The Effects of Austerity on the Sustainability of the Greek Public Debt

SANDEEP JAIN

Master of Science Thesis
Stockholm, Sweden 2013
The Effects of Austerity on the Sustainability of the Greek Public Debt

Sandeep Jain

(Greek parliament, 2012)
Abstract

The current Greek debt crisis has forced the Greek government to adopt austerity measures. In this paper, the most favourable debt reduction strategies among all the other strategies, for both Greece and its creditors will be examined. These strategies have been recently suggested in the economic world, to help achieve deficit reduction and enhance the growth rate of Greece. This is very important for the economic world - to avoid the insolvency of Greece and to find the best debt reduction strategy which is favourable for both the parties, so that the Greek public debt-to-GDP ratio can reach a level of sustainability within a reasonable timespan. In an endeavour to answer the research question, a simulation framework has been carried out based on the economic model as given by Cline, (2011). When using this economic model, \( g \) has been made endogenous and it is dependent on the extent of austerity. This has been taken into consideration while carrying out the simulation exercises for this paper. Furthermore, three different debt reduction strategies (the lowering of interest rates, debt write-off and increasing the primary surplus) have been implemented, considering the different scenarios of the economy, when executing these simulation exercises. After carrying out the simulation framework, it has been concluded that the further reduction of the interest rate would be the most favorable debt reduction strategy for both Greece and its creditors. This interest rate strategy would not only lower the Greek public debt-to-GDP to a sustainable level within a reasonable time period, but will also keep the growth rate positive in the long run during this period of weak economic recovery.

Key-words: Austerity, Deficit reduction, Fiscal policy, Public debt, Debt-to-GDP ratio
Acknowledgements

This paper would not have been possible without the help and unending support of Professor Stefan Fölster. I am greatly obliged to him for all his guidance, patience and constructive advice during the entire process of writing this paper. His precious time spent in helping me through this course is invaluable.

I would also like to extend my deepest gratitude to my wife, whose continuous support motivated me greatly during my thesis work, and as a result of which, I was able to complete my paper successfully.

Sandeep Jain
# TABLE OF CONTENTS

1. Introduction .................................................................................................................. 1
2. Definition of debt sustainability .................................................................................... 4
3. Optimal debt-to-GDP ratio .......................................................................................... 4
4. Theoretical Framework ................................................................................................. 5
   4.1 Barro-Ricardo Equivalence ..................................................................................... 6
   4.2 Ramsey optimal policy ............................................................................................ 6
   4.3 Neo classical theory for public debt (Tax smoothing approach) ............................... 7
   4.4 A positive theory of fiscal deficit ............................................................................ 7
   4.5 Dynamic political economy theory ......................................................................... 8
5. Empirical Literature review ........................................................................................ 8
   5.1 Austerity and economic growth ............................................................................... 9
   5.2 Review of Ramsey optimal tax policy ..................................................................... 10
   5.3 Review of tax smoothing approach and political economy theory ......................... 11
   5.4 Review of new taxes versus new spending cuts ....................................................... 12
   5.5 Review of relationship between public debt and economic growth ....................... 13
   5.6 Age of Austerity ..................................................................................................... 15
6. The Simulation Framework .......................................................................................... 18
   6.1 The Simulation Literature Review ......................................................................... 18
   6.2 Cline’s Economic Model ........................................................................................ 19
   6.2.1 Comparison between Cline’s and Troika Projections ......................................... 20
   6.3 The Baseline Scenario ......................................................................................... 20
   6.4 The Simulation Exercises ...................................................................................... 22
   6.5 The First Package .................................................................................................. 23
   6.6 The Second Package .............................................................................................. 26
   6.7 The Third Package ................................................................................................. 28
7. Analysis ....................................................................................................................... 30
   7.1 The First Package .................................................................................................. 30
   7.2 The Second Package .............................................................................................. 33
   7.3 The Third Package ................................................................................................ 34
8. Conclusion ................................................................................................................... 36
References ....................................................................................................................... 40
Appendix A ...................................................................................................................... 46
1. Introduction

Our economic world is gradually trying to resurrect itself from the clutches of intense and extensive recession that has been on-going for the past few years. Many countries are facing very high fiscal debts. How long it will take for the countries to deal with their high debts is currently a hot topic during this tough economic situation the world over. This question has gained a great deal of importance especially, due to the current fiscal crisis and bailout packages provided to Greece. Many discussions have been held regarding the restructuring of fiscal debts, policies and measures already implemented in several other countries, and how they could be applied to deal with the Greek public debt. The debt-to-GDP ratios for many countries are increasing. Greece, Portugal, Ireland, Spain and recently Cyprus, are among the many countries which are experiencing large increments in their debt-to-GDP ratios. Among the G-7 countries, Japan, UK and the United States are expected to double their debt-to-GDP ratio as well, in the coming short period. The government of United Kingdom is discussing this issue seriously and has already implemented an austerity program to deal with this issue (Auerbach, 2011).

Greece is also trying to implement some austerity measures in order to survive in this current crisis before being forced to default. The International Monetary Fund, the European Central Bank and the European Commission are currently fulfilling the borrowing needs of the Greek government. It is however, difficult to understand the root cause or the factors behind this fiscal crisis. If this were possible, then the fiscal crisis could be dealt with in an effective manner and the austerity measures could then be enforced accordingly. The improper fiscal policy, poor domestic fiscal control and weak fiscal institutions have been the main critical factors resulting in this unexpected occurrence of fiscal crisis in Greece (Kaplanoglou and Rapanos 2011).

The Greek economy might not recover if it lacks more debt relief, as Greece is still recognised as a failure state. In 2012, private sector bondholders cut their “nominal claim” by 50%, but this did not include huge amounts of bond holdings by the European Central Bank. Now, 70% of the Greek debts are owed to the European governments and the IMF. The probability of the repayment of debt is shrinking, as is the Greek economy. According to the latest forecast from the Greek government, in 2014, their debt-to-GDP ratio will reach a level of 190%. This is already 30% higher than the IMF prediction that was made in June 2012. This debt burden may not reach a sustainable level in a reasonable timespan, unless the Greek government gets additional time relief from the European governments, especially from Germany, to implement its austerity measures (“Greece debt burden”, 2012).

In order to reduce the budget deficit, policy makers try to implement austerity measures either by raising taxes or by cutting expenditures. Policy makers should aim to find the right proportion of tax and spending, as it is very important according to the economic and political theories. It is also well known that economic activities tend to be reduced when taxes are
raised, and that not every bit of spending by the government leads to economic growth. Due to this, it is imperative to understand the effect of fiscal austerity on the economic growth (Glomm, Jung, and Tran, 2012).

Short-term measures are clearly attractive, but countries like Greece have had to look ahead of these in regards to the need of urgent fiscal adjustments. Local economists are not in favour of the recent austerity measures of salary and pension cuts. According to them, reductions in spending would cause an even bigger drop in the economy (“Toil and trouble,” 2012). Policy makers and establishments have been quite occupied in solving the debt crisis of Greece, but they are not even close to finding any solution, which can lead the Greek economy to the path of recovery. There is an on-going discussion within the economic world regarding the austerity measures implemented in Greece – that they are not strict enough to help Greece lower its debt-to-GDP ratio to 120% within a sensible timespan. On the other hand, severe austerity measures could cause a negative blow to the economic growth and the result of this could cause the Greek political authorities to face extensive challenges. The economic world is still sceptical about whether the austerity objectives would ever be met by the government of Greece (Rogers and Vasilopoulou 2012).

A few months ago, the Greek parliament agreed to pass the austerity budget for 2013. This budget has provided little relief as well as rescue funds to help avoid the proximate collapse of the Greek economy. If the austerity budget was unapproved by the parliament, then Greece would have lost about €31.5 billion ($40billion) from its bailout package and would have then gone default on the next repayment of its debt. This would have surely resulted in the exit of Greece from the Eurozone. In December 2012, the European Union, the European Central Bank and the IMF gave the Greek government a deadline of four months to conduct negotiations regarding the bailout package to be implemented in 2013 and 2014. The Greek government suggested cuts in their operating costs, but these were not approved. These cuts have been changed to “permanent spending reductions” by cutting down salaries and pensions. In this way, Greece could save €4.6 billion this year by reducing its pensions. Salaries in the public sector were supposed to be reduced by 35% and the highest limit of a salary has been fixed at €5000. According to the 2013 budget forecast, the Greek economy is expected to shrink by another 4.5% this year (“Toil and trouble,” 2012). Due to these reasons, I think Greece would be the perfect candidate for carrying out the quantitative analysis needed for this paper.

As there have been many recent, continuing discussions regarding the debt reduction strategies that should be further implemented in order to achieve sustainability of the Greek public debt, a study of this would definitely be very useful and necessary for both Greece and its creditors. This study should help them determine the best debt reduction strategy to implement in the different economic scenarios. Through applying this strategy, they could then possibly achieve sustainability of the public debt within a reasonable time period. As I have been following these discussions closely, I believe it would be very purposeful to evaluate
the impact of the different austerity measures on the Greek economy. Keeping this in mind, this paper deals with the following research question:

Which debt reduction strategy would be the most favourable for both Greece and its creditors in achieving sustainability of the Greek public debt in a reasonable timespan?

For this paper, a simulation framework of a small open economy has been executed in order to find the answer to the research question. The three debt reductions strategies, (the lowering of interest rates, debt write-off and increasing the primary surplus) which have been taken from the latest simulation literature review are considered while carrying out simulation exercises. Data regarding the Greek public debt indicators with some projections for the period of 2010 to 2030 has been used as a benchmark for this simulation framework. A debt simulation model (Appendix A) has been implemented for this paper and this is based on the economic model presented by William R. Cline, (2011). He is an American economist who has been working as a senior associate at the Peterson Institute for International Economics since 1981 and has a joint position at the Center for Global Development. He has also worked as a deputy managing director and chief economist of the Institute of International Finance, Washington, DC. Dr. Cline has been responsible for numerous publications and his main research topics include capital flows, debt relief, the environment, finance, international financial institutions, trade and development as well as the economics of global warming (Peterson Institute, 2013). In his 2011 paper titled ‘Sustainability of Greek Public Debt’, Cline has made several projections regarding the public debt indicators. Troika on the other hand, has projected differently in the same period. The comparison between these projections has been explained in section 6.2.1 of this paper.

Cline has assumed that the growth rate of Greece generally increases from 2.1% to 3% during 2013 to 2020. However, the growth rate (g) can also depend on the extent and form of austerity according to the literature review. When considering this, Cline’s model seems to be a mechanistic application with national accounts, and the IMF and other financial commissions often use this type of model. Subsequently, the main contribution of this paper is to conduct simulation exercises where g is made endogenous and is dependent on the extent of austerity. This should help in the analysis of how the results from the research regarding the connection between austerity and growth, would then affect the sustainability of the Greek public debt. Also, in order to analyse results for the long-term basis as well, the time period that Cline used in his paper, which is from 2010 to 2020, has been extended to 2030.

The following sections give an overview of this paper; Section 2 deals with the definition of debt sustainability, Section 3 reviews the optimal debt-to-GDP ratio, Section 4 introduces the theoretical framework, Section 5 discusses the empirical literature review and Section 6, is where the simulation framework has been carried out. The final two sections present the analysis and conclusion.
2. Definition of debt sustainability

Debt sustainability is generally defined as the capacity of a country to encounter its debt commitments without requiring debt relief or enlarging amount overdue. The IMF describes a debt as being “sustainable if it satisfies the solvency condition without a major correction given the costs of financing” (IMF, 2002). Debt solvency is achieved when a country can pay back its debt, principle and interest through future primary surpluses. More specifically, “solvency requires that the current debt plus the present discounted value of all expenditures does not exceed the present discounted value of all revenues (or, equivalently, that the current debt not exceed the present discounted value of future revenues net of non-interest expenditures)” (Wyplosz, 2005).

As sustainability builds upon solvency, it therefore needs to be completely forward-looking. In this case, future balances matter only, and not the past and the current debt level. All this depends upon the future primary balance and if the debts can be paid back. Sometimes, a country might not be able to sustain even small debts and sometimes even huge debts can be paid back. In fact, most economies carry large debts and at times, these debts can be long lasting (Wyplosz, 2005).

3. Optimal debt-to-GDP ratio

In this section, the sustainability level proposed by the IMF is discussed, together with some examples highlighting the reasons why this level has been considered when making fiscal policies. Some sensible limits have been recommended for the optimal level of debt-to-GDP ratio in present discussions regarding fiscal consolidation. Such levels usually originate from work carried out by the IMF staff, but it does not mean that IMF formally approves these levels themselves. A public debt-to-GDP ratio of 60% is normally considered a sensible limit for developed nations. This limit suggests that the fiscal sustainability would be under risk if the debt-to-GDP ratio crosses the level of 60%. On the other hand, for developing nations, a ratio of 40% has been recommended for long term (Chowdhury and Islam, 2010). In April 2010, the Fiscal Affairs Department of the IMF took account of these ratio levels in its report, and suggested expressive fiscal adjustments for both the developed and developing countries in order for them to reach these proposed levels of debt-to-GDP ratio by 2030. Thus, there is now a trend to consider these ratio levels as being the optimal level of debt-to-GDP ratio and that crossing these benchmarks can threaten the sustainability of public debt (IMF, 2010).

Furthermore in the 1990s, when preparing for the economic and monetary union and then the ultimate creation of the Eurozone, the 60% level of debt-to-GDP ratio was one of the goals set by the European governments. This ratio was considered a median debt-to-GDP ratio and there was no mention of an optimal ratio. A report from the IMF, however, did not clarify the base for this proposed level of debt-to-GDP ratio for both the developed and developing countries. Nevertheless, it was noted in the ‘Sustainability framework’ of the IMF carried out
in 2002, that the 40% level of external debt-to-GDP ratio provides a worthwhile benchmark. However, this report also emphasized that the debt-to-GDP ratio crossing the 40% level does not necessarily indicate any crisis. Actually, there is an 80% possibility of not having any crisis even if the public debt-to-GDP ratio surpasses the 40% level (IMF, 2002).

Belgium had the highest public debt-to-GDP ratio in 1988. Japan had 60% in the same year and this rose to the highest debt-to-GDP ratio of a 170% in 2007. Italy also had more than a 100% debt-to-GDP ratio in 2007 (OECD, 2008-09). Even though these countries had a rather high debt-to-GDP ratio, these countries still did not face a high rate of interest or inflation which commonly occurs during the rise of government fiscal deficits. Japan on the other hand, experienced just the opposite, a deflation and a zero rate of interest. It was noted that a very low inflation was one of the reasons that had caused a high level of debt-to-GDP ratio in Japan (Chowdhury and Islam, 2010).

Moreover, a reasonably high inflation rate could increase the nominal GDP and lower the debt-to-GDP ratio, except in the situation where gross liabilities of the government increase. It is generally asserted that higher public debts at present have to be repaid through higher taxes in the future. This statement is not true in some circumstances, where an increase in the nominal GDP is higher than the interest on the debt. In such cases, there is no need to repay debt as this would decrease part of the GDP (Chowdhury and Islam, 2010). This was also claimed by Evsey Domar about 69 years ago, when he stated that “the problem of the burden of debt is essentially a problem of achieving a growing national income” (Domar, 1944).

In addition, it has been often argued that high public debts lead to a lower growth, but this is not completely based on strong empirical evidence. In July 2010, a report was published by the IMF, in which a study on the developed and developing economies had been carried out during the period of 1970 to 2007. They discovered that the elasticity of growth is only -0.02 with respect to the debt. This study also discovered that the elasticity of growth with respect to years of schooling, adds positively to growth and is more than 2.0 (Kumar, Singh and Woo, 2010). Therefore, the negative effects on growth due to a percentage increase in the debt-to-GDP ratio can be easily overcome by a percentage increase in the growth-endorsing variables attained by public spending. It is therefore, vital to consider the structure of debt, instead of focusing just on the total value of debt (Chowdhury and Islam, 2010).

4. **Theoretical Framework**

Different theories regarding the optimal policies for austerity measures, that were suggested in the past and discussed by the different researchers, have been highlighted in this section.
4.1 Barro-Ricardo Equivalence

We are considering a very simple theory of debt here called the Barro-Ricardo Equivalence. According to this theory, the path of the debt and the timing of government spending and taxes do not matter so much, and only the present discounted value of these things is vital. Households tend to incorporate budget constraints implemented by the government and save in order to pay the expected prospective taxes. David Ricardo first suggested this idea in 19th century and it then became more prominent in 1974, through a paper “Are Government Bonds Net Wealth?” written by Robert Barro (Government debt, 2010). In this paper, he claimed that output could not be affected by debt-financed tax cuts, as households would probably use the increased net income to save for future increased taxes. This was quite noticeable in the early 1980s, when the economic strategy of the government was centrally based on the debt-finance cuts (Barro, 1974).

Since the difference between spending and taxes completely determines the time path of government debt, this theory claims that the optimal path of government debt is indefinite. Only the present discounted value of taxes and spending is taken into consideration. The Barro–Ricardo equivalence is based on three main assumptions and are given below:

1. Households and governments can borrow and lend according to their needs, without creating any effect on the real interest rate in a perfect capital market.
2. Households are either generous towards their children or they live eternally.
3. The government can implement the policy of lump-sum taxes.

Since the Barro-Ricardo Equivalence calls for households and governments to remove the transition hurdles completely for spending and taxes, a perfect capital market is thus very important. If households were not generous towards their children and did not live eternally, they would not save or leave behind enough for their children to repay the debts and would then only consume entirely from a debt financed tax cut. Ultimately, if a government cannot implement the policy of lump-sum taxes, then the hefty taxes would cause large damages and could force the government to implement low taxes to spread out the burden of the debt over a period of years (Government debt, 2010).

4.2 Ramsey optimal policy

In the Ramsey optimal policy, only distortionary tax (excise tax) is available to the government. The government must be able to obtain a particular amount of “revenues in the least-distortionary manner” (Government debt, 2010). Ramsey considered a consumer economy consisting of several goods. A government needs one of each of the several goods in a fixed quantity, and these goods are purchased at given market prices. Revenue to buy these goods is collected through excise taxes and these taxes are charged at a flat rate on the consumption goods. This is based on the assumption that the quantities and prices for these goods are set up competitively for any given form of excise taxes. Ramsey sought after patterns of excise taxes that would give the maximum utility to the end user, and thus reduce
both the “excess burden” as well as “welfare cost” of taxation (Lucas and Slokey, 1983). The “Ramsey optimal policy could help in finding the optimal path of government debt through finding the optimal path of tax revenues” (Government debt, 2010).

4.3 Neo classical theory for public debt (Tax smoothing approach)

Barro (1979) first introduced this theory. It states that the government should not modify its taxes too often and drastically; otherwise, an economy would be “subject to shocks to preference and/or productivity”. Drastic and quick revision of taxes is ineffective because of the convexity of the “deadweight cost of taxation in the tax rate”. The optimal policy states that governments have deficits during the period of time when government spending is high, and that governments have surpluses when government spending is low (Battaglini and Coate, 2008). In the determination of public debt issue, the main hypothesis of this theory is that, for instance, when there is a temporary increase in government spending due to war, there is a consequent positive effect on debt issue. There is then a negative effect due to the temporary increase in income, and this results in a “countercyclical” reaction to the debt issue. In addition, this also creates a “one to one effect created on the growth rate of nominal debt due to expected inflation rate”. This theory also pointed out that debt–income ratio would not affect the growth rate of debt. However, the level of government expenditure would affect growth rate of debt slightly (Barro, 1979)

4.4 A positive theory of fiscal deficit

In Barro (1979) and in Lucas-Stokey (1983), public debt has been “modelled” as a way of sharing out tax distortions over a period of time. Barro (1985, 1986, and 1987) has revealed that in the late 1970s, the conduct of public debt in both the United States and in the United Kingdom could be described pretty well based on this ideal theory of fiscal policy. However, this theory failed to give satisfactory reasons to two current topics - (i) the current speedy amassing of government debt in the course of peacetime in many industrialised nations, including United States and (ii) the huge differences in the debt policies practiced by different states having similar economic situations. To help understand these scenarios, Alesina and Tabellini (1990), proposed a positive theory of fiscal deficit and government debt, and this has provided a valuable glimpse regarding the reasons behind these specifics. The authors, however, did not consider the assumption regarding the fiscal policy which generally, is set up by generous social planners who always think about maximising the welfare of an end–user. Also, they had considered an economy which had two different policy makers - each having different intentions due to a discontinuity at the workplace that resulted from the outcome of elections (Alesina and Tabellini, 1990).

The main idea of this theory is that, when there is a dissimilarity of thoughts between the recent and future policymakers, each government tries to use public debt in such a manner that it can manipulate the options of the future government. Due to disagreements between
the recent and future policymakers as well as doubt regarding the future appointment of the policymakers into office, this stops the current government from completely “internalising the cost of leaving debt to the future government”. This leads to the situation where the equilibrium stock of public debt becomes larger than it is optimally required in the social context. In short, it can be seen that a deficit bias in democratic countries occurs due to disagreements among the citizens, and is not due to their limited knowledge regarding public debt. This theory also suggested that due to the differences in the political institutions the world over, the diverse debt policies implemented or practiced in the various democracies or by the same nation during different phases of time, might be better understood. The result of the economic model used for this theory showed that, if the equilibrium level of public debt were likely to be larger, then the degree of divergence between future and current government debt policies would also be large. Due to this, the current government may not be re-elected, as the public consumption would strictly decrease (Alesina and Tabellini, 1990).

4.5 Dynamic political economy theory
Battaglini and Coate (2008) suggested this dynamic economic theory of public spending, taxation and debt. This theory has been derived from the famous tax smoothing approach to fiscal policy first established by Barro (1979) and takes into consideration the analogous economic environment as mentioned by Barro (1979). Here, the government body, instead of a generous planner, makes the decisions regarding policies. Furthermore, this theory assumes that the revenue collected could be disseminated back from the government bodies to their districts, where they have been collected through “pork-barrel spending”. (Pork barrel is a type of government spending for local ventures protected exclusively or mainly used to gain revenue in a representative's region).

Moreover, this theory assumes that a government body, whose members are chosen through ballot by “single member, geographically defined constituencies”, undertakes the policy decisions. These representatives (legislatures) try to collect their revenue in two different ways: they either charge a proportional tax on the income earned by a worker, or they borrow funds by issuing risk-free one period bond from the capital market. They can also choose to buy bonds, and use the earnings obtained from the interest, to finance the public spending for the upcoming years. Public revenue is used for the welfare of all citizens by financing the provision of public goods and for “pork-barrel spending”. It is however, not easy to determine the value of the public goods provided to citizens, especially during unexpected circumstances, for example, in the case of wars or natural catastrophes. The governing body therefore, enforces the policy decisions according to majority rule (Battaglini and Coate, 2008).

5. Empirical Literature review
This section presents the various views, discussions and methodologies proposed by the researchers to argue the pros and cons of the different austerity measures and their
relationships with some of the public debt indicators. Furthermore, a review of the optimal policies by the past researchers has been discussed; where most of the studies have concluded that the implementation of austerity measures has a positive effect on optimal growth path of the public debt.

5.1 Austerity and economic growth
There is a significant discussion on-going regarding the current state of tension between economic growth and fiscal austerity. Conventional macroeconomic theory states that if austerity measures are implemented at the lowest point of a recession, then the economic depression might be aggravated and long lasting (Posner and Sommerfeld, 2012). However, according to the famous economist Alesina, “consolidation can usher in expansionary contractions that boost growth by enhancing confidence in a nation’s credit and currency” (Alesina and Perotti 1995). Countries may have to consider both a sharp increase in public deficits and debts, as well as the weakness of the economy, if consolidations are to be prompted. According to the findings of some studies, fiscal consolidation occurs due to the weak economy and high unemployment (Larch and Turrini 2008; Guichard et al. 2007).

On the other hand, some studies are more optimistic and argue that governments most probably introduce consolidation during the period of good economic conditions (Hagen and Strauch, 2001). In addition, a study about the largest consolidations discovered that growth rates had an upward start even before the fiscal contraction had started (Blochliger, Song, and Sutherland 2012). According to the hypothesis of economic crisis, most of the countries introduce consolidation during the periods when the economy of the respective nation is beginning to come out of recession. During these periods, the reduction in deficit through the lowering of the interest rates in both the markets and the central banks can help in increasing the growth rate (Hagen and Strauch, 2001).

In 1994, Sweden carried out major deficit reductions when its economy started to return to growth after a deep recession. Proper timing in the fiscal consolidation can revive the economy by creating confidence in central banks and worldwide markets. Between 1994 - 1998, the interest rates on the Swedish government bonds fell from 10% to 5% (Lilico, et al. 2009).

85 consolidations were implemented from 1978 to 2007 among the OECD countries and half of them were persistent enough in stabilising the debt-to-GDP ratio for at least two years (Guichard et al. 2007). If consolidations occur at the right time, they can also lead to political benefits. Implementation of big cuts and increases in taxes by the governments, can lead to substantial improvement in economic growth, and this can defend the decision of fiscal austerity. This happened similarly in 1993, when Bill Clinton, the former president of USA, passed the deficit reduction law. This gave a big, positive drive to the growth of the growing US economy and resulted in lifting all the fiscal constraints (Posner and Sommerfeld, 2012).
George H.W. Bush, the U.S. president before Bill Clinton, meant to begin the consolidation programme in 1990, when the U.S. Economy was on the decline. However, he was unsuccessful in driving the economy progressively for the last two years of his electoral period, in spite of large cuts and an increase in taxes. The deficit increased even more due to the weaker economy during the first few years and Bush was therefore, unable to achieve appreciation from the fiscal progress during his years in office, even though the implementation of his fiscal measures had helped to kick start the growth. Bush lost the election to Clinton in 1992, as he was unable to claim the credit for putting the U.S. economy on the growth path. So ultimately, economies that implement sustained consolidations, can gain considerable gains over time (Posner and Sommerfeld, 2012).

Figure 1: Deficit/surplus as a percentage of GDP (2000-2010)

As we can see from the figure above, by 2010, the surplus nations slid into deficits with a median rate of 2.8% of the GDP, as compared to 4.8% of the OECD nations altogether. Also, 9.2% of the group of nations had never-ending deficits between 2000 and 2010 (Posner and Sommerfeld, 2012).

5.2 Review of Ramsey optimal tax policy

Turnovsky and Brock (1980), Barro (1979), Kydland and Prescott (1977), and Pigou (1947) pointed out that the optimal policy by Ramsey could be useful with regards to the study of fiscal policy over a period of time, that is if several goods being levied were considered a single combined good for consumption. In this situation, the taxes charged at a given level during the “period t” are considered excise taxes on the “good t”. This is since the taxes collected in this given period of time would generally, not be placed optimally equivalent to the consumption of the government in that same period of time. Here, the “theory of optimal taxation can be considered as a theory of optimal use of public debt”. Phelps (1973), Friedman (1969), Bailey (1956) and Calvo (1978) observed that the Ramsey optimal policy could be used in the study of both fiscal and monetary policies, that is if one could consider the “holdings of
cash balances” as consumption of a second ‘good’ on each day. The ‘inflation tax’ set off by the expansion of monetary policy would then be recognised as a regular excise tax.

Tax rates on the different goods are charged at the same time in the framework of the Ramsey theory. This assumption can only be applied in the inactive situation described originally by Ramsey in his theory. Nonetheless in reality, this is not so because each government sets its own tax rates and policies, and cannot force the next incoming government to follow them as well (Lucas and Slokey, 1983) Kydland and Prescott (1977) have shown through a sequence of explicit instances, that there would be a drastic difference in policies, if we consider the dynamic framework instead of a static framework as suggested by the Ramsey theory. A government may be unwilling to continue with the tax policy it found optimal initially, particularly, if it has second thoughts about the optimal tax policy frequently. Stortz (1955-1956) argued that the optimal tax policies in Ramsey’s framework are “time inconsistent”.

Time inconsistency takes place when the best tax policies for the future are announced in the present, but are actually carried out in the future. The traditional problem of ‘capital levy’ is the main reason for the time inconsistency of optimal tax policies. Lump sum and non-distorting taxes are assumed to be unavailable in Ramsey’s policy. It is always better to charge an excise tax on inelastic goods in terms of both demand and supply, in order to tax ‘pure rents’. In a dynamic situation, capital used for goods that are produced in the earlier period, always consist of time inconsistency and therefore its gains are “optimally taxed away”. The optimal model of capital accumulation should not be encouraged if the future announcement of such impound taxes is made (Lucas and Slokey, 1983).

5.3 Review of tax smoothing approach and political economy theory
Barro (1979) assumed in his analysis, that a government can perfectly foresee its unpredictable spending needs. Aiyagari et al. (2002) in their paper, undertake the most appropriate concern of uncertainty. Integrating political decision-making in a way as mentioned in the political economy theory, has helped to resolve a significant theoretical complexity involved in the tax smoothing approach. This was first observed by Aiyagari et al. (2002). They revealed that the tax smoothing idea does not necessarily mean the “countercyclical theory of surplus and deficits” as it was assumed previously in Barro (1979). The optimal policy in some situations helps governments attain enough bond holdings. The government can thus, finance its spending through the interest earned on these bond holdings. “Distortionary taxation” can also be avoided in order to finance its spending. Surplus earnings from the interest exceeding the spending requirement can then be distributed to their citizens through lump sum money. The forecast regarding a steady state having a large accumulation of government assets with no taxes is therefore unacceptable. This forecast can be avoided if exogenous restrictions are enforced regarding the amount of the debt held by the government (Battaglini and Coate, 2008). Aiyagari et al. (2002) clearly disapproved these as being “ad hoc”. This gives the impression that legislators assigned a huge amount of government assets could try to decrease
them by distributing the proceedings back to their constituencies. This frames the core of the political economy theory. Due to no “ad hoc” debt restrictions, the political equilibrium consisting of government bond holdings with respect to long run levels is lower than the efficient level. In addition, a dynamic model is exhibited by the equilibrium policies as proposed by Barro (1979) where, when the “value of the public good is high, the debt goes up” and vice versa. Furthermore, the debt works towards achieving smooth taxes (Battaglini and Coate, 2008).

5.4 Review of new taxes versus new spending cuts
Discussions on the fiscal austerity, especially by the European Union, have gone too far without gaining any conclusive results. The magnitude of deficit reduction has been the centre of discussion among many economists. But, according to Alesina and Giavazzi (2012) policy makers should focus on both budget contraction options of relationship between taxes and spending cuts, as well as policies related to this composition. Therefore, how far a government should go with its austerity measures in order to achieve an optimal path of government debt has now become quite a current hot topic of discussion in the present economic world (Alesina and Giavazzi, 2012).

At this time, economists are engaged in dynamic arguments regarding the measurements and the evaluation of the effects of huge fiscal austerity measures that have been carried out in the European countries. Researchers have accumulated data of austerity measures for the past 40 years across the OECD countries and this has helped them gain a better understanding about some “uncontroversial” topics, regardless of the different approaches adopted by the different countries. Firstly, the austerity measures attained via an increase in taxes are more recessionary than those attained through spending cuts. Secondly, consolidations based on spending cuts and with connections to the right policies are less recessionary. Sometimes, these consolidations even create an optimistic impact on the growth path. These policies comprise of “easy money policy, liberalisation of goods and labour markets and other structural reforms”. A lot of research is needed to recognise both the right policies which can be used during consolidations, as well as a clear understanding of the different ways through which spending-based stabilisations could be encouraged. Thirdly, “permanent consolidations of the budget” could be achieved through spending-based austerity measures only (Alesina and Giavazzi, 2012). The IMF has also given its consent in two recent publications, where in fact, spending-based austerity measures worked in reality. This is not due to the austerity composition, but more or less just “by chance”. This is since spending-based austerity measures accompany either a decrease in long-term interest rates, or stabilization of exchange rates, the stock market and sometimes, all of these (IMF, 2010, and Devries et al, 2011).

Alesina and Giavazzi totally disapproved this argument because interest rates, exchange rates, the stock market and financial prices tend to react according to the declaration of fiscal policy, and thus cannot be considered exogenous. For example, if investors predict accurately and
believe that permanent consolidation of the budget is due to spending-based measures only, this will in return give a positive boost in confidence. This will consequently lead to a reduction in interest rate and an increase in stock prices. One can therefore, get more realistic proof by comparing the different kind of fiscal austerity measures on “output and on confidence”. The austerity measures based on taxes have not gained much success, as they failed to restrict the growth of the debt-to-GDP ratio (Alesina and Giavazzi, 2012).

When declaring fiscal packages, the confidence of entrepreneurs dips drastically, and this is observed when the output also falls. In contrast, measures based on spending (if they are accompanying the right policies at the same time), affect the economic confidence positively at the same time. These tend to increase the output within a period of one year. This can be seen in the case of some European nations, where the revenue from taxes over GDP is near 50%. In such situations, these countries do not have any scope left for raising additional revenue from taxes (Alesina and Giavazzi, 2012). Besides, a recent study has shown that many European countries have already reached the top of the Laffer curve. Subsequently, any increase in the tax rate could result in a very low increase in the tax revenue, and a possible downturn of the economy (Uhlig and Trabandt, 2012).

Hence, if we consider all the above-mentioned points, it is high time arguments regarding the level of austerity programmes are stopped. Even a minimal tax-based austerity can cause a huge decline in the economy compared to one, which is caused by a large austerity programme based on spending cuts. Similarly, a little adjustment in spending can stabilize the debt-to-GDP ratio more effectively than a huge tax-based adjustment (Alesina and Giavazzi, 2012).

5.5 Review of relationship between public debt and economic growth
Austerity is usually justified where high public debt results in the slow growth of a nation. A recent study presented by Panizza and Presbitero (2012) states that this fact might not really stand in reality. It could be such that the high public debt occurred due to a slow economic growth. According to the authors, the policy makers should be cautious when cutting of debts, particularly, if it is needed in order to enhance the growth. Does a high level of public debts decrease the economic growth? This is a vital policy question regarding the relationship between public debt and economic growth, and always surfaces whilst making fiscal policies. An affirmative reply would suggest that the expansionary fiscal policy, even if it is useful in the short run and increases the debt-to-GDP ratio, might actually decrease the growth in the long run. Hence, it could partially or entirely undo the positive outcomes of the fiscal incentives (Panizza and Presbitero, 2012). Generally, the empirical literature in the recent years shows that there is a negative relationship between economic growth and public debt. This adverse relationship becomes even more evident in a situation when the debt reaches 100% of the GDP (Reinhart and Rogoff, 2010a, 2010b; Kumar, Singh and Woo 2010; Cecchetti et al., 2011).
According to Krugman (2010), the relationship between debt and growth does not indicate any causality. The statement that the levels of public debt increase due to low economic growth can motivate the relationship between growth and debt. Panizza and Presbitero (2012) suggest a new instrument variable that is usually established by economists in order to present relationships between debt and growth. This instrument variable has helped the authors to discard the concept that high debts lead to slow economic growth among the OECD countries. Panizza and Presbitero (2012) also verify the negative relationship between debt and growth, which has also been noted in other earlier studies. In addition, their paper shows that “debt does not have a causal effect on growth”. The authors have applied an econometric model in order to reject the statement that “debt has no growth effects”, in order to answer to the question mentioned above. The result of their model showed that this statement could not be rejected. In fact, there is no paper available in the literature regarding the debt and growth relationship that could strongly argue, “debt has a causal effect on economic growth” (Panizza and Presbitero, 2012).

Panizza and Presbitero (2012) have not found any indication that future growth in advanced economic nations has been damaged by the high public debt. Hence, considering the current outcomes, the relationship between debt and growth should not be discussed as a supporting argument when considering fiscal consolidation. However, this paper also claims that it does not mean that countries can maintain any level of debt when there is no adverse effect of public debt on economic growth. There must be a level of debt, after which this debt cannot be sustained and similarly, there must be a level of debt-to-GDP ratio after which all distortionary effects of debt tend to start. The sample used in this paper, regarding advanced economies, is still less than the particular country’s debt limit and after this limit, the debt begins to have an adverse effect on economic growth (Panizza and Presbitero, 2012).

When there is “multiple equilibrium”, a government with full funds and a high level of debt might decide to implement a restricted fiscal policy. This policy is implemented with the view of trying to reduce the probability of having a bad equilibrium in the country, in case the sentiments of investors would change. These restricted fiscal policies may reduce economic growth (Perotti, 2012). But, these same policies could also turn out to be failed policies, and can consequently raise the debt-to-GDP ratio (DeLong and Summers, 2012).

In this situation, it would be correct to say that debt decreases growth because the high level of debt paves the way towards uncertainty and restricted policies (Panizza and Presbitero, 2012). Ultimately, this analysis gives good reason to understand that long-term policies are normally planned with the aim of reducing the levels of debt. It is also been noted that contraction policies should not be implemented during the time of recession, as these policies are the cause of the negative effect of public debt on economic growth. However, at times, policy makers may have no other choice, but to implement these policies due to the demand and pressure from actors in the market (Panizza and Presbitero, 2012).
5.6 Age of Austerity

The relationship between the improvement in an economy and the decline in deficit is termed the age of austerity. Debates regarding a speedy fiscal consolidation, about whether it is of help or is an obstacle in the path of a weak economic recovery, are a current hot topic during this time of global recession. In other words, is a policy of rapid deficit reduction a requirement for sustaining the economic recovery or is it a clash with the intention of sustaining the economist would recovery? This could be a requirement if we carried out instant, large cuts that in turn, could assist the government to sustain its credibility in the market and prevent the interest rate from increasing further. Economic recovery could thus be sustained. In addition, the implementation of austerity measures helps in increasing the private investments, as these measures may strengthen the economic recovery by improving the confidence of the private investors and make them more positive about the economic growth in the future (Kitromilides, 2011).

Alternatively, the aim of deficit reduction by carrying out large spending cuts and trying to maintain the economic recovery, might clash with other spending cuts that are “too much and too soon”. These have a considerable negative effect on the economy, as well as on the confidence prevailing in the private investors. This may then lead to the end of the economic recovery and a plausible “double dip recession”. In the case of a negative response of the market caused by a lack of large spending cuts or large cuts, this could lead to a “double dip recession”. Both these situations lead to the termination of recovery and there is no effect of accelerated reduction in deficit. Now, which situation is more likely to occur? Would economic recovery be more risky or less risky, depending on whether fiscal austerity is implemented or not? These questions and arguments supporting the “age of austerity” strategy have been evaluated in the following arguments (Kitromilides, 2011).

Firstly, the New Consensus Macroeconomics (NCM) has suggested, in its theoretical framework, that the flexible fiscal policy is a useless tool used for stabilising policy (Arestis, 2007). This means that a modification in the fiscal stand will not affect the aggregate demand and the conventional Keynesian multiplier effect would be negative or near to zero. Theoretical opinion and empirical evidence behind the idea of the “crowding-out” effect have been used to justify this conclusion. This has been further strengthened by the Ricardian equivalence theory given by Barro (1974). Here, the effect of a government’s deficit spending does not increase the aggregate demand, as this same effect is offset by a decrease in the demand in the private sector at the same time. Consequently, there would be a decrease in private investments due to an increase in interest rates (“crowding out”), resulting in a decrease in private consumption as well. The private sector would also start to save more in order to pay future taxes (“Ricardian equivalence”). In the same way, the fiscal contraction achieved by reducing the budget deficit would not affect the aggregate demand, because an effect on it, is caused by the contraction of fiscal policy, which would be offset by a decrease in savings, which is a result of lower interest rates (Kitromilides, 2011).
During the 1930s, the period of recession, deficit spending by government was not advised, as this spending did not lead to any increase in aggregate demand. Fiscal contraction during weak economic recovery, however, was acceptable, as it had no tightening effect on the aggregate demand. Arestis (2009) criticised the theoretical and empirical basis of the abovementioned conclusion after studying the latest theoretical improvement and empirical facts. The author concluded that a demotion of fiscal policy by (NCM) is not reasonable, as there is very little theoretical and empirical support to recommend that fiscal policy should not be applied as a tool for stabilising policy (Arestis, 2009).

Secondly, Reinhart and Rogoff (2010), in their research paper named “Growth in a Time of Debt”, studied the relationship between public debt and economic growth. They noted that the median growth rate decreases by 1% when the ratio of debt-to-GDP goes over 90%. Hence, fiscal austerity measures are needed to avoid debt accumulation from going over this limit, and to prevent a negative effect on economic growth. They also said that nations with a debt-to-GDP ratio above this level would contract by approximately 0.1% yearly (Reinhart and Rogoff, 2010). In 2009, three countries from the Eurozone went over the limit of 90% - the debt-to-GDP ratio in Italy was 115.8, it was 115.6 in Greece and 96.7 in Belgium. Three other Eurozone countries approached this limit as well, where France had 77.6, Portugal had 76.8 and Germany had 73.2. Countries outside the Eurozone like the United Kingdom for instance, had 68.1% and the United States had 83.29%. If we consider the limit specified by Reinhart and Rogoff (2010), it appears that these economies could possibly face trouble soon (Kitromilides, 2011). Nevertheless, this was not the case during the period immediately after World War II. The debt-to-GDP ratio in the U.K. and the U.S. had considerably passed the 90% limit but this had not caused any negative effect on the economic growth. Lately, however, Japan has succeeded in combining its debt-to-GDP ratio of close to 200% with low interest rates (Kitromilides, 2011).

Recently in April 2013, there has been also a lot of controversy regarding Rogoff and Reinhart’s paper “Growth in a Time of Debt”. Three economists Thomas Herndon, Michael Ash, and Robert Pollin from the University of Massachusetts, repeated the research conducted by Reinhart and Rogoff. They noted that the “coding mistakes and selective omission of available data, lead to severe errors that incorrectly represent the relationship between public debt and economic growth among twenty advanced economies in the post-war period.” These economists found that the average real growth rate for economies having a debt-to-GDP ratio of above 90% is actually 2.2%, and not -0.1%. Also, there is a major nonlinearity in the relationship between public debt and economic growth. Reinhart and Rogoff have admitted that these 3 named economists are correct in recognising the mistake, but also argued that their findings did not still change the basic message of the paper (CNBC, 2013).

Reinhart and Rogoff (2010) favoured a long-term fiscal consolidation, rather than an immediate, rapid reduction of deficit through the period of a weak economic recovery. However, Rogoff (2010) disagreed with this view and claimed that immediate measures are
required because markets could be both volatile and rigorous, and could react suddenly due to the accumulation of debt. Hence, a clear, kind market environment could disappear all of a sudden, if a nation moves towards its maximum limit of debt. As a result of this, rapid fiscal consolidation might be an unnecessary risk and fiscal contraction may then be required (Rogoff, 2010).

Finally, continuing with the arguments favouring the support of a rapid adoption of the “age of austerity” strategy, it is noted that a high level of budget deficit in a normal time as well as a high level of debt accumulation, can make the world’s financial market very volatile. In response to this, governments try to make and implement policies that are credible to the financial markets. Bond markets and credit rating institutions should be convinced about these policies, so that they can evaluate the credibility of deficit reduction arrangements by the democratic governments. Markets generally expect governments to deal with their problems seriously, and then to formulate policies according to them, as this suggests a willingness to implement fiscal austerity adjustments. There may be a clear interaction between the condition of public finance and the stability of the banking system, which might affect the sentiments of the market. For example, this was needed during the financial crisis of 2007, where the stable banking system was in danger of collapsing and its effect on borrowing requirements of the government, as well as on the situation of public finance could not be avoided (Kitromilides, 2011).

A collective increase in public debt, including doubts over the capability of the government in dealing with an upcoming banking crisis, can generate more apprehension in the market. This can lead to further increased uncertainties in both the borrowing capacity of the independent nations, as well as the stability of the banking sector. This pattern occurs frequently in similar situations. Trichet (2010) states that the ECB calculated the total amount of “taxpayer risks” allocated in order to sustain the financial sector during the financial crisis in 2007 and they were totalled to 27% of GDP. Due to these reliable public finances, governments were successful in avoiding a financial crisis. Hence, fiscal consolidation is very critical when handling future crisis and risks of melt down of the financial system. However, this statement can go wrong if the market believes that the “age of austerity” strategy is not productive. This might lead to more damage than calming down the volatility in the market, and at the same time, also change the view regarding credible policies required in handling large deficits. The debt crisis and problem of reorganising the worldwide banking and financial sector, must therefore, be dealt with simultaneously, but this is not happening in this current time (Trichet, 2010).

The market is also like any lender who wants a guarantee that debts would be paid back by the borrowers. When the debt burden becomes too large and lenders get anxious in such situations, they demand for deficit reduction adjustments usually comprising spending cuts and increases in tax revenue. This is normally termed austerity and the larger the austerity
implemented, the stronger the lender’s belief about the hope of debt settlements (Kitromilides, 2011).

6. The Simulation Framework
In this section of the paper, the latest review regarding the simulation literature has been dealt with. An economic model has been picked from the present literature, to carry out the debt simulation exercises, in order to answer the research question.

6.1 The Simulation Literature Review
Eurostat has reported that the Greek public debt-to-GDP ratio in 2010 was 148.3 and 170.6 in 2011 (Trading economics, 2012). According to the OECD estimations, the Greek gross public debt was €339 billion and the government financial assets were €76 billion, amounting to a net debt of €263 billion (OECD, 2011). Based on the current IMF assessment regarding the Greek loan programme, it states that the current debt relief adjustments have been unsuccessful in re-establishing sustainability of the Greek debt. Therefore, measurements containing a mixture of reduction of debt principle and an additional reduction of interest rates on the unpaid loans would be needed. Greece might need some additional relief from the Eurozone countries, either in the shape of new subsidise loans or an out and out debt write-off. This will help Greece’s large debts to reach a sustainable level, in spite of the latest debt respite adjustments (Paris, 2013).

IMF further evaluated that if shortcomings to the Greek austerity measures develop, in such a case, 3% of the Greek annual GDP would be needed for further debt respite and this would amount to €6 billion ($8 billion) for fiscal transfers during the period of 2013 to 2020. In addition, this could involve interest rates near zero on loans provided by the European Financial Stability Facility as well as on bilateral government loans (Paris, 2013).

On the other hand, the Eurozone has agreed to cut the Greek debt by an additional €40 billion, and has granted the Greek government €44 billion in “bailout money and help” (BBC news, 2012). The IMF has also stated in its report, that for the Greek debt to reach a sustainable level, it would need to cut its debt principle by 25% on the loans provided by the EFSF and bilateral governments, and on government bond holdings issued by the central bank. A latest bond buyback by the Greek government has led to a reduction its debt by €20.6 billion. Furthermore, savings that could accumulate due to lower interest rates and longer settlement periods on present loans could decrease the debt by 16% of the GDP by 2020. However, all this may still be inadequate in helping the Greek debt to reach a level of sustainability. Latest austerity measures have been planned to reduce the debt by 1.4%. In 2015, the Greek government is planning to adopt additional measures to lower its debt-to-GDP ratio so that it can reach 124% by 2020, and even further to 110% by 2022. After
considering all these facts, on 16th January 2013, the IMF agreed to grant Greece another loan payment of €3.3 billion (Paris, 2013).

Austerity measures involved in the debt reduction plan are supposed to be complemented by Private Sector Involvement (PSI). In this, private debtors are forced to write-off €100 billion, accept lower interest rates as well as a 53.5% “haircut” on the face value of the Greek sovereign bonds held by them. The IMF, EFSF and EU have also agreed to reduce the interest rate on the loans to Greece, but no write down in the value of Greek debt which is held officially. The finance ministers of the European Union have proposed that Greece’s debt-to-GDP ratio should be directed towards a downward course achieving 120.5% of the GDP by 2020. This would be achieved with the help of contributions from both the government and private sector (Rogers and Vasilopoulou 2012).

6.2 Cline’s Economic Model

The Cline (2011) debt simulation model suggested in Appendix (Table A.2) has been implemented for this paper. In his paper, the optimal growth path of the Greek debt is based on the July 2011 bailout package and has stated the assumptions regarding growth, GDP deflator price increase, primary fiscal surplus and amounts of privatization as being similar to those recommended by the IMF (2011b) for the same time period. Cline has calculated his simulation framework on some projections where the real growth rate started off at values of about 2.1% from 2013, and plateaued to 3% from 2017 onwards. The primary surplus has been set to about 6.4% from 2014 onwards. He used the time period of 2010-2020 to determine the alternative paths for Greek public debt. The model also states that the difference between the borrowings required to fund the fiscal deficit and the funds accumulated through privatization, represents the annual change in debt. In addition, the difference between the interest paid on the debt and the primary surplus amounts to the fiscal deficit. In his calculations, the earnings from interests are not attributed to financial assets even though they are subtracted to obtain the resulting net debt (Cline, 2011).

Moreover, Cline points out in his model, that gross borrowings have to cover up future amortizations of loan. The main aspect of the current austerity adjustments is to lower amortization in the upcoming years, either through PSI (Public Sector Involvement) for an exchange of debt, or by carrying on official Eurozone financing with a long repayment period rather than obtaining new financing from the private market. Simultaneously, through these adjustments, Greece is supposed to meet its liquidity purpose. On the other hand, another main aspect of the current austerity measures is to lower the interest rates as this would then reduce the burden of interest on borrowings from the EU and private sector. Through this, insolvency would be maintained and this would also help Greece keep away from higher interest rates that are usually charged for new borrowings from the private market during panic situations (Cline, 2011).
6.2.1 Comparison between Cline’s and Troika Projections

In contrast to Cline (2011), Troika has assumed that it will take longer for Greece to implement its structural reforms, and that a longer time frame is essential for them to get macroeconomic returns. Troika has also assumed a longer and more austere recession with growth averaging 2.67% between 2015 and 2020 (as structural reforms begin to pay back) and 1.67% per year from 2021 to 2030 (as the economy returns to prospective growth). However, there would still be a lower PSI involvement as the market condition would not be good for Greece and little aspiring privatisation involvement could be considered beneficial for debt sustainability. Also, PSI has been projected to reach 2% of the GDP for the period of 2013 to 2014, and attain the highest level at 2.5% during 2015 to 2017. It will then decreases again and reach 2% per year between 2018 and 2020.

The primary surplus has also been projected to improve in the future and will reach 4.5% of the GDP for the period of 2014 to 2016. It falls back down to 4.25% between 2017 and 2020, to 4% from 2021 to 2025 and from 2026 to 2030, the primary surplus is projected at 3.5% (Troika report, 2011). Amortisation however, has been assumed based on the Cline (2011) projections from 2010 to 2020, and after this period, it has been set to zero from 2021 onwards. This is assuming Greece will not amortise its loan for a longer period of time, as the creditors might consider giving the government some relief regarding this matter. The average rate of interest has also been projected to be in a decreasing mode from 4% in 2013 to 0.5% by 2030 (see details in appendix table A.2), and this has been selected in order to find the path leading to sustainability of the Greek public debt.

6.3 The Baseline Scenario

The present baseline scenario of the public debt indicators has been shown in Table 1. This data has been collected from both the IMF database as well as from Cline (2011). Its values have been calculated using his economic model and the projections have been made according to a report published by the IMF regarding the latest austerity measures. This report from Troika (consisting of the European Commission, the European Central Bank and the International Monetary Fund) deals with the Greek debt, projections regarding its GDP growth and other indicators of the Greek public debt (Troika report, 2011).

Henceforth, the abovementioned projections from Troika have been taken into consideration whilst calculating the baseline scenario for the Greek public debt indicators as stated in Table 1 given next.
Table 1: Baseline scenario: Public debt indicators of Greece (percent and billion Euros)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross debt/GDP</td>
<td>148</td>
<td>170.6</td>
<td>196</td>
<td>207</td>
<td>209</td>
<td>209</td>
<td>190</td>
<td>174</td>
<td>158</td>
<td>125</td>
<td>110</td>
</tr>
<tr>
<td>Net debt/GDP</td>
<td>115</td>
<td>128</td>
<td>146</td>
<td>157</td>
<td>160</td>
<td>161</td>
<td>147</td>
<td>132</td>
<td>118</td>
<td>88</td>
<td>73</td>
</tr>
<tr>
<td>Interest/GDP</td>
<td>7.3</td>
<td>7.8</td>
<td>8.1</td>
<td>8.1</td>
<td>8.4</td>
<td>5.7</td>
<td>1.8</td>
<td>1.6</td>
<td>1.6</td>
<td>0.65</td>
<td>0.58</td>
</tr>
<tr>
<td>Amortization/GDP*</td>
<td>0</td>
<td>12</td>
<td>7.4</td>
<td>8.9</td>
<td>6.5</td>
<td>3.7</td>
<td>0.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Primary surplus/GDP</td>
<td>-4.9</td>
<td>-0.8</td>
<td>1.1</td>
<td>4.5</td>
<td>4.5</td>
<td>4.25</td>
<td>4.0</td>
<td>4.0</td>
<td>3.5</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>Growth (percent)</td>
<td>-1.7</td>
<td>-5.3</td>
<td>-5.2</td>
<td>-</td>
<td>2.63</td>
<td>2.67</td>
<td>2.67</td>
<td>1.67</td>
<td>1.67</td>
<td>1.67</td>
<td>1.67</td>
</tr>
<tr>
<td>Gross debt (bn €)</td>
<td>337</td>
<td>367</td>
<td>374</td>
<td>394</td>
<td>408</td>
<td>418</td>
<td>424</td>
<td>402</td>
<td>378</td>
<td>320</td>
<td>289</td>
</tr>
<tr>
<td>Assets (bn €)*</td>
<td>76</td>
<td>101</td>
<td>130</td>
<td>140</td>
<td>149</td>
<td>149</td>
<td>139</td>
<td>141</td>
<td>143</td>
<td>147</td>
<td>149</td>
</tr>
<tr>
<td>Privatization (bn €)*</td>
<td>0</td>
<td>2.9</td>
<td>3.81</td>
<td>3.8</td>
<td>4.9</td>
<td>5.0</td>
<td>4.5</td>
<td>5.8</td>
<td>6.0</td>
<td>7.7</td>
<td>7.9</td>
</tr>
<tr>
<td>GDP (bn €)**</td>
<td>227</td>
<td>215</td>
<td>190</td>
<td>190</td>
<td>195</td>
<td>200.</td>
<td>223</td>
<td>231</td>
<td>239</td>
<td>255</td>
<td>263</td>
</tr>
<tr>
<td>Average interest rate</td>
<td>4.89</td>
<td>4.66</td>
<td>4.00</td>
<td>4.00</td>
<td>4.00</td>
<td>4.00</td>
<td>4.00</td>
<td>3.0</td>
<td>1.00</td>
<td>1.00</td>
<td>0.5</td>
</tr>
</tbody>
</table>

(*Cline, 2011; **IMF, 2012)

**Results**

Table 1 presents information about the central baseline for the indicators of the Greek debt during 2010 to 2030 after the implementation of the projected recent austerity measures. The complete details of this table are given in the appendix table A.2. The main results of this table are summarised as follows:

- Gross debt hits the highest point at 209% of the GDP in 2015 and 2016, and then falls to 110% by 2030 when the projected austerity measures for the future are implemented.
- The net debt reaches a highest point at 161% of the GDP in 2016 and then falls to 73% by 2030.
- The interest burden as a percent of GDP is projected to fall from 8.4% in 2016 to 0.5% by 2030.
- Amortization falls from 12% of the GDP in 2011, to 0.5% by 2020 and then to 0% by 2021 onwards.
- The primary surplus is projected to rise from 1.1% of the GDP in 2013, reach at peak of 4.5% during 2014 to 2016 and then fall to 3.5% from 2026 to 2030.
- The average interest rate is projected to fall from 4% in 2013 to 0.5% by 2030.
All these abovementioned paths suggest sustainability of the Greek public debt if the austerity targets are achieved.

6.4 The Simulation Exercises
To answer the research question of this paper, three austerity packages, each consisting of three simulation exercises have been carried out whilst applying Cline’s simulation model (see detail in Appendix A) in which growth has been calculated by making growth (g) dependent on debt reduction, i.e. g = g + z (DEF_t - DEF_{t-1}). The outcome (g) of this equation has been used when carrying out the simulation framework with different assumptions regarding the three austerity packages. Here, z is a growth coefficient and is considered the elasticity of growth with respect to change in deficit (see details in A.6). As the research literature is divided on the size of the fiscal multiplier which is also considered the same as the elasticity of growth, the value of z has therefore, been determined according to Ramey’s estimated range of 0.6 to 1.1 (Ramey, 2009).

Furthermore, three different debt reduction strategies (austerity measures) have been considered where the different outcomes of growth rates have been calculated using the above stated equation. The strategies used are the lowering of interest rates, debt write-off and increasing the primary surplus. It is nevertheless, important to note that it is the creditor nations which control the interest rate and debt write-off, whereas the debtor nation only controls how fast it should increase the primary surplus by implementing spending cuts or taxing more.

Considering the latest review of the simulation literature, the three strategies have been chosen. The IMF has currently evaluated that Greece would need an extra reduction of interest rates, as well as a debt write-off in order to reach a sustainable level of debt-to-GDP ratio (Paris, 2013). Furthermore, the creditors’ nations have forced Greece to implement permanent spending reductions (which is a part of primary surplus) in the beginning of 2013 in order to acquire the recent bailout package (“Toil and trouble,” 2012).

In the previously mentioned literature review, there is a current debate in the economic world regarding the austerity measures adopted in the case of Greece; that they are not strict enough to help Greece lower its debt to 120% of the GDP within a sensible period of time (Rogers and Vasilopoulou 2012). If we examine the baseline scenario results which have been calculated keeping in mind the current projections, and discussions regarding austerity adjustments, Greece would need to lower its debt-to-GDP ratio to a sustainable level. Even after considering all these current projections, the debt-to-GDP ratio only reached 110% by 2030 in the baseline scenario. In this case, I assume that it would be necessary to make changes to the projections regarding the three debt reduction strategies that have been chosen for the simulation exercises. These would be in the shape of a further reduction of the interest rate, a cut to the debt principle or a further increase in spending cuts or taxes. By doing this,
the Greek debt-to-GDP ratio might be able to reach a sustainable level of 60% within a reasonable time period.

6.5 The First Package
Now, the changes to the projections regarding the three debt reduction strategies will be explained in more detail. In the first austerity package, three simulation exercises have been carried out. In the first simulation, the debt reduction strategy of lowering the interest rate has been considered, and z has been set to 1. This is assuming deficit reduction gives a contraction to the economy. The interest rate here has been projected for both a short and long period. From 2013 to 2015, the interest has been set to 3%, then 2% from 2016 to 2020, and lastly it has been set to 0% as the long-term interest rate during 2021 to 2030. This could lead to a reduction in the deficit and consequently, lower the debt-to-GDP ratio as well. Hence in this situation, the hypothesis set is that the debt-to-GDP ratio would reach a sustainable level of 60% by the year 2030. The growth rate would also increase and reach a higher level than that given in baseline growth rate by 2030.

The creditors might then agree to lower the interest rate, as this could help to reduce the debt burden on Greece and also increase its growth rate in the future. This could prove to be a positive strategy for the creditors, as Greece would be able to repay its loans in a shorter period of time compared to that, which has been projected using the current fiscal adjustments. In this way, Greece could also assume that its economy will be in better situation if the creditors were to agree to implement this strategy.

In the second simulation exercise, the debt write-off strategy has been considered by setting z =1, as was used in the first simulation, and the all the values of the other indicators are similar to the baseline indicators. As mentioned in the literature review, there is a need to cut the debt principle to bring the Greek debt-to-GDP ratio down to a sustainable level. This debt principle has also been cut for both the short and long periods in this simulation exercise, in order to see if this strategy could lower the debt-to-GDP ratio within a sensible time period. In 2012, the creditors agreed to reduce the Greek debt by €40 billion. This piece of information has been kept in mind when making projections regarding the debt write-off in this scenario - where it has been assumed that the creditors are ready to reduce the debt principle by €20 billion from 2013 to 2017 as a short term measure, and then by €10 billion from 2018 to 2030 for the long term. With this, it is expected that the Greek debt-to-GDP ratio might then reach a sustainable level of 60% within a reasonable time span. For this very scenario, the hypothesis set is that the debt-to-GDP ratio will reach a level of 60% by 2030, and the growth rate would probably reach a level that is higher than that of the baseline in the same year.

The creditors in this above scenario however, might not agree to reduce the debt principle by so much, as they could probably lose 50% of their principle by 2030. In spite of this, this
strategy might increase the growth rate in the long run, and by 2030, it could reach a higher level compared to that of the baseline growth rate. As a result of this, the creditors might not implement this strategy for a long term basis, but they can accept a reduction of the debt principle for some lump sum amount for a short period, just as they did in 2012. This could possibly lead to a big, positive and immediate boost to economic growth for a short period of time. Resulting from this, Greece could willingly accept this strategy, as this would lower the debt-to-GDP ratio by more than 50% by the year 2030, again compared to the ratio of the baseline scenario.

Finally in the third simulation, primary surplus has been used as the debt reduction strategy. Here, the Greek public debt indicators for this exercise are similar to that of the baseline scenario, except for the primary surplus. This has been increased by 2% over the baseline indicator from 2013 to 2018 and by 3% from 2019 to 2030 for the long-term basis. This might help to reduce the debt-to-GDP ratio to a value close to the sustainable level by the year 2030. Here, the hypothesis set is that the debt-to-GDP ratio is expected to be lower than the ratio of baseline scenario, and that the growth rate could also reach a lower level by 2030 compared to that of the baseline scenario level. Here, Greece has to save more in the future due to an increase in spending cuts.

Creditors would prefer this strategy, as in this case, Greece has to save more in order to amortise its loan and the creditors can consequently, expect repayment of their loans. However, it might take a longer time for the Greek debt-to-GDP ratio to reach close to the level of sustainability. It may also be difficult for Greece to increase its primary surplus as the growth rate would be reduced in the long run, and the Greek economy would shrink further.

Results:

Figure 2: Alternative Paths for Greek Debt (assuming debt reduction gives a contraction)

<table>
<thead>
<tr>
<th>Year</th>
<th>Debt/GDP % (Base line)</th>
<th>Debt/GDP % (Interest rate)</th>
<th>Debt/GDP % (Debt write off)</th>
<th>Debt/GDP % (Primary surplus)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>148</td>
<td>148</td>
<td>148</td>
<td>148</td>
</tr>
<tr>
<td>2011</td>
<td>171</td>
<td>167</td>
<td>177</td>
<td>177</td>
</tr>
<tr>
<td>2012</td>
<td>185</td>
<td>191</td>
<td>196</td>
<td>196</td>
</tr>
<tr>
<td>2013</td>
<td>207</td>
<td>205</td>
<td>213</td>
<td>213</td>
</tr>
<tr>
<td>2014</td>
<td>209</td>
<td>204</td>
<td>217</td>
<td>217</td>
</tr>
<tr>
<td>2015</td>
<td>204</td>
<td>199</td>
<td>209</td>
<td>209</td>
</tr>
<tr>
<td>2016</td>
<td>195</td>
<td>190</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>2017</td>
<td>182</td>
<td>174</td>
<td>193</td>
<td>193</td>
</tr>
<tr>
<td>2018</td>
<td>166</td>
<td>166</td>
<td>184</td>
<td>184</td>
</tr>
<tr>
<td>2019</td>
<td>158</td>
<td>157</td>
<td>176</td>
<td>176</td>
</tr>
<tr>
<td>2020</td>
<td>150</td>
<td>151</td>
<td>169</td>
<td>169</td>
</tr>
<tr>
<td>2021</td>
<td>142</td>
<td>141</td>
<td>161</td>
<td>161</td>
</tr>
<tr>
<td>2022</td>
<td>133</td>
<td>131</td>
<td>151</td>
<td>151</td>
</tr>
<tr>
<td>2023</td>
<td>125</td>
<td>120</td>
<td>141</td>
<td>141</td>
</tr>
<tr>
<td>2024</td>
<td>117</td>
<td>109</td>
<td>131</td>
<td>131</td>
</tr>
<tr>
<td>2025</td>
<td>110</td>
<td>109</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>2026</td>
<td>99</td>
<td>99</td>
<td>109</td>
<td>109</td>
</tr>
<tr>
<td>2027</td>
<td>90</td>
<td>90</td>
<td>99</td>
<td>99</td>
</tr>
<tr>
<td>2028</td>
<td>80</td>
<td>80</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>2029</td>
<td>71</td>
<td>71</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>2030</td>
<td>62</td>
<td>62</td>
<td>71</td>
<td>71</td>
</tr>
</tbody>
</table>

Results:
Figure 2 displays the results of the first package of simulation exercise, where all the three debt reduction strategies have been tried using the assumption that debt reduction results in a contraction to the economy. In this case, the debt reduction strategy of lowering interest rate has been effective, but still, the debt-to-GDP ratio could not reach a sustainable level (in the long run) by the year 2030. At a 3% interest rate from 2013 to 2015, the debt-to-GDP ratio decreases immediately by 6% in 2014. After reducing the interest rate to 2%, the ratio goes down by a further 9% from 2016 to 2020 and also by an average of 10% from 2021 to 2030. Finally, the debt-to-GDP ratio reaches a level of 71% by the year 2030, where it is still higher than the sustainable level of 60%.

During 2013 and 2017, we can see the debt write-off strategy’s short term effect, where the debt-to-GDP ratio goes from 213% in 2013 to 223% in 2014, 217% in 2015, and finally reaches a level of 200% in 2017. In addition, it is seen to fall gradually in the long term from 2018 and reaches 49% by the year 2030. The primary surplus strategy however, has no visible short-term effect, as the debt-to-GDP ratio does not fall, and instead, reaches 252% in 2017. This is highest among all the other debt reduction strategies. In the long term, from 2018, the ratio starts falling and reaches 123% by 2030, which is also higher than the baseline level ratio seen in 2030.

**Figure 3: Economic growth and debt reduction** (assuming deficit reduction gives a contraction)

![Economic growth in contraction](image)

The effect of austerity measures on the economic growth of Greece, using the contraction scenario of the economy, is seen above in Figure 3. Reducing the rate of interest has resulted in a fiscal surplus, which has then reduced the growth rate, due to its dependence on the change in deficit. After implementing the interest rate strategy, the growth rate reaches a level lower than the baseline scenario growth rate, by the year 2030. In the case of debt write-off and primary surplus, after these strategies have been implemented from 2013, the economic growth rises and becomes positive from the negative in 2015. In the long run, the growth rate finally reaches a lower level compared to the baseline growth rate level as seen for the year
2030. A significant dip in the growth rate has been seen, particularly in the year 2021, and this is for all the three strategies implemented. The reasons for this dip will be explained later in the analysis section.

6.6 The Second Package
In the second package, the three simulation exercises have been carried out by using the same assumptions as those made in first package, except that the value of z has been set to -1, assuming that deficit reduction is expansionary. When lowering the interest rate in this scenario, the hypothesis set is that the debt-to-GDP ratio is expected to reduce significantly, and that it will reach a sustainable level of 60% by the year 2030. The growth rate will also increase due to the expansionary fiscal reduction, and it should reach a level that is higher than that of the baseline scenario, by the same year. Greece and its creditors would thus, interpret the results from this strategy in a similar manner as they did in the first package.

In the debt write-off strategy used this scenario, the hypothesis set is that the debt-to-GDP ratio will reach a level of 60% before 2030, and that the growth rate would also likely rise and reach a higher level than that as suggested in the baseline growth rate level for the same year. It will be difficult for the creditors to reduce the debt principle significantly in this scenario, as the debt-to-GDP ratio can reach a level of sustainability much earlier, and thus, cause the creditors to lose a considerable principle amount. Nevertheless, due to an expansionary deficit reduction, the growth rate might be boosted positively. But, as mentioned earlier, the creditors might be ready to lower the debt principle for a short period, in order to give an immediate boost to the economic growth whereas for the long term, this might actually lead to be a substantial loss to the creditors. Greece would be in a profitable position in this scenario if its creditors chose to implement this strategy.

The hypothesis set in the case of primary surplus is that the debt-to-GDP ratio is expected to be lower than the baseline scenario by 2030, and that the growth rate is also expected to reach a higher level compared to the level of the baseline scenario and this is again due to the expansionary deficit reduction. Creditors would more likely, force Greece to implement this strategy as it not only produces a low debt-to-GDP ratio in the long run, but also increases the growth rate in the long run. Under these conditions, a positive situation is created where Greece can repay its loans much earlier.

Results:
Figure 4: Alternative Paths for Greek Debt (assuming deficit reduction is expansionary)

Figure 4 illustrates the results of the second set of simulation exercises, where all three debt reduction strategies have been tried using the assumption of expansionary debt reduction in the economy. In this case, the debt reduction strategy of lowering the interest rate has been effective, as the debt-to-GDP ratio declines and reaches a sustainable level of 47% in the long run by 2030. By lowering the interest rate to 3% in 2013, the debt-to-GDP ratio reaches a level of 166% in 2014 from 193% in 2013 - an immediate effect is seen here. The level of 193% is the record high in the given period of 2010 to 2030.

In utilising the debt-write off strategy from 2013 to 2017, we can see its short-term effect - from an all-time high of 188% in 2013, the debt-to-GDP ratio gradually starts falling by an average of 8% from 2014 to 2021 and after this period, the ratio goes down by an average of 10% from 2022 to 2030. It reaches 36% by 2030, a value much lower than the baseline debt-to-GDP ratio. In contrast, the primary surplus strategy has no visible short-term effect as the debt-to-GDP ratio does not fall and instead reaches 205% in 2016. This is the highest debt-to-GDP ratio among all the other debt reduction strategies. In the long-term from 2017, the ratio starts falling and finally reaches 85% by the year 2030, a level that is lower than the baseline level ratio for the same year.
In Figure 5, we see the effect of austerity measures on the economic growth of Greece in an expansionary condition. Here, the lowering of the interest rate gives a big boost to the growth rate as it reaches a level of 1.81\%, which is higher than the baseline scenario. For the debt option, it goes up by 8\% immediately in 2014 as a result of the implementation of the debt write-off strategy in 2013; this is an example of the short-term effect during the expansionary condition. In the case of the primary surplus option, after implementation in 2013, the growth rate increases by 6.3\% and reaches its highest level of 5.56\% by 2021, after which, it steadies to 1.72\% by the year 2030. This is a little higher than the 2030 baseline projection of the growth rate. A considerable rise in the growth rate is seen in 2021 for all the three strategies. This will be discussed later on in the analysis section.

6.7 The Third Package

In the third package, the three simulation exercises have also been carried out using similar assumptions as those made in first package, except that here, the value of z has been set to 1, assuming that deficit reduction gives a contraction. In addition, it has been assumed that the debtor country has implemented growth-oriented reforms that increase g by 1\% point a year over the baseline scenario from 2013 onwards.

When we lower the interest rate, the hypothesis set here is that by 2030, the debt-to-GDP ratio will reach a sustainable level, and that the growth rate will also increase, reaching a higher level than that projected in the baseline growth rate by the same year. Greece and its creditors would interpret the results from this strategy in a similar manner as they did the second package. In the debt write-off strategy of this scenario, the hypothesis set is that the debt-to-GDP ratio will reach a level of 60\% before 2030, and the growth rate will also likely rise and reach a higher level than that projected in the baseline growth rate level by the year 2030.
Greece and its creditors would interpret the results from this strategy in a somewhat similar way as that in the second package.

For primary surplus, the hypothesis set is that by 2030, the debt-to-GDP ratio is expected to be lower than the baseline scenario and the growth rate is expected to reach a higher level than that compared to the level of the baseline scenario. Here, Greece and its creditors would also interpret the results from this strategy in the same manner as they did in the second package.

Results

**Figure 6: Alternative Paths for Greek Debt** (assuming growth oriented reforms and debt reduction gives a contraction).

In Figure 6, the paper has tried to evaluate the answer to the research question using similar projections as mentioned in the scenario of the first package. However, the elasticity of growth has been set to 1 and assumes that the debtor nation has implemented growth-oriented reforms that increase g by a 1% point a year over the baseline scenario from 2013 onwards. The debt-to-GDP ratio reduces significantly and reaches a much lower level than that of the baseline scenario by 2030. After applying the interest rate option in 2013, the debt-to-GDP ratio decreases in 2014, after which it then starts reducing continuously due to a lowering of the interest rate, and finally reaches a level of 59% by the year 2030. After implementing the debt write-off strategy in 2013, the debt-to-GDP ratio reaches a peak in 2014. It then gradually falls and reaches a level of 41% by the year 2030; this level is much lower than the baseline ratio. The primary surplus option would not be a good option for a short period, as by increasing the surplus by 3% in 2013, this leads to an increase in the debt-to-GDP ratio by 17% in 2014. However, the ratio eventually falls and reaches a level of 103%, again a level that is lower than the value projected in the baseline ratio of 2030.
Figure 7: Economic growth and debt reduction (assuming growth oriented reforms and debt reduction gives a contraction).

Figure 7 shows the case of growth-oriented reforms that have been implemented by the debtor nation. The lowering of the rate of interest in this scenario increases the growth rate in the long run, and it reaches a level of 2.53% that is 0.86% higher than the baseline growth rate. In the debt write-off option, after implementing it in 2013, the growth rate increases by about 6% in 2015 and it reaches a level of 2.62% by the year 2030. As seen in the first and second packages, a considerable negative growth rate is also seen in 2021 for all the three strategies implemented here, and this dip will be explained further in the analysis section.

The primary surplus option has also been adopted in a somewhat similar path as that which was followed by the debt write-off strategy. In a short period, the primary surplus growth rate differs from all the other growth rates obtained using other strategies, but in the long run, it reaches a level of 2.62% by 2030. This is similar to the growth rate calculated using the debt write-off strategy and this value is also higher than the baseline growth rate projected in 2030.

7. Analysis
In this section, the results of the economic model have been analysed. The theories and literature review mentioned previously in this paper have been used to answer the research question and to accomplish the purpose of this paper

7.1 The First Package
In the first austerity package, the debt reduction strategy involving a lowering of the interest rate has resulted in lowering the debt-to-GDP ratio to a level of 71% by 2030. When implementing this strategy, the Greek debt-to-GDP ratio can be lowered and Greece could achieve the sustainable level with a 0% interest rate for a long period as specified in the given
scenario. However, it might take a couple more years for the economy to reach a sustainable level. With the debt write-off strategy, the debt-to-GDP ratio reaches a level of 49% by the year 2030. Hence, by implementing this strategy, the Greek debt-to-GDP ratio reaches 62% in 2029, which is almost near the sustainability level. According to the simulation literature mentioned by Paris (2013), this scenario supports his study where he has mentioned that Greece might need some relief in the shape of debt write-offs.

Moreover, in the case of primary surplus, the debt-to-GDP ratio reaches 123% by 2030, and this is above the baseline ratio as well as much higher than the sustainable ratio. Here, the debt-to-GDP ratio of Greece cannot reach a sustainable level by 2030. In spite of this, we can still implement spending cuts or more taxes in the contraction condition of the economy, as according to the Barro-Ricardo equivalence theory, the path of debt and the timing of government spending and taxes do not matter much, as only their present discounted value is important. In this given scenario, the Greek debt can thus, still reach a sustainable level, even though it might take a few more years after 2030. Furthermore, the assumption stated in the dynamic political theory given by Battaglini and Coate (2008) which permits governments to have the possibility of keeping long lasting debts, can also be considered in this scenario. When a government body increases the taxes in the austerity composition of spending cuts and taxes in order to increase the primary surplus, then the government can have the option of keeping its debts for a longer period. Here also, it does not matter if it takes a few more years for Greece to reach to achieve a sustainable level of its debt.

Besides, the IMF (2010) and Devries et al. (2011) observed in their recent reports, that when reviewing the implementation of new taxes versus new spending cuts, spending cuts measure work in reality, as they are accompanied by a lower rate of interest. This is similar to the projections seen in this scenario, where the interest rate is also decreasing with increase in the primary surplus. This is also seen in the baseline scenario involving an increase in primary surplus (in case of increase in spending cuts), where this strategy has helped to lower the debt-to-GDP ratio. In addition, if we assume that an increase in primary surplus is based on spending cuts, then the output increases by 3.4% in one year and this is after a 2% increase in the primary surplus is implemented in 2013, as seen in this scenario. Alesina and Giavazzi, (2012) have also mentioned that the output will increase within a year after spending cuts measures are implemented.

The economic growth of Greece in the first package (where a deficit reduction gives a contraction) has also exhibited different growth rates for both the short and long periods. After a lowering of the interest rates from 3% in 2013 to 2% in 2016, and to 0% between 2021 and 2030, a lowering of the growth rate results, where the level reaches 1.53% by the year 2030, which is lower than that calculated in the same baseline scenario. Hagen and Strauch (2001) have mentioned that a lowering of interest rates during the period when an economy starts to come out of recession, can lead to an increase in the growth rate. This can be seen here in particular; when the interest rate starts to decrease, the Greek economy starts
to come out of recession and this is from the year 2013. According to the baseline scenario, a positive increase in the growth rate is expected from 2013, and this is exactly what has happened here, when we lower the interest rate in this scenario.

While implementing the debt write-off strategy from 2013 in the given scenario, there is an increase in the rate by 6.5% in 2015. This reflects a short-term effect of the debt write-off in this scenario. On the other hand, in the long run, it will remain at a lower level than the growth rate of the baseline scenario, as it reaches 1.63% by the year 2030. For a short term, this strategy can inject a good boost to the economic growth from the year of implementation of the debt write-off strategy, as is seen during 2013 and 2016.

The growth rate, in the case of primary surplus, is also affected. The primary surplus is projected to increase by 2% over the baseline indicator in 2013. This has given a short-term effect to the growth rate as it increases from 2013 and becomes positive in 2015 by gaining a 6% increase from 2014 to 2015. Posner and Sommerfeld (2012) mentioned that implementing big spending cuts or increasing taxes could result in a considerable increase in the economic growth, if it is implemented at the right time. This can be seen to be true as there is an increase in the growth rate during 2013 to 2016, when primary surplus increases by 2% over the baseline indicator. This has then also increased the primary surplus to 6.5% in total during the same period. In the long run, it remains at a lower level, compared to the baseline growth rate as it reaches 1.62% by 2030 and this is lower than the baseline scenario growth rate.

According to Krugman (2010), high levels of public debt are the result of a low economic growth. This can be seen here, where the low Greek economic growth does not help to lower the debt-to-GDP ratio, and so the implementation of austerity adjustments is justified. This statement can be assumed to be true for all the three packages. Perotti (2012) on the other hand, has mentioned that restricted fiscal policies might reduce economic growth. This can also be seen in this scenario. The growth rate reaches a level of 1.62% by 2030, and this level is even lower than that of the baseline scenario. In addition, “too much and too soon” spending cuts can have a considerably negative effect on the economy as mentioned by Kitromilides (2011) – this can be observed in 2021, when a further increase in spending cuts in the form of increasing primary surplus has been observed, and this has caused a considerable negative growth.

Another reason for this rather significant dip in 2021, whilst implementing all the three strategies as seen in Figure 3, is that the projected austerity measurements implemented in the same year, in the baseline scenario, have already brought about a fiscal surplus. Here, we have implemented one of the three strategies - either a further reduction of the interest rate, a reduction of the debt principle or a further increase in the primary surplus in the very same year. This results in a considerable increase in the fiscal surplus that causes negative growth, since growth is dependent on change in deficit, and a deficit reduction leads to a contraction in the economy.
7.2 The Second Package

With an expansionary deficit reduction, the strategy of lowering the interest rate and keeping the other projections similar to that of the baseline scenario projections, results in a lowering of the debt-to-GDP ratio to 47% by 2030. This strategy will help Greece to lessen its debt-to-GDP ratio and achieve a sustainable level, by maintaining a 0% interest rate for a long period as in the given scenario. Implementation of the debt write-off strategy also results in reducing the debt-to-GDP ratio as it reaches 36% by 2030. Therefore through this, the Greek debt-to-GDP ratio reaches 65%, a level almost close to the sustainability level and this is by the year 2027.

Furthermore, in the case of primary surplus, by the year 2030, the debt-to-GDP ratio reaches 85% that is lower than the baseline ratio, but still higher than the sustainable level. In this scenario, the Greek debt-to-GDP ratio cannot achieve a sustainable level by the year 2030 through this strategy. In spite of this, spending cuts or more taxes can still be implemented in the expansionary condition of the economy, even after 2030, in order to reach a sustainable level. We can also relate this scenario to the Barro-Ricardo equivalence theory, as was done in the first package. Also, if an increase in primary surplus is based on spending cuts, then the output increases by 2.94% in one year after implementing a 2% increase in the primary surplus in 2013. Alesina and Giavazzi (2012) mention the same that the output will increase within one year of implementing spending cuts.

The dynamic political theory suggested by Battaglini and Coate (2008) can similarly be applied to this package. It therefore, does not matter even if it takes a few more years for the Greek public debt to reach a sustainable level. Greece can therefore, still implement the primary surplus strategy in the expansionary conditions, even if it could take a few more years after 2030, for Greece to achieve debt sustainability. Furthermore, in this scenario, we can see that after implementing the primary surplus strategy, the expansionary fiscal policy has increased the debt-to-GDP ratio in the short run from 2014 to 2016. The growth rate subsequently reaches a highest level of 4.77% in 2017, after which, it then gradually decreases and reaches 1.72% by the year 2030. This is thus, quite similar to the findings by Panizza and Presbitero (2012) who state that the expansionary policy is useful in the short run as it increases the debt-to-GDP ratio, but it might decrease the growth rate in the long run.

Here, the economic growth of Greece, in which a deficit reduction is expansionary, has also shown different growth rates for both the short and long periods. After lowering the interest rates according to the projections made for this scenario, a big boost results in the growth rate in the short period, where it increases by 12.4% in one year due to the expansionary deficit reduction. Thus, lowering the interest rate greatly increases the growth rate in the short period and it reaches a highest level of 8.21% in 2021. In the long run, however, it still remains higher than the baseline scenario growth rate and reaches 1.81% by the year 2030.
In the case of the debt write-off strategy, from 2013 in the same scenario, there is an immediate increase in the rate by 8.1% in 2014. An immediate effect in the following year is visible after the writing off debt principle is implemented in 2013. In the long run, the rate remains at a higher level than the growth rate of the baseline scenario, and reaches a level of 1.71% by the year 2030. As for the short term, the economic growth gains a big boost in the year after the debt write-off strategy is implemented in this scenario. The growth rate also slows down in the long run and it is only 0.04% higher than the growth rate of the baseline scenario, even after considering the expansionary deficit reduction.

The growth rate, in the case of primary surplus, is also affected. It is observed, that after implementing the primary surplus strategy in 2013, a rise to growth rate is seen in the short period. However, it declines in the long run as it reaches 1.72% by the year 2030 and this is from an increase by 6% from 2013 to 2014, in just one year. Posner and Sommerfeld (2012) observed that implementing huge spending cuts or increasing taxes, can result in a significant increase in the growth rate, especially, if it is implemented at right time. An increase in the growth rate in the period of 2014 to 2016 occurs as the primary surplus increases by 2% over the baseline indicator in 2013. In the long run however, it remains at a higher level compared to the baseline growth rate and reaches 1.72%, which is only 0.05% higher than the baseline scenario growth rate by the year 2030.

A pretty significant upswing in the growth rate is noted in 2021 while executing all the three strategies as seen in Figure 5. The reason for this rise is the same as that which has been explained for the dip observed in the first package. Here, the dip has changed to a rise, and this is only due to the expansionary debt reduction since the elasticity of growth is set to -1 in this scenario. This results in a substantial increase in the surplus after the projections regarding these three strategies are implemented respectively. Therefore, a significant rise in the growth rate is seen, as growth is dependent on the change in deficit. As mentioned earlier, the “too much and too soon” spending cuts can have a considerably negative effect on the economy (Kitromilides, 2011). Here, a contrast to this statement is seen in the result of this package. The growth rate rises significantly in 2021 in the expansionary condition and so, the “too much and too soon” spending cuts is seen to be favourable in expansionary conditions.

### 7.3 The Third Package

In this package, lowering the interest rate results in reducing the debt-to-GDP ratio to 59% by the year 2030. Here, the interest rate strategy is very effective as the debt-to-GDP ratio reaches a level of sustainability by 2030. Also, the debt write-off strategy is also effective as the debt-to-GDP ratio reaches a level of 41% by the same year. Hence, by executing this strategy, the debt-to-GDP ratio reaches a level of sustainability even before the year 2030 as seen in this scenario.
When using the primary surplus strategy in this package, the debt-to-GDP ratio reaches 103% by 2030, and this is higher than the sustainable ratio. As such, even in this scenario, the Greek debt-to-GDP ratio cannot reach a sustainable level by 2030. The Barro-Ricardo equivalence theory can be considered here too. Through a continued implementation of the primary surplus strategy even after 2030, Greece could still reach a sustainable level, but this would be after 2030. The observations made by the IMF (2010) and Devries et al. (2011) in their recent reports, as mentioned in the first austerity package, have also been experienced in this scenario. Additionally, the dynamic political theory by Battaglini and Coate (2008) can also be considered here. Once again according to this theory, it does not matter if it takes a few more years for Greece to reach to achieve a sustainable debt level.

Here, the economic growth of Greece has also affected the growth rate for both the short and long periods. For instance, the growth rate after lowering the interest rate in 2013, results in a big boost to the growth rate in a short period. The growth rate first decreases in 2014, but it significantly increases by 9% in 2015. This is a little different compared to the other packages as the growth rate increases positively after two years, instead of the year just after the interest rate strategy is implemented. Lowering of the interest rate has thus, greatly increased the growth rate in a short period, as it reaches a highest level of 3.79% in 2017. In the long run, the rate still remains higher than the baseline scenario growth rate and reaches 2.53% by the year 2030.

As for the debt write-off strategy used in this scenario, from 2013, there is an immediate increase of the growth rate of 1.5% in 2014 and a further 6% in 2015. This shows the short period effect after the debt write-off principle is used in 2013. In the long run, it remains at higher level than the growth rate of the baseline scenario and finally reaches 2.62% by the year 2030. This strategy increases the growth rate in the short term, but it slows down in the long run, and is only 0.95% higher than the growth rate of the baseline scenario.

The growth rate, in the case of primary surplus, is also affected. After implementing the primary surplus strategy in 2013, it gives rise to a growth rate in the short period. The growth rate, however, declines in the long run as it reaches 2.62% by the year 2030, from an increase by about 3.4% from 2013 to 2014 in one year, and then by about 6% in 2015. Here also, the Posner and Sommerfeld (2012) observations are applicable as according to them, the employment of big spending cuts or increasing taxes results in an increase to the growth rate if it is applied at the right time. With an increase in the growth rate during 2014 to 2016, the primary surplus is projected to increase by 2% over the baseline indicator in 2013. In the long period, the growth rate slows down and reaches 2.62%. It still remains at a higher level compared to the baseline growth rate by the year 2030.

Furthermore, a noteworthy dip in the growth rate is also seen in 2021 when executing all the three strategies as seen in Figure 7, and this is similar to the first package and its results visible in Figure 5. This is due to reasons similar to that as explained in the scenario of the first
package, as even an increase of g by 1% in the contraction situation cannot avoid this considerable dip. In addition, as mentioned earlier in the first package, the “too much and too soon” spending cuts can also have a considerably negative effect on the economy as mentioned by Kitromilides (2011). This is seen here also in 2021, when a further increase in spending cuts in the form of increasing primary surplus, has caused a considerable negative growth.

8. Conclusion

Here, a conclusion has been reached from the analysis conducted above, for the purpose of determining the answer to the research question of this paper.

The main aim of this paper is to evaluate the impact of austerity measures on the Greek economy. The simulation framework, with the different scenarios and projections for the various public debt indicators, has been used to gain data to answer the research question. It is based on the economic model from Cline (2011), except that g is considered to be endogenous and dependent on the extent of austerity. Within this framework, three austerity packages with differing projections for three unlike debt strategies (lowering the interest rate, debt write-off and increasing the primary surplus) have been considered, in order to see the impact of these strategies on the Greek economy during the period of 2010 to 2030.

In the first package, it can be concluded that the primary surplus strategy would not be as effective as both the interest rate and debt write-off strategies since the creditors control the interest rate and debt write-off strategy. Due to this, the creditors might decide to implement the interest rate strategy as it can take a few more years after 2030, for the Greek debt-to-GDP ratio to reach a sustainable level. Even though the growth rate reaches a level that is a little lower than that of the baseline scenario for this strategy, it is still favourable for the creditors to implement this strategy. This is since the creditors, at least, will not lose their principle amount as they could have if they implemented debt write-off strategy. On the other hand, this interest rate strategy would be expensive for the creditors as compared to the primary surplus strategy, as they would have to give up their income earned on the interest rates. However, this same strategy would still be favourable in the view of sustainability as the Greek debt-to-GDP ratio will reach a sustainable level much earlier, than if the primary surplus strategy is implemented.

The empirical results concerning the primary surplus from this package have a high similarity to the findings regarding the debt-to-GDP ratio from the IMF (2010) and Devries et al. (2011). The growth rate observed in case of the primary surplus in this package is quite similar to the results mentioned by Posner and Sommerfeld (2012). The empirical results from the debt write off strategy have produced the expected result as mentioned by Paris (2013).
The hypothesis regarding the interest rate strategy in the first package is rejected for the resulting growth rate in this scenario. This is because the interest rate is already low in the baseline scenario and it comes close to zero in the long run. Lowering the interest rate to zero from 2021 to 2030 results in a fiscal surplus. This decreases the growth rate in the contraction scenario, as the growth rate is dependent on a change in deficit. In spite of this, the debt-to-GDP ratio reaches close to the level of sustainability by the year 2030. The reduction of the interest rate to 0% for a long period leads to a large effect, which subsequently reduces the future, new borrowings tremendously and reduces the gross debt. However, the GDP does not increase so much due to a decrease in the growth rate. Therefore, the debt-to-GDP ratio does not reach 60% by the year 2030. Based on this, we reject the hypothesis regarding the debt-to-GDP ratio in this scenario.

In the case of the debt write-off strategy, we do not reject the hypothesis for the debt-to-GDP ratio, but the hypothesis regarding the resulting growth rate in the same scenario is rejected. Here, the growth rate is seen to decrease and reaches a lower level compared to that calculated in the baseline scenario. The debt write-off principle results in a huge reduction in deficit and give rise to a fiscal surplus. Eventually, the growth rate declines, as it is dependent on a change in the deficit.

Furthermore, we do not reject the hypothesis regarding the primary surplus for the growth rate, as it declines as predicted, and by the year 2030, it reaches a level lower than that compared to the baseline scenario. On the other hand, the hypothesis for the debt-to-GDP ratio is rejected as the ratio reaches a higher level than that compared to the baseline level. This decline in the growth rate does not increase the GDP. In addition, the projections made for increasing the primary surplus have been unable to decrease the debt as much as that which has been achieved using the other strategies. The debt-to-GDP ratio is therefore, still higher than the baseline ratio by the year 2030.

In both the second and the third packages, the growth rate for all the three strategies reaches a higher level than that of the baseline scenario growth rate by the year 2030. However, the interest rate strategy would be effective for both Greece and its creditors, as this strategy helps the debt-to-GDP ratio to reach a sustainable level by 2030. On the other hand, the primary surplus strategy would not be as useful as the interest rate strategy, even though it still can be applied if the creditors are not ready to lower the interest rate due to their loss of income resulting from the interest earnings. In this case, it might take some more years after 2030 for the economy to reach a sustainable level. The creditors probably need not employ the debt write-off strategy in this scenario, as the Greek public debt-to-GDP ratio can eventually reach a sustainable level in a reasonable time. This is when using the other two strategies and also without the creditors having to lose big amounts of their debt principles.

In this case, we do not reject the hypothesis for both the debt-to-GDP ratio and the resulting growth rate for all the three strategies in both the second and the third packages respectively.
In the second package, some empirical results for the primary surplus strategy are similar to the findings made by Alesina and Giavazzi, (2012). The growth rate, in the case of the primary surplus, for both the second and third packages, is quite similar to the results mentioned by Posner and Sommerfeld (2012). Additionally, in the third package, the empirical results for the debt-to-GDP ratio are also found to be similar to the findings mentioned by the IMF (2010) and Devries et al. (2011) in their recent reports. Furthermore, the findings of Panizza and Presbitero (2012) have a very high similarity to the results observed in the second package.

In all the three packages, the effect of a low economic growth rate on public debt can be seen, and this outcome has a very close relationship to the findings of Krugman (2010). Both the Barro-Ricardo equivalence and the dynamic political theories can also be taken into consideration for all the three packages, and particularly, when considering the implementation of the primary surplus strategy. The effect of the “too much too soon” spending cuts is however, observed only in the first and second packages.

Future research regarding the sustainability of the Greek debt can be conducted by considering as another debt reduction strategy - privatization that is controlled by the debtor nation. This can replace the debt write-off strategy, as this has been concluded as being unfavourable for the creditor nations in terms of the Greek public debt in reaching a level of sustainability. Moreover, the elasticity of growth, z, which has been set to 1 in this paper, can be changed to any value between 0.6 to 1.1, as suggested by the literature review that has been discussed earlier. This might lead to different results for the growth rate, and hence, affect the debt-to-GDP ratio inversely for all three strategies in each of the three packages. The answer to the research question would also then vary considerably.

In a nutshell, it can be concluded that the interest rate strategy would be the most effective measure among all the three packages, in successfully lowering the debt-to-GDP ratio to a sustainable level in a reasonable timespan. It also maintains the growth rate at a sensible level by the year 2030, compared to the level of the baseline scenario. However, it is important to note that as mentioned earlier, even though this strategy is beneficial to the Greek growth, it may be costly for the creditors compared to the primary surplus strategy where they do not lose any revenue earned through the interest rate. This is because they would have to lose a significant part of the income generated from the interest that they can earn on the loans that have been given to Greece.

If we calculate the loss incurred by the creditors, then it would reach €81bn by the year 2030. This can be seen when we compare the interest rates projected in the baseline scenario and the projections made in this paper regarding the further reduction of the interest rate. On the other hand, if we consider the 4% level of interest rate as projected for 2013 in the baseline scenario, and assume that this rate is constant until 2030, then the creditors may lose €133bn. Though the debt write off strategy is the most effective, it would still not be favourable for the creditors. This is because if the creditors implement this strategy, then according to the
assumptions made in this paper, they can expect to at least €230bn by the year 2030. Thus, it would be favourable for the creditors to implement the rate of interest strategy if they want the Greek public debt to reach a level of sustainability in a reasonable time period, keeping in mind the overall interest of the economic world. Hence, the creditors would have to be generous with Greece so that it can then achieve a level of debt sustainability in a reasonable timespan.
References


Bailey, M.J. (1956), The welfare cost of inflationary finance, Journal of Political Economy 64, 93-110


Calvo, G., A. (1978), on the time consistency of optimal policy in a monetary economy, Econometrica 46, 1411-1428.


Greece debt burden, How to end the agony. (2012, November 10th-16th) The Economist, p. 12


Larch, M. and Alessandro, T. (2008), “Received Wisdom and Beyond: Lessons from Fiscal Consolidations in the EU.” European Economy


OECD Observer No 270/271 December 2008-January 2009


Toil and trouble. (2012, November 10th-16th), The Economist, p. 25


Appendix A

\[ DEF_t = INT_t - PS_t = \sum_i r_i D_{i,t-1} - \pi_t Y_t \quad (A.1) \]

This equation implies that the fiscal deficit is the difference between net interest payment and primary surplus. Whereas interest payments amounts to be the total of current year’s interest rate for the particular category and multiplying this total with outstanding debt on the last day of the previous year in that particular category. Moreover the primary surplus is calculated by multiplying GDP and the “planned target primary surplus as a percent of GDP”, i.e. \( \pi \). (Cline, 2011).

\[ BG_t = DEF_t - PVZ_t + AMZ_t + BR_t \quad (A.2) \]

This equation states the gross borrowings which are needed to cover the fiscal deficit, amortization of debt and bank recapitalization. In addition, amount received from privatization programme would be deducted from gross borrowings (Cline, 2011).

\[ D_t = \sum_i D_{i,t} \quad K_t = K_{t-1} + BR_t \quad ND_t = D_t - K_t \quad (A.3) \]

Here gross public debt is the sum of present year’s debt outstanding for the particular category. Furthermore, financial asset for present year \( K_t \) is equal to the previous year’s financial asset plus bank recapitalisation for the present year. Finally the net debt for present year would be achieved by subtracting the present year’s financial asset from gross public debt (Cline, 2011).

\[ D_t = D_{t-1} + NB_t \quad (A.4) \]

Gross public debt for this year can be calculated as public debt from the previous year plus new borrowings from this year as shown in (A.4)

\[ GDP_t = g(GDP_{t-1}) \quad (A.5) \]

This equation describes that present Year’s GDP would be equal to the product of present growth and previous year’s GDP.

\[ g = g + z (DEF_t - DEF_{t-1}) \quad (A.6) \]

Here \( g \) is calculated through real growth of present year plus product of \( z \) (\( z \) is a growth coefficient and is an elasticity of growth with respect to change in deficit) and difference between the present year deficit and previous year deficit.
Table A.1 Definitions

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>Gross Public debt</td>
</tr>
<tr>
<td>ND</td>
<td>New public debt</td>
</tr>
<tr>
<td>BG</td>
<td>Gross Borrowings</td>
</tr>
<tr>
<td>NB</td>
<td>New Borrowings</td>
</tr>
<tr>
<td>AMZ</td>
<td>Amortization</td>
</tr>
<tr>
<td>PVZ</td>
<td>Privatization</td>
</tr>
<tr>
<td>K</td>
<td>Financial assets</td>
</tr>
<tr>
<td>BR</td>
<td>Bank recapitalization</td>
</tr>
<tr>
<td>DEF</td>
<td>Fiscal Deficit</td>
</tr>
<tr>
<td>PS</td>
<td>Primary surplus</td>
</tr>
<tr>
<td>$\eta_i$</td>
<td>Interest rate, debt category $i$</td>
</tr>
<tr>
<td>INT</td>
<td>Interest payments net</td>
</tr>
<tr>
<td>Y</td>
<td>GDP</td>
</tr>
<tr>
<td>$\pi$</td>
<td>Primary surplus, fraction of GDP</td>
</tr>
</tbody>
</table>

(Cline, 2011)
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross debt (percent of GDP)</td>
<td>148</td>
<td>170.6</td>
<td>184.5</td>
<td>196</td>
<td>207</td>
<td>209</td>
<td>209</td>
<td>204</td>
<td>199</td>
<td>195</td>
<td>190</td>
</tr>
<tr>
<td>Net debt (percent of GDP)</td>
<td>115</td>
<td>128</td>
<td>136</td>
<td>146</td>
<td>157</td>
<td>160</td>
<td>161</td>
<td>157</td>
<td>154</td>
<td>151</td>
<td>147</td>
</tr>
<tr>
<td>Interest payment (percent of GDP)</td>
<td>7.3</td>
<td>8.2</td>
<td>7.8</td>
<td>8.1</td>
<td>8.1</td>
<td>8.4</td>
<td>6.1</td>
<td>6.0</td>
<td>5.8</td>
<td>5.7</td>
<td></td>
</tr>
<tr>
<td>Amortization (percent of GDP)</td>
<td>0</td>
<td>12</td>
<td>6.8</td>
<td>7.4</td>
<td>8.9</td>
<td>6.5</td>
<td>3.7</td>
<td>2.4</td>
<td>0.7</td>
<td>1.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Gross borrowing requirement</td>
<td>56.7</td>
<td>44</td>
<td>23.8</td>
<td>19.6</td>
<td>14.4</td>
<td>9.5</td>
<td>3.4</td>
<td>0.9</td>
<td>2.3</td>
<td>-0.15</td>
<td></td>
</tr>
<tr>
<td>Primary deficit</td>
<td>11.1</td>
<td>1.7</td>
<td>10.5</td>
<td>-2.1</td>
<td>-8.6</td>
<td>-8.8</td>
<td>-9.0</td>
<td>-9.0</td>
<td>-9.2</td>
<td>-9.5</td>
<td></td>
</tr>
<tr>
<td>Interest payment, net</td>
<td>15.7</td>
<td>16.5</td>
<td>14.8</td>
<td>15.8</td>
<td>16.4</td>
<td>12.5</td>
<td>12.6</td>
<td>12.7</td>
<td>12.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bank recapitalization*</td>
<td>15</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amortization*</td>
<td>27.2</td>
<td>14.6</td>
<td>14.9</td>
<td>17</td>
<td>12.4</td>
<td>7.2</td>
<td>4.8</td>
<td>1.5</td>
<td>3.2</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>Bond Buy back</td>
<td>20.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Debt write-off</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary surplus (percent of GDP)</td>
<td>-4.9</td>
<td>-0.8</td>
<td>-5.2</td>
<td>1.1</td>
<td>4.5</td>
<td>4.5</td>
<td>4.5</td>
<td>4.25</td>
<td>4.25</td>
<td>4.25</td>
<td>4.25</td>
</tr>
<tr>
<td>Real GDP Growth (percent)</td>
<td>-1.7</td>
<td>-5.3</td>
<td>-6.5</td>
<td>-5.2</td>
<td>-0.26</td>
<td>2.63</td>
<td>2.67</td>
<td>2.67</td>
<td>2.67</td>
<td>2.67</td>
<td>2.67</td>
</tr>
<tr>
<td>Gross debt (bn €)</td>
<td>337</td>
<td>367</td>
<td>371</td>
<td>374</td>
<td>394</td>
<td>408</td>
<td>418</td>
<td>421</td>
<td>422</td>
<td>424</td>
<td>424</td>
</tr>
<tr>
<td>Total assets end of the year</td>
<td>76</td>
<td>101</td>
<td>129</td>
<td>130</td>
<td>140</td>
<td>149</td>
<td>140</td>
<td>136</td>
<td>137</td>
<td>138</td>
<td>139</td>
</tr>
<tr>
<td>Financial asset**</td>
<td>76.2</td>
<td>91.2</td>
<td>96.2</td>
<td>96.2</td>
<td>96.2</td>
<td>96.2</td>
<td>96.2</td>
<td>96.2</td>
<td>96.2</td>
<td>96.2</td>
<td>96.2</td>
</tr>
<tr>
<td>Net debt, end of year</td>
<td>261</td>
<td>276</td>
<td>275</td>
<td>278</td>
<td>298</td>
<td>312</td>
<td>322</td>
<td>325</td>
<td>326</td>
<td>328</td>
<td>328</td>
</tr>
<tr>
<td>Privatization receipts</td>
<td>0</td>
<td>2.9</td>
<td>3.0</td>
<td>3.81</td>
<td>3.8</td>
<td>4.9</td>
<td>5.0</td>
<td>5.2</td>
<td>4.23</td>
<td>4.34</td>
<td>4.5</td>
</tr>
<tr>
<td>Nominal GDP</td>
<td>227</td>
<td>215</td>
<td>201</td>
<td>190.5</td>
<td>190</td>
<td>195</td>
<td>200.2</td>
<td>206</td>
<td>211.5</td>
<td>217.1</td>
<td>223</td>
</tr>
<tr>
<td>Interest rate (percent)</td>
<td>4.89</td>
<td>4.66</td>
<td>4.49</td>
<td>4.00</td>
<td>4.00</td>
<td>4.00</td>
<td>4.00</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
</tr>
</tbody>
</table>

(*Celine, 2011, ** OECD, 2011) (Continues to the next page)
<table>
<thead>
<tr>
<th></th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
<th>2026</th>
<th>2027</th>
<th>2028</th>
<th>2029</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gross debt/GDP</strong></td>
<td>182</td>
<td>174</td>
<td>166</td>
<td>158</td>
<td>150</td>
<td>142</td>
<td>133</td>
<td>125</td>
<td>117</td>
<td>110</td>
</tr>
<tr>
<td><strong>Net debt/GDP</strong></td>
<td>140</td>
<td>132</td>
<td>125</td>
<td>118</td>
<td>111</td>
<td>103</td>
<td>95</td>
<td>88</td>
<td>81</td>
<td>73</td>
</tr>
<tr>
<td><strong>Interest/GDP</strong></td>
<td>1.9</td>
<td>1.8</td>
<td>1.7</td>
<td>1.6</td>
<td>1.55</td>
<td>0.74</td>
<td>0.7</td>
<td>0.65</td>
<td>0.62</td>
<td>0.58</td>
</tr>
<tr>
<td><strong>Amortization (percent of GDP)</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Gross borrowing requirement</strong></td>
<td>-10.6</td>
<td>-10.9</td>
<td>-11.3</td>
<td>-13.0</td>
<td>-13.2</td>
<td>-14.2</td>
<td>-14.8</td>
<td>-14.9</td>
<td>-15.3</td>
<td>-15.6</td>
</tr>
<tr>
<td><strong>Interest payments, net</strong></td>
<td>4.2</td>
<td>4.1</td>
<td>4.0</td>
<td>3.9</td>
<td>3.8</td>
<td>1.8</td>
<td>1.8</td>
<td>1.7</td>
<td>1.6</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>Amortization</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Primary surplus(percent of GDP)</strong></td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td><strong>Real GDP Growth (percent)</strong></td>
<td>1.67</td>
<td>1.67</td>
<td>1.67</td>
<td>1.67</td>
<td>1.67</td>
<td>1.67</td>
<td>1.67</td>
<td>1.67</td>
<td>1.67</td>
<td>1.67</td>
</tr>
<tr>
<td><strong>Gross debt (bn €)</strong></td>
<td>413</td>
<td>402</td>
<td>390</td>
<td>378</td>
<td>365</td>
<td>350</td>
<td>335</td>
<td>320</td>
<td>305</td>
<td>289</td>
</tr>
<tr>
<td><strong>Total assets end of year</strong></td>
<td>140</td>
<td>141</td>
<td>142</td>
<td>143</td>
<td>145</td>
<td>146</td>
<td>146</td>
<td>147</td>
<td>148</td>
<td>149</td>
</tr>
<tr>
<td><strong>Financial assets</strong></td>
<td>96.2</td>
<td>96.2</td>
<td>96.2</td>
<td>96.2</td>
<td>96.2</td>
<td>96.2</td>
<td>96.2</td>
<td>96.2</td>
<td>96.2</td>
<td>96.2</td>
</tr>
<tr>
<td><strong>Net debt, end of year</strong></td>
<td>317</td>
<td>306</td>
<td>294</td>
<td>282</td>
<td>269</td>
<td>254</td>
<td>239</td>
<td>224</td>
<td>209</td>
<td>193</td>
</tr>
<tr>
<td><strong>Privatization receipts</strong></td>
<td>5.7</td>
<td>5.8</td>
<td>5.9</td>
<td>6.0</td>
<td>7.3</td>
<td>7.4</td>
<td>7.5</td>
<td>7.7</td>
<td>7.8</td>
<td>7.9</td>
</tr>
<tr>
<td><strong>Nominal GDP</strong></td>
<td>227</td>
<td>231</td>
<td>235</td>
<td>239</td>
<td>243</td>
<td>247</td>
<td>251</td>
<td>255</td>
<td>259</td>
<td>263</td>
</tr>
<tr>
<td><strong>Interest rate (percent)</strong></td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
</tbody>
</table>