table 5.2. Outcomes of the first-differenced model are very similar to the results that I obtain from other regression settings. Debt stock to GDP variable and its square is highly statistically significant, still supporting the hypothesis for a U-shaped relationship between real long-term interest rates and general government debt stock ratio. The threshold level of debt stock ratio is found as 52 percent of the GDP, which is also very close to the outcomes from the other regressions.

---

69 Demean option is also used to mitigate cross-sectional dependence.
As the government debt stock might well be dependent on the current level of real long-term interest rates, as highlighted in the methodological approach chapter, there might be a potential endogeneity between them. In order to address this problem, my research relies on the 2SLS approach. As instruments for general government debt stock I use the three-year lagged debt stock and three-year lagged growth rate. In order to test for overidentifying restrictions, I apply the Sargan-Hansen test. In this test, rejection of the null hypothesis will raise doubts on the validity of the selected instruments, since the null says that the instruments are correctly excluded and the selected instruments are uncorrelated with the error term. However, in this context, I fail to reject the null hypothesis at conventional statistical significance levels. Using the Kleibergen-Paap and Stock-Yogo test statistics, I also reject the existence of under-identification and weak identification problems at conventional significance levels.

Table 5.2 shows the results for different IV regression settings. Country and time fixed effects are controlled for in these regression settings. The second column represents the instrumental variable approach estimates. By and large, regression results do not differ substantially. Although the linear effect of an increase in the debt stock ratio on real long-term yields is slightly decreased to 2.8 basis points, the coefficient estimate on debt stock ratio is still strongly statistically significant, and the general government structural deficit ratio is still insignificant. There might also be a potential endogeneity problem in some of my macroeconomic controls. To

---

70 Sargan, 1958
71 Test statistic is found as 1.016 with a p-value of 0.3134.
control for endogeneity, which might be the case on a larger scale, I apply the Arellano-Bond dynamic panel estimation approach with two-year lags.

Table 5.2. Alternative Specification Results

<table>
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<th>VARIABLES</th>
<th>(1) First Difference</th>
<th>(2) 2SLS</th>
<th>(3) Arellano-Bond</th>
<th>(4) Arellano-Bond</th>
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<td>0.0281***</td>
<td>0.0517***</td>
<td>-0.105***</td>
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<td>(0.0313)</td>
<td>(0.0104)</td>
<td>(0.0157)</td>
<td>(0.0173)</td>
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<td>Debt^2</td>
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<td>0.00101***</td>
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<tr>
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<td>(0.000197)</td>
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<td>(0.000103)</td>
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<tr>
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<td>(0.0474)</td>
<td>(0.0286)</td>
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<tr>
<td>Short-Term Rate</td>
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<td>0.240***</td>
<td>0.325***</td>
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<td>(0.0611)</td>
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<td>0.165**</td>
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<td>(0.0710)</td>
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<td>-0.0113**</td>
<td>-0.00811***</td>
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<td>-0.537***</td>
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<td>(0.180)</td>
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<td>(0.0805)</td>
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<td>(0.293)</td>
<td>(0.316)</td>
<td>(0.354)</td>
<td>(0.350)</td>
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<td>20</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

Standard errors in parentheses  
*** p<0.01, ** p<0.05, * p<0.1

Columns:
1. First difference model with quadratic form of debt stock
2. 2SLS using three-year lagged debt stock and deficits as instruments
3. Arellano-Bond dynamic panel estimators with two year lags without quadratic form of the debt stock
4. Arellano-Bond dynamic panel estimators with two year lags with quadratic form of the debt stock

Results are shown in the last two columns of the Table 5.2. The third column shows the linear effect of an increase in debt stock ratio on long-term yields. The effect of a one-percentage point rise in the debt stock ratio is associated with a 5.2 basis points increase in real long-term yields, holding other controls constant. A U-
shaped relationship between the general government debt stock ratio and real long-term yields is also supported by the selected dynamic panel estimation approach. The threshold level of the debt stock ratio is found as 52 percent, as a ratio to GDP. The structural deficit ratio is still insignificant. After that, I feel confident to reemphasize the main result of my research that it is the debt stock ratio that matters.

Concerning the other variables, I conclude that real short-term rates, rates in the money markets, have a significant positive impact on real long-term rates. This is an expected result suggesting that the Central Bank policies matter. An expansionary monetary policy, thus a possible reduction in the real short-term rates, is expected to offset the impact of expansionary fiscal policies, at least in the short-run. Inflation is not taken into consideration in this assessment. It is also important to note that, the real short-term rates are determined by the difference between nominal rates and the rate of inflation. The ECB targets inflation rates by using the nominal short-term rates, and also depending on the fiscal policy scope expansionary monetary policies may well result in an increase in inflation.

In the literature, the effect of inflation on real long-term yields is somewhat blurry. High inflation rates may boost consumption spending, and may deter savings in a way to increase real interest yields, since during the inflationary times real value of financial assets erodes. Yet, inflation may encourage precautionary saving as well. If the first proposition is the case, an increase in the rate of inflation will increase the real long-term interest rates. If the second one is the case, then an increase in the rate of inflation will decrease the real long-term yields. The inflation rate is also an indication of ambiguities in the economy. During the inflationary times risk
perceptions will be more pronounced in way to increase risk premium, thus the real borrowing costs. In my research, the coefficient estimate on the inflation rate is found to be positive. Estimates are also statistically significant in all regressions. Therefore, I conclude that a rise in the rate of inflation is estimated to increase the real long-term interest rates.

An increase in the output gap gives people more financial means for saving and consumption since it increases disposable incomes. If households tend to save more during the good times of the cycle, an increase in the output gap will decrease the real long-term yields. Results show that the effect of the output gap is ambiguous. The coefficient estimate on the output gap has a flipping sign, and it is not significant in each regression.

With an aim to capture effects of domestic saving-investment balances in the economy, current account balance, as a ratio to GDP, is included in the model. If a country is running a current account deficit that means domestic savings are less the investment demand. Therefore, this country needs foreign savings in order to finance the domestic investment demand. If sustainability of the current account balance triggers risk perceptions then it foreign financing might become more costly in real terms as compared to domestic financing. Many developing countries, such as Brazil, Turkey, and Argentina experienced crisis due the worries on sustainability of current account balances. If that is the case we expect a negative sign on the current account

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72 The actual GDP is lower than the potential GDP, that means output gap ratio has a negative sign, and vice versa. Therefore, an increase in output gap means ratio’s being either more positive or less negative in its value.
balance variable. Regression outcomes, however, do not yield significant results for the current account balance variable. One possible explanation could be that the concerns on the sustainability of current account balances may not be a serious concern in the well-integrated trade structure of Europe.

High real stock market returns were the primary explanation behind the high world real interest rates during the early 1980s. It is believed that high profitability shifts investment demand curve to the right, and leads to higher interest rates. If that is the case, I should have found a positive sign for the coefficient estimate on the real stock market returns control. However, the coefficient estimate on the real stock market return variable has a negative sign and it is statistically significant in all regressions. In this context, I can argue that high investment returns also represent better growth prospects for the economy. During the good times, concerns about debt sustainability, and thus the risk premium, would be lower. Therefore, it is not surprising to find slightly positive coefficients on real stock market returns.

Transparency is considered to reflect structural strengths or weaknesses of an economy. The more transparent a country is, the more reliable would be the national fiscal policy making process. Therefore, an increase in the transparency score could decrease the long-term interest rates. According to the regression outcomes, the sign on the transparency score coefficient is negative when it is significant. This supports the aforementioned proposition. Yet, the coefficient estimate on the transparency

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73 Negative sign on the current account balance coefficient indicates that an increase in the absolute value of current account deficit, as a ratio to GDP, is associated with an increase in the real long-term interest rates, since current deficits are shown by a negative sign.

74 See Barro and Sala-i-Martin, 1990, and Blanchard and Summers 1984
score is not significant in each regression. Therefore, statistical evidence is somewhat weaker for transparency scores.

Membership in the EMU might affect real interest rates in two different channels. Single currency and a better financial integration may ease financing conditions for the members in a way to reduce real borrowing costs, thus real long-term interest rates. On the contrary, common pool problems may also be the case. Although there is a single monetary policy authority, ECB, member countries still enjoy their fiscal policy sovereignty. After the establishment of the EMU average debt stock in Europe has shown an increasing trend. There is a strong correlation between being an EMU member and piling up debt. Moreover, one-size-fits-all interest rate policies of the ECB may not yield same results in all member economies. This research does not yield convincing results to support any such proposition.

Lastly, the US long-term interest rate has an effect on the long-term interest rates in Europe. Interlinkages through the integration of financial markets in the EU and the US, is the main reason behind that. Regressions, except the last one in Table 5.2, yields significant positive coefficient estimates for US interest rate variable. If the long-term interest rate is also affected by the real short-term rates, then I can suggest that monetary policy scope in the US has spillover effect on the EU.

5.2. Policy Implications and Conclusion

The financial and economic crisis that hit almost all advanced economies after 2007 severely affected the public finances of most of the EU members. There has been a sharp deterioration of government budget balances and a parallel increase
in debt to GDP ratios. The average general government deficit in the EU area is now around 85 percent of the GDP, which was 59 percent before the global financial crisis. The debt stock to GDP ratio is higher for the EMU area, 90 percent of GDP. Most of the European countries have been running a debt stock to GDP ratio well above the debt thresholds levels found in this study after the global financial crisis. If I adhere to the so-called U-shaped curve structure as mentioned before, the relationship between the debt stock ratio and real long-term interest rates is negative at first, then positive, thus upward sloping. As debt stock ratio continues to increase real yields are expected to increase as well. In order to show the severity of the existing situation, I can make a simple calculation. If I take the estimated linear positive effect as 5 basis points at the means of the data, and apply it to the increase in the debt stock ratio for EMU countries, which was almost 25 percent since 2007, I will get an increase of 1.25 percentage points in real interest rates. Such an increase in the real long-term interest rates may have dire sustainability implications for the Euro area countries. This difference in the real yields simply represents almost a two-fold rise in the real borrowing costs on average as compared to the levels before the global crisis.

As we know, in some Eurozone members, such as Greece, Spain, Italy and Portugal, the situation of the situation of public finances became so critical as to put their fiscal sustainability at risk during the crisis. The spreads on sovereign interest rates in these countries have increased far beyond the increase calculated above, and they were supported with large financial assistance packages by the EU and the IMF. Even though one-time support helps crisis-hit countries alleviate immediate risks, long-term recovery will be dependent on sustainable cost and term structure of
government debt. In this context, raising real interest rates will definitely make life harder for governments. Moreover, recovery from sluggish growth rates and turning back to the sustainable growth path is dependent on the investment climate, which is a function of real interest rates.

Taking all these factors into account, fiscal adjustment is necessary in Europe, not just because the debt sustainability is at risk, but also because decreases in the real yields is very critical for a better investment climate and sustainable growth.

For the future of the EMU, better coordination in fiscal policies is vital. Fiscal irresponsibility of individual members is making it harder to sustain the common currency, Euro, and the idea of having a single Central Bank, the ECB. That does not necessarily mean that member states should sacrifice their fiscal sovereignty in order to rescue the EMU. The Maastricht Treaty in 1992 and annexed Protocols set common fiscal rules in the EU. General government debt stock limit, which is determined as 60 percent of GDP, is not much from the model thresholds. If these fiscal rules are implemented correctly, there might not be an upward pressure on real yields, and debt sustainability would no longer be a concern. Yet effective supervision and better enforcement is a missing part in the big picture. Common fiscal architecture should be revised, and the preventive arm of SGP should be revived.

75 Debt threshold is 60 percent of the GDP, and the deficit threshold is set as 3 percent of the GDP. For more information visit http://www.eurotreaties.com/maastrichtec.pdf.
It is clear that fiscal recovery process is slow, and it has its own associated political costs. Pursuing a prudential fiscal policy under the existing circumstances sounds like chewing a bitter drug. Yet, I should also note that moderate achievements in fiscal indicators would lead to a self-reinforcing improvement in the cost structure of government borrowing, and profitability of potential investment projects.
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