

The Greek debt crisis- using the Solow model to simulate future fiscal balance and output growth

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Abstract

Since the financial crisis of 2008 many European countries have been plagued by growing fiscal deficits and public debts. The country found by many to be the worst off is Greece and in this study we use the Solow model of economic growth to attempt to find a savings level for Greece which provides enough capital for both investment and debt service. We use two different scenarios where one is based on economic forecasts concerning fiscal balance and public debt by Greece and the EU and one where we let Greece adopt the fiscal policies of Switzerland. Through OLS estimation we find how certain variables such as public expenditure affect the savings level. By using the Solver software in Microsoft Excel we optimize the public finance levels according to our two scenarios and see how this affects the savings level which in turn influences investment and economic growth. The results of our study are somewhat grim from a Greek perspective. In both scenarios Greece has to reach large budget surpluses unheard of historically for the country to cut their public debt level. We also find that the country cannot attain both economic growth and a sustainable debt level simultaneously.

Key words: Solow model, debt crisis, budget deficit, Greece.

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1. Introduction

In the aftermath of the global financial crisis many countries around the world, especially advanced western economies, have accumulated large public debt. According to an IMF working paper debt in advanced economies is projected to rise from an average of 73% of GDP in 2007 to 108% of GDP at the end of 2015. These are debt levels that have not been seen since the end of World War II (Baldacci, 2010). By 2014 debt ratios in all G-7 economies except Canada will be close to or above 85% of GDP. Even with an economic recovery budget deficits will remain sizeable for years to come. Partly because budget balances in many advanced economies were weak even prior to the crisis because of increased spending and revenue losses. (Velloso, 2010)

Furthermore, a rather substantial addition to the fiscal problems in the western world is starting to reveal itself in the form of an increasing ageing population. This phenomenon will contribute to the already pressured fiscal balances in form of a steep increase in age-related spending (Baldacci, 2010). An ageing population will lead to higher costs associated with services such as pensions and healthcare, but it will also lead to lower economic growth as the share of working individuals in the economy fall. (ECOFIN, 2009) In Europe these alarming signs turned into concerns of an emerging debt crisis in the late 2009 and early 2010 when it stood clear that some of the countries in the Euro zone's periphery were struggling with huge budget deficits and debt levels.

One of the most severely debt-ridden countries at the moment is Greece, which will be the focus of our thesis. We have chosen to study the country by using the Solow model of economic growth. According to the Solow model savings can be used for capital investment, which in turn output is assumed to be a function of. By manipulating private savings, investment, public revenue and expenditure for future dates according to two different economic scenarios, we aim to find if a country as deep in debt as Greece has any hope of combining economic growth with fiscal balance. Our main focus will be on the scenario that has been presented by the Greek government in its "Economic Adjustment Program" which projects that Greece will display a positive fiscal balance within in a few years. To attain a long-run sustainability perspective of these fiscal adjustments they will be combined with the European Commission's public debt target. This target states that member countries should have reached a threshold debt level of 60% of GDP in 2060. (ECOFIN,2009) Our other scenario is an alternative to the joint Greek and EU scenario where we study what would happen if Greece would return to the fiscal policy of the early 80s.

Our results show that it will be very hard for a country as indebted as Greece to achieve both economic growth and fiscal sustainability. Public expenditure will have to fall to unreasonably low

levels for private savings to increase to levels high enough for the capital stock to increase. An aging population also means less workers in the future which puts even further pressure on the capital stock if output growth is to be feasible. Both our scenarios make some rather strong assumptions about future macroeconomic outlook and as with any economic research that deals with the long run, there is a high degree of uncertainty.

The economic concerns for Greece escalated in late 2009, when Greek officials announced that their budget deficit for the fiscal year would be twice as big as previously informed. This information caused yields on Greek government bonds to increase during the end of 2009 and beginning of 2010. During the following spring the newly elected Greek government made attempts to suppress their fiscal problems by presenting austerity plans for the public sector. The market and especially the credit rating agencies were not convinced and interest rates on Greek debt continued to rise. This was followed by additional and even stricter austerity plans by Greek authorities. These actions led to a temporary reassuring of the market but meanwhile, as an answer to cutbacks, social unrest arose in Greece. The government's credibility to be able launch the austerity package was questioned and as a response interest rates continued to increase.

In general, if financial markets perceive a higher risk of default in a country it raises the interest rates on government bonds to compensate for the extra risk. This means higher debt service payments which can lead to that the country experiences difficulties to pay interest on its debt (Baldwin, 2010). This is exactly what happened to Greece. The economic turmoil led to that the country finally in May of 2010 was forced to ask euro zone countries and the IMF for an unprecedented bailout because it could no longer service its debt. (Wall Street Journal) The bailout was followed by a second rescue package in July this year (Economist).

Since the events of the spring of 2010, Greece has been forced to make a paradigm shift in its fiscal and economic policies to come to terms with its internal and external imbalances. Ever since the introduction of the Euro and the entry into the EMU collaboration the country's growth model have been based on consumption, which in retrospect have proven to be malicious. The fast growth that had been seen since the adaption of the euro was based on unsustainable factors. At the entry in 2001 access to low-cost credit contributed to a boost in demand, especially in consumption. However these demand improvements was not met with complementary changes on the supply side of the economy, changes like an improvement in competitiveness which is of crucial importance when joining EMU due to the fixed exchange rate. Instead increases in fiscal policies and real wages were carried out which led to substantial imbalances in the government budget. As a consequence Greece has been compelled to refocus away from consumption based growth and instead chose a growth

path aligned on investments and exports. For this to happen Greece will need to increase their output growth and tighten their spending to be able to close the negative gaps in future fiscal balances. Another objective of the Greek adjustment program currently underway is to establish a more sustainable saving to investment relationship (Hellenic Republic Ministry of Finance, 2011).

Among some of the previous studies that have been conducted concerning public debt and its effects is that of Carmen M. Reinhart and Kenneth S. Rogoff who study economic growth and inflation during different levels of government and external debt in their working paper *"Growth in a time of debt"* from 2010. Their analysis is based on data on 44 countries spanning over 200 years. One of their main findings is that the relationship between government debt and real GDP growth is weak for a debt to GDP ratio below a level of 90 percent of GDP. Above 90 percent growth rates fall by one percent at the median and average growth falls considerably more. Consequently high levels of debt have negative implications when trying to foster economic growth (Rogoff, 2010).

In the paper *"Sovereign default risk and bank fragility in financially integrated economies"* Patrick Bolton and Oliver Jeanne analyze contagious sovereign debt crises in financially integrated economies. They show that financial integration without fiscal integration leads to an inefficient supply of government debt. Furthermore, the large financial integration between national markets in areas like the Euro-zone means that a sovereign debt crisis can lead to contagion to other states. This means that if the safety of a countries government bonds is questioned, others will soon be closer scrutinized as well. The contagion effect is mostly due to banks owning large amounts of other countries government bonds (Bolton, 2011).

Kumar and Baldacci shows that higher deficits and public debt lead to an increase in long-term interest rates and the magnitudes of the increase depends on institutional and other structural conditions and spillovers from global financial markets. This implies that large fiscal deficits and high levels of public debt are likely to put substantial upward pressure on government bond yields (Kumar, 2010).

A report by the IMF (Leigh, 2010) based on a monetary and fiscal model states that fiscal consolidation generally will have contractionary effects on output. The contraction can be cushioned by a reduction in the interest rate. Although over the long run reductions in government debt is likely to raise output. Lower government debt was found to reduce real interest rates which in turn stimulate private investment. Furthermore the lower burden of interest payments creates possibilities to make reductions in distortionary taxes. The model simulations made in the report conclude that for every 10 percentage point fall in the debt to GDP ratio output raises by approximately 1,4% in the long term.

In a NBER working paper based on historical data Alesina and Ardagna (2009) states that sharp reductions of budget deficits have been followed by sustained growth rather than recessions. When it comes to the fiscal adjustments necessary cuts on the spending side is shown to be the most beneficial. The cuts should be rather substantial, credible and perceived as permanent which sends a message of a change in regime eliminating the need for larger divisive adjustments in the future. Furthermore spending cuts which are combined with untouched tax levels are more likely to reduce debt levels and deficits compared to when taxes are raised.

The notions presented by Alesina and Ardagna is however questioned by Paul Krugman who argues that their results of fiscal consolidation were helped by the fact that the countries studied benefited from recent moves into trade surpluses and declines in interest rates (NYtimes).

In our paper we will begin with providing our readers with background information on the time leading up to and during the Greek debt crisis. We will present both internal and external factors which have been presented as causing or worsening the Greek fiscal balance. Following this is a presentation of the Hellenic stability and growth program adopted in 2010 which provides fiscal prospects of the Greek economy prepared by the Greek government in cooperation with the EU. We will base one of our scenarios on this program in the later data section.

In the next section we present the Solow model which our thesis is based on. We show the relationship between output and investment and how investment is constrained in the case of Greece, since it depends on savings which are here limited because of the country's high debt servicing expenses. We continue by estimating a regression for savings in Greece where we use government expenditure as one of the explaining variables. Government expenditure has a known effect on private savings, but earlier empirical studies have shown ambiguous results whether the effect is positive or negative. The regression becomes the link in our model showing how the policies of the public sector affect the private sector.

In the final section we use our model to analyze the two different economic scenarios discussing their feasibility and likelihood.

2. Background

2.1 The Greek debt crisis

2.1.1 Background to the Greek debt crisis

In the early May of 2010 the looming Greek debt crisis came to full bloom as the authorities from the European commission and the Greek government officially announced, that a major bail-out consisting of and €100 billion would be set in place to assist Greece prevent them from defaulting on their massive debt and help keep the euro stable. The package would help, but also demand adjustment from Greece whose earlier efforts to stabilize its economy were deemed inefficient. Besides the European commission both the IMF and the ECB were prominent in creating the new policies for Greece to enact (BBC, 2009). There had been contact between the economic officials of the EU and ECB and their Greek counterparts before 2010 about the economic conditions in Greece, but the policy changes then advised had not been on the scale and level of what was announced at this point (Public Finance EMU, 2010).

2.1.2 Buildup

The Greek economy had been on a slide since the global economic downturn of 2008. From the beginning of the new millennium up until 2008 the Greek economy had registered high yearly GDP growth of approximately 4%, but at the same time running high budget deficits with an increase in debt to GDP ratio as a consequence (WDI). Between 2001, when Greece adopted the euro as its currency and 2008, the average budget deficit equaled 5%. Compare this to a Eurozone average of 2%. Greece had developed a reliance on financing from international capital to allow them to roll over their debt, which never posed a challenge as long as international markets were liquid. As the crisis unfolded and funds dried up problems were bound to ensue. Speculation also began whether Greece might default (Nelson, 2005).

The high budget deficits were thus exceeding the maximum of 3% of GDP determined by the EU's stability and growth pact for all member countries. The total debt-to-GDP level was as at a level of 94%, also far higher than the 60% allowed by the same EU pact. The worldwide economic downturn of 2008 exposed the weak fiscal state of Greece and since they were so reliant on external funding, changes in investors' confidence were of greater consequence to Greece than other countries also hit hard by the crisis.

General political tumult led to a change of government in 2009 putting the Socialist Party led by Prime Minister George Papandreou in power. The new prime minister vowed to cut down spending on Greece's extensive military and to clamp down on tax evasion, while also promising €3 billion of fiscal stimulus to recharge a stagnating economy (Guardian, 2010). Despite these plans the change of regime did not lead to the rejuvenation of the economy that had been hoped, since the new ruling party found that the former government had underestimated the public and fiscal debts of 2008 and 2009. The new government revised the existing budget deficit of 6.7% of GDP upwards to 12.7% almost doubling it (Nelson, 2010). When news of this reached the markets it caused confidence to drop while GDP- and employment-growth was brought to a halt. This also led to a huge hit to the financial sector when, as a consequence of the weak financial balances, Greek government bonds were downgraded by the leading rating agencies. This brought bond prices down and yields up when investors started selling of their Greek assets (CME Group, 2010).

At the start of the crisis the yield spread between German and Greek 10-year bonds were 10 to 40 basis points. From late 2009 until early 2010 the spread dramatically increased to 400 basis points which was record high at this time. High spreads were indicative of declining investor confidence in the Greek economy (Nelson, 2010).

In the midst of this Prime Minister Papandreou again announced reforms in the middle of December of 2009 to reduce the countries deficit promising large cuts to the public sector and a general cut in government spending. These reforms were not met by keen ears and thousands of Greeks took to the streets in the following days to protest the government (Guardian, 2010). The economic malaise led to liquidity tightening up following large bank withdrawals of 14% of total deposits by the Greek public which in turn caused the banks to lower their lending further curtailing growth. At the point of writing the Greek banks have become more dependent on help from the ECB for their daily transactions following both the reduction in deposits and since the banks are not allowed to have normal access to financial markets (CME Group, 2011).

All seemed not lost for Greece when they, despite the general anxiety regarding the country's economy, managed to successfully sell €8 billion worth of bonds in the end of January 2010, €5.6 billion at the end of March and finally €1.56 billion a month later in April. This capital came at a high cost however since the interest rate was now at a higher level than normal. Furthermore it was still far from enough money to cover up their maturing debt and repayments of 2010 for which it was estimated Greece needed to borrow another €54 billion.

At the end of March 2010, in an attempt to calm the financial markets, the Eurozone countries along with the International Monetary Fund (IMF) pledged to come forth and provide financial assistance

to Greece should it be needed and asked for by the Greek government. A few weeks later a proposed help package was presented whereby Greece were granted a three-year loan of €30 billion at a 5% interest rate which was higher than what was demanded from other Southern European countries, but lower than what they would have had to pay in private markets. The news that their government had been in talks with other Euro countries and the IMF led to outrage among some parts of the Greek public who felt that the country was giving away its economic sovereignty and fear also grew that new loans would lead to stricter cuts in spending (Guardian, 2009). It did not take long before the Greek government had to ask for this help package since reactions to a report from Eurostat, EU's head statistical department, which revised the government deficit of 2009 upwards by 1% from 12.6% of GDP to 13.6%, were all but good. Investors felt alarmed and on April the 23rd 2010 Greece had to ask for financial assistance from the IMF and other Eurozone countries. Before granting the assistance the other Eurozone countries led by Germany requested the details of Greece's planned budget cuts for the following years. A few days later the spread between the Greek and German 10-year bonds hit an all-time high at 650 basis points as rating agency Standard & Poor's downgraded the Greek credit rating to junk status. This would have meant that Greek bonds no longer could be used as collateral for loans from the ECB. Alas the ECB responded quickly to this by rewriting their rules allowing the Greek bonds to be used as collateral again, despite their junk status (Bolton, 2011).

It was apparent even before they were even officially asked for, that the €30 billion in financial assistance granted, would not be enough for Greece to withstand any longer period. Talks therefore continued among the other Eurozone countries and the IMF of a larger bail-out consisting of €100 billion. Germany were at first negative, but agreed after what they found adequate demands had been put on Greece. Germany and the other Eurozone countries would also be able to quarterly monitor the Greek austerity measures (Nelson, 2010). Some of the demands for the bail-out to take place were that Greece were forced to decrease their public spending and increase their income by e.g. increasing the VAT from 21% to 23%, putting a halt on all public sector salaries and pensions for 3 years, increasing public transportation fees and raising taxes on fuel, alcohol and tobacco. The target was to have the budget deficit at 3% in 2014. But before that the total debt was expected to rise to a level of 149% in 2013 from approximately 115% in 2010 before dropping of (BBC, 2010).

In the beginning of May Greece announced that it would need the €100 billion rescue package from the EU and IMF. In return the country would continue with austerity measures such as those mentioned above to cut their budget by €30 billion. Markets initially responded favorably initially with the yields on Greek 10-year bonds sinking by a few hundred basis points. During the rest of the 2010 Greece were still dependent on the EU to enable them to service their immediate debt obligations (CME Group, 2011).

In 2011 decisions were made in the Greek parliament to increase the retirement age and to privatize government-owned companies in an attempt to raise €50 billion. The government also continued with other austerity measures causing anger amongst part of the public leading to rioting and strikes. The Greek credit rating took another hit when Standard & Poor's downgraded their credit rating again. This made Greece the country with the lowest credit rating in the world, just a few steps above the default rating (CME Group, 2011). Even though implementing strict austerity measures and other fiscal restructuring the Greek government struggling with an unsatisfied public was forced once more to ask the euro-zone, ECB and IMF for another bailout package in the end of July this year (Economist, 2011).

2.1.3 Possible causes of the crisis

The current economic turmoil plaguing Greece is viewed to be caused by both internal and external factors. The internal problems are mostly structural problems with a large and ineffective public sector which leads to excessive government spending while corruption and widespread tax evasion hinder the collection of the necessary revenue to cover the spending. At an international level the adoption of the Euro and the somewhat lacking control of the EU to prevent unwarranted debt accumulation (Nelson, 2010).

2.1.4 Internal factors

The years following the adoption of the Euro as the official currency in 2001 the Greek GDP grew annually at an average of 4.3% until 2007, more than 1% higher than the Eurozone average at the time. The growth in GDP was largely driven by increased consumption which was made possible by the Greek public having an easier access to credit compared to previously before their Euro-membership. Public investment also increased financed by the EU and the central government. Unfortunately while government expenditure increased by 87% the six years following the Euro adoption, revenues only grew by 31% (Hellinic stability, 2010). One of the main factors of the high spending was as mentioned above the large public sector, which was the most costly as a percentage of total government expenditure of all OECD countries. No reasons to warrant this such as higher efficiency or superior quality were found. In 2009 the government expenditure reached a level of 50% of total GDP despite measures had been taken through the decade to decrease costs. The public sector was still over-staffed and inefficient (Nelson, 2010).

During the more economically successful years of the 2000s wages had also increased sharply causing some to say that Greece has lost its competitiveness. Since they no longer have the ability to devalue their currency, wages might have to go down in order to boost competitiveness and hopefully increase exports (Public Finance EMU, 2010). After 2008 the economies largest industries tourism and shipping were hit hard by the worldwide crisis with revenues decreasing up to 20%

Like many western countries Greece has to solve the problem of an aging population. Of the Greeks approximately 20% are over 64 years old and this is expected to increase to 32% by the year 2060. This is a potentially large burden for the Greek economy since Greece has had one of the most generous pension systems in Europe. The pension rate of the average Greek is 70%-80% of their previous income. People also work for a shorter duration of their lifetime compared to other European countries and are still entitled to a full pension.

The weak tax collection has limited the Greece governments' ability to raise revenues. Tax evasion is widespread among those of the Greek populace who are not employed in the private sector. It is estimated that the tax evasion of some of those employed in the public sector and those who are self-employed constitutes "an informal economy" which equals 25%-30% of GDP (Telegraph, 2011). Some of the suspected causes of the tax evasion are lax tax collection and low penalties for under-reporting ones wealth and income (Nelson, 2010).

2.1.5 External factors

As much as it was an economic boost for Greece to become a part of the Eurozone, with hindsight some critics believe that the Euro adoption also played a large part in contributing to the current crisis. With the adoption of the Euro Greece was allowed to borrow at the same interest rates as larger economic heavyweights Germany and France since investors had preconceived visions that a Euro membership should guarantee stability. The easier access to cheap credit allowed Greece to service their debt, while at the same time accumulating more of it than they would have been able to had they been facing the same rates as before the Eurozone membership (Nelson, 2010).

Another factor is the lack of enforcement of the Stability and Growth pact by the European Union. The pact was created in 1997 by EU members to increase the surveillance and enforcements of the public finance rules defined by the Maastricht treaty to increase the merging of the different economies of soon to be Euro-zone countries. The pact defined the maximum budget deficit of a country as 3% of GDP and the maximum public debt at 60% of GDP. Countries who failed to follow these restrictions, despite given time to apply corrective measures, were at the risk of being fined by

the European Union of as much as 0.5% of GDP. After the launch of the Euro many countries had trouble following the restrictions, but the European Union remained happy as long as member states promised that they would correct their deficits in due time. Greece was first warned in 2003 when their budget was revised up to 3.2%. At the same time attention was drawn to the fact the head statistical unit of the EU Eurostat had not left their seal of approval to any data supplied by the Greek government since the year 2000. More investigations were conducted in 2007 by the European Commission leading to all reported deficits between 2004 and 2007 being revised upwards (Nelson, 2010). The same investigations also brought up the fact that the total debt of Greece had been over 100% already at the time of their Eurozone membership. This fact had been hidden by Greece early in the decade with the help of investment bank Goldman Sachs who had created a set of complex swap derivatives which allowed Greece to borrow money without it constituting debt under official Eurozone regulations. The arrangement led to officials from Goldman Sachs being brought in for questioning by the US government during 2010 (Guardian, 2010).

Incorrect macro statistics had been a known problem for outsiders looking into Greece ever since their euro adaptation. Reports on balances have been delayed or incorrect when sent to Eurostat, who are in charge of keeping statistics on the European Union and its member states. Experts from Eurostat have been sent to Greece more than any other country in the European Union in order to recheck data and also informing Greek officials about correct methods of gathering fiscal data. The reason the news of the misreported statistics caused such concern in 2009 when the new government announced them, was that they arrived at a point when the Greek economy already was at a weakened state (Eurostat, 2009).

2.2 The Hellenic stability and growth Program

To come to terms with its fiscal imbalances and to foster a sustainable growth path the Greek government adopted the Economic Adjustment Program (EAP) in May 2010. The EAP is a comprehensive multi-year adjustment program that has the goal of performing a fiscal consolidation to reduce future deficits and to reduce the public debt to a sustainable level. Furthermore it is focused on carry through labor market and business environment reforms to boost Greek competitiveness. When it comes to future growth a new model based on investments and exports is launched instead of focusing on consumption.

One of the main objectives of the Greek adjustment program is to establish a more sustainable saving to investment relationship. From 2000 until 2009 a gap between private saving and total gross capital formation were seen, a gap which were covered with unsustainable current account balances.

Due to the contraction in the economy private savings decreased by 3,1% of GDP in 2010 and running up to debt crisis Greece had a record low total savings rate of 2,2%. Medium term prospects of the EAP projects an increase in private saving and with the gradual reduction of the negative saving of the government a lower current account balance is expected. Table 2.1 presents previous savings and the prospects of how investment will be financed until 2014:

Table 2.1

	<i>The finance of gross capital formation (% of GDP)</i>				
	<u>2006</u>	<u>2009</u>	<u>2010</u>	<u>2011</u>	<u>2014</u>
i. Gross fixed capital formation	20.9	17.1	14.7	14.0	14.0
ii. Change in stocks	-0.5	-0.4	0.5	0.9	0.7
iii. <u>Total investment</u>	<u>20.4</u>	<u>16.7</u>	<u>15.2</u>	<u>14.9</u>	<u>14.7</u>
iv. Private saving	11.5	14.8	11.7	10.4	10.8
v. Saving of general government	-3.8	-12.1	-8.3	-5.6	-2.0
vi. Current account balance	12.7	14.0	11.8	10.0	5.9
vii. <u>Total finance</u>	<u>20.4</u>	<u>16.7</u>	<u>15.2</u>	<u>14.9</u>	<u>14.7</u>

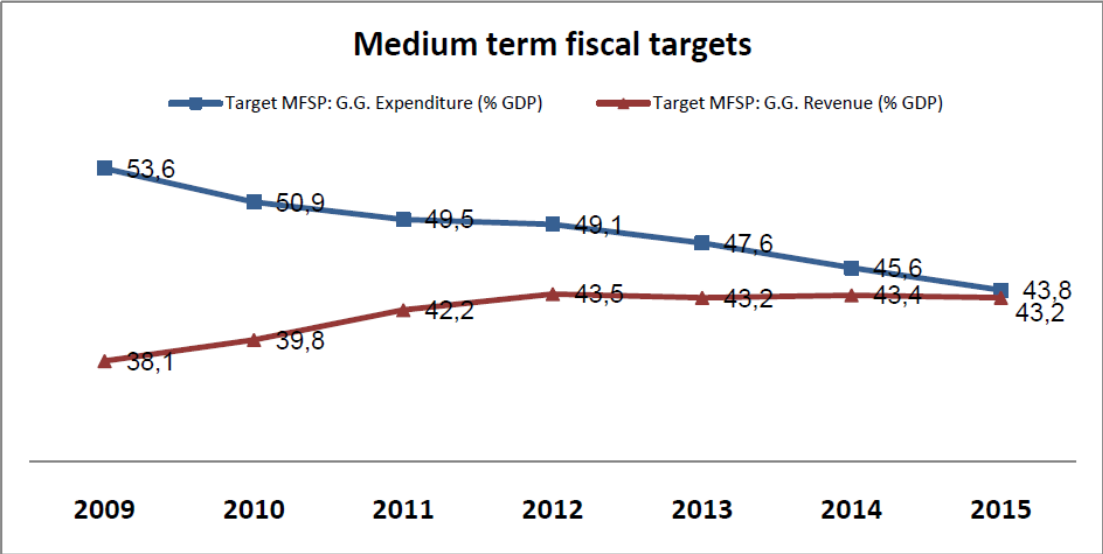
Source: Hellenic Republic Ministry of Finance, 2011

The EAP presents medium term prospects in the form of a fiscal strategy for the general government during the period 2012-2015. The fiscal plan aim at reducing the public debt and improve the possibilities for long term growth in the economy. In the EAP several policy targets is presented: a goal of a government deficit below 3% of GDP in 2014 and 0.6% in 2015 means that fiscal adjustments must be combined with large primary surpluses. For this to be possible the nominal GDP must increase by more than 3% in 2013 and in the long run the aim is an average growth of more than 5%. This is said to be necessary to cushion the snowball effect on public debt. According to the EAP these targets require both a reduction in government expenditure as well as an increase in government revenue. (Hellenic Republic Ministry of Finance, 2011,)

The explanation to the high level of debt in Greece given by the authorities is the substantial government deficits seen particularly the 2009 combined with the subsequent decrease in output that followed. The public debt increased to 142,8% of GDP in 2010 compared to 127,1% in 2009 and 110,7% of GDP in 2008. According to the baseline scenario in line with the medium term fiscal strategy public debt will peak at a level of 159,9% in 2012 and decline to 139,5% in 2015.

By implementing the medium term fiscal strategy a sustainable reduction of the public debt is enabled. The reduction will be accomplished by setting fiscal policy targets which aims at producing large primary surpluses in the medium term starting in 2012. Although the average maturity of debt is relatively high at 7.3 years large rollover of debt will be needed for the next few years. (Hellenic Republic Ministry of Finance, 2011) The economic policy presented in the EAP will according to Greek authorities gradually improve the negative debt ratio (Hellenic Republic Ministry of Finance, 2011). In table 2.2 the medium term fiscal targets for government revenue and expenditure can be seen.

Figure 2.1



3. Theoretical concepts of public finance

3.1. The government budget constraint

The economic conditions for the government does not differ that much from conditions of other agents in the economy. Whether describing a private household, a firm or a government they are all subjects to constraints during their lifetime. In general agents cannot consume more than they earn hence they are limited by a budget constraint which needs to be balanced at the end of their existence. Nevertheless, if considering the agents utility maximization problem, it could be desirable in some periods to spend more than is earned to be able to smooth consumption over time. When faced with temporary change in income rational agents save or borrow to spread the effects of consumption over time to avoid the destabilizing effect of highly variable consumption patterns. (Burda, 2005)

Equivalently to other economic agents the government can borrow and lend, provided that they later repay its debt with interest or that they are repaid by its debtors. If considering a long-run scenario the economic conditions for the government are described in the inter-temporal budget constraint.

3.1.1 The two-period-model

The inter-temporal budget constraint can be explained with a two-period-model describing the constraints on the government over two periods, the present and the future. Revenue is earned by collecting net taxes (taxes minus transfers) (T_t) and (T_{t+1}) and government spending is measured by the amount (G_t) and (G_{t+1}). Previous debt, accumulated beforehand, is denoted by D_t and must be serviced with the interest rate r . If the government spends more than its income it is running a deficit which, in period one, can be expressed as $(G_t - T_t + rD_t > 0)$. If running a deficit today the government must borrow to be able to finance the extra expenditure. The total borrowing of the government can be divided into two parts: the primary deficit $G_t - T_t$, the amount by which expenditures (excluding interest payments) exceed revenues, and interest payments on the current debt rD_t .

A governments inter-temporal budget constraint I said to be fulfilled when future primary surpluses ($T_{t+1} - G_{t+1}$), receipts minus spending excluding interest rates payments, is sufficient to repay not only the current deficit plus interest but also previous debt (D_t) plus interest (rD_t) (Burda, Wyplosz, 2005, p. 113). The inter-temporal budget constraint can be denoted:

$$\begin{aligned}
T_{t+1} - G_{t+1} &= (1 + r)(T_t - G_t) + D_t + rD_t \\
&= (1 + r)(D_t + G_t - T_t)
\end{aligned} \tag{1}$$

Which can be rearranged such that:

$$D_t = (T_t - G_t) + \frac{T_{t+1} - G_{t+1}}{1+r} \tag{2}$$

Hence for the government to fulfill its inter-temporal budget constraint the sum of the present value of primary budget surpluses should be equal to the initial debt (Burda, 2005). Having this in mind one can, by observing the constraint, conclude that it is possible for the debt burden D to be constantly positive (Romer, 2006).

3.1.2 Theoretical concept of sustainability in public finances

Sustainable public finances can be defined as the ability of the government to handle the financial burden of its debt today and in the future. This implies a debt level that does not lead to interest payments too large to handle (ECOFIN, 2009). The primary budget balance $(T_t - G_t)$ plays an important role in these analyses because it determines at which rate old debt can be terminated or at which rate new debt accumulates, it stipulates the conditions necessary for the government to meet the cost of its debt through future revenues. The primary balance is directly controlled by authorities through fiscal policy that affects government spending and taxes.

Furthermore, a fiscal position that leads to a constantly increasing debt- to GDP- ratio, through continued borrowing, is not sustainable in the long-run. A fiscal situation where the public debt to GDP ratio exceeds the level that debt holders find tolerable will be difficult to manage. Critical levels of the debt to GDP ratio differs from country to country depending on judgment of the strength of the financial system and current economic developments. If struggling with a public debt which rapidly increases the fiscal policy of a country will need to focus not only on stabilizing debt to GDP ratio, but also on finding a new decomposition of the primary balance that ensures a lower target for the income to debt ratio.

The debt to GDP ratio is denoted by the equation:

$$\frac{D}{Y} = \frac{(1+r) D_{t-1}}{(1+g_y) Y_{t-1}} - \frac{T-G}{Y} \tag{3}$$

Where, g_y , is the rate of GDP growth. The equation shows that the debt to GDP ratio rises with an increase in the interest rate, a primary balance deficit and a decrease in the GDP growth rate. If the growth rate, g_y , exceeds the interest rate it is possible to keep the debt to GDP ratio constant even when experiencing a primary deficit. On the contrary if the interest rate exceeds growth in GDP a primary surplus is needed just to keep the debt to GDP ratio at a constant level. This can be seen by taking the change in the debt to GDP ratio:

$$\begin{aligned} \frac{D_t}{Y_t} - \frac{D_{t-1}}{Y_{t-1}} &= \frac{(1+r)D_{t-1}}{(1+g)Y_{t-1}} - \frac{D_{t-1}}{Y_{t-1}} - \frac{T_t - G_t}{Y_t} \\ &= \left[\frac{r-g}{1+g} \right] \frac{D_{t-1}}{Y_{t-1}} - \frac{T_t - G_t}{Y_t} \end{aligned} \quad (4)$$

In conclusion, the definition of sustainability derived from the intertemporal budget constraint states that: the current public debt and the discounted value of all future expenditure should be covered by the discounted value of all future government revenue over an infinite horizon (Makin, 2005). Practically this means that the government must run sufficiently large surpluses in the future to be able to finance the interest costs of the current debt and cover future government expenditure. If policies are adapted in the manner so that these conditions are met it ensures public finance sustainability (ECOFIN, 2006).

3.2 Government debt effects and policy measures

The effects of a large government debt and/or deficit on national savings are not clear cut. According to the standard neoclassical model, a large government deficit should ceteris paribus lead to reduced savings and increase demand (Baldacci, 2010). Some empirical studies have however found the opposite, with saving increasing instead. That saving should increase is in line with the theory of *Ricardian Equivalence* where the public internalizes the government's budget constraint. In short this means that the increased expenditure of the state increases the saving of the public in anticipation of future tax hikes which are needed to fulfill the intertemporal budget constraint (Burda, 2010). The yield curve of government bonds is expected to increase in anticipation of prolonged deficits. The effects are mostly on mid-and long-term yields whereas the short-term yields are mostly determined by cyclical conditions and the current stance of monetary policy. Prolonged deficits and therefore increases in public debt, may in combination with low output expectations raise concerns of a state's ability to service their debt. This in turn can cause the yields to increase further.

Countries with high debt levels will want to increase their revenues to be able to achieve a sustainable debt-level and to pay the interest generated by their debt. One way of doing this is by increasing taxes, but due to the distortionary effects of taxes this is likely to lower output growth. Studies have indicated that high public debt levels over 90% of GDP have been linked to weak GDP growth. At debt-levels under 90% of GDP there is no significant effect on GDP growth, but for levels above, output growth starts decreasing by approximately 4% on average for both OECD-and emerging economies. An alternative is to curtail spending but this can also have a contractionary effect on output. Another method is by applying an inflationary monetary policy, which makes it possible for a country to reduce the real value of its debt. Short-term debt is often marginally affected by inflation, but the effects on long-term debt can be very substantial. There are problems with this method however, since it is the central bank of a country that is responsible for the monetary policy. In most countries the central bank makes its decisions independent of the government and it would therefore not always be willing to implement an inflationary policy. A country with high inflation would also be penalized by higher interest rates (Rogoff, 2010).

Historic examples have shown that debt accumulated during wartime is often less problematic than debt accumulated during more peaceful times. After a war many resources are relocated back to where they were before the war, drawing the economy closer to its pre-war equilibrium in terms of output growth and debt. A high debt-level accumulated during peacetime is likely due to political and economic turmoil, which might be persistent even in the long-term (Rogoff, 2010).

Although a debt crisis often begins at a country specific-level, the large financial integration between national markets in areas like the Euro-zone means that a sovereign debt crisis can lead to contagion to other states. If the safety of one countries government bonds is questioned, others will soon be closer scrutinized as well. The contagion effect is mostly due to banks owning large amounts of other countries government bonds. In emerging markets, banks own almost all of the government bonds which is said to be caused by their under-developed financial markets. In advanced countries banks also often hold substantial amounts in government bonds for risk-diversification and liquidity-management purposes (Bolton, 2010).

Bonds are frequently used as collateral in interbank loans and are especially important when banks are dealing with their countries central bank, which generally accepts only highly rated securities in return for their lending. Using the Euro zone as an example again, a French bank can use German government bonds as collateral for their loans. This causes financial integration since each country's banks will want to hold bonds from several other different government issuers to diversify their risk in case of an eventual sovereign default. This is the advantage of increasing the financial integration

since it enhances the economic activity of a region. Naturally there is also a cost and it comes in the form of increased systemic risk, meaning that the probability of a sovereign debt crisis having a contagious effect has increased. By prudently managing their debt, each country is supplying a public good to the other states and each one is responsible for the whole financial system. Studies have shown that member countries of the Euro zone have undersupplied what is called “safe debt” and oversupplied what is viewed as “risky debt” (Bolton, 2010).

If a sovereign debt crisis occur and the country is not able to service its debt this is usually dealt with in either of two ways. (i) The nation “partially” defaults usually by rescheduling its debt. (ii) The other alternative is that a buyer of last resort is found that holds the debt that the country owes its lenders. This is usually carried out by either the IMF or a collection of the country’s debtors (Baldwin, 2010).

4. Model

In this chapter we will present the underlying theory needed for constructing our model for the Greek economy. We wish to use this model to analyze whether a country as deep in debt as Greece can combine fiscal sustainability with economic growth.

4.1 Economic growth and the Solow model

When focusing on economic growth we are not concerned with short-run fluctuations in GDP. A convenient way to disregard business cycles and look at long-run economic development is to look at the economy as being in a steady state. The steady state can be seen as the optimal level for growth in GDP.

A model widely used and well suited for understanding long run economic growth is the Solow model. The model describes growth by two main equations namely the capital accumulation equation and the aggregate production function. The aggregate production function is assumed to have a Cobb-Douglas form and is given by:

$$Y = f(AK, L) = AK^\alpha L^{1-\alpha} \quad (5)$$

When analyzing the prosperity of a nation, the absolute value of GDP is not as important as the GDP per worker, since it is at this level that comparisons with other economies can be made (Sorensen, 2010). Transformed to a per worker level the production function is denoted:

$$\begin{aligned} \frac{Y}{L} &= A \frac{K^\alpha L^{1-\alpha}}{L} = \\ y &= k^\alpha A^{1-\alpha} \end{aligned} \quad (6)$$

The production function describes how the economy's aggregated output, Y , is a function of the level of technology, A , the capital stock, K , and the labour force, L . Output is expected to rise with an increase in either of the input variables, the increase per capita is however restricted by the fact that the production function is characterized by diminishing marginal productivity (Burda, 2005).

The level of technology in the economy, A , is not an input of production, its assumed to increase regularly and at a constant rate and is seen as exogenous in the model. The size of the labor force available is affected by the rate of population growth, (n) , and is therefore also assumed to be given. Since the level of technology and available labor is assumed to be exogenous we will focus on the conditions of the stock of capital, K .

The accumulation of productive equipment in the form of capital is a key element for economic growth. Changes in the level of capital is dependent on three factors, the investment rate (I), population growth (n) and the depreciation rate of existing capital (δ). New capital is accumulated through investment but simultaneously old capital wears out during production and become obsolete, it depreciates. The rate of depreciation is generally assumed to be $\delta = 0,05$ (Jones, 2002). At the per capita level the capital to labor ratio (K/L) = k is affected by the changes in the population growth. As the population growth increases so does the available labor force which leads to a decrease in the capital to labor ratio. The capital accumulation function is given by:

$$K - K_{t-1} = sY - \delta K_{t-1} \quad (7)$$

Where $sY = I_{t-1}$ and s is the fraction of GDP saved to finance investment. Adding the factor of population growth and writing the expression in per capita form we get:

$$k - k_{t-1} = sy - (\delta + n)k_{t-1} \quad (8)$$

If there is an increase in the capital to labor ratio an increase in output per labor ratio follows. However the increase is characterized by diminishing returns to capital per worker i.e. each additional unit of capital brought to production increases the output to labor ratio by less and less.

For a change in the capital stock to be positive, the level of investment needs to exceed the rate of depreciation and the part of capital diluted by population growth:

$$sy \geq (\delta + n)k_{t-1} \quad (9)$$

When $sy = (\delta + n)k_{t-1}$ the amount of investment is equal to the dilution of the capital stock caused by population growth and depreciation, this is seen as the optimal level of investment. Here the capital to labor ratio remains constant, the per capita change in capital is equal to zero ($k - k_{t-1} = 0$) and the economy reaches its long -run steady state with a capital level of k^* . The reason why the level of capital to labor reaches it optimal value at $sy = (\delta + n)k_{t-1}$ and not at a higher savings rate is due to the principle of diminishing marginal productivity. An infinite increase in the savings rate or investment rate will not contribute to an infinite increase in per capita capital and output. This is due to the fact that when more capital is added to the capital stock more capital depreciates because of the proportional level of depreciation on capital. This means that more investment is needed to keep the capital stock at a constant level. But because of the principle of diminishing marginal productivity there is not enough output to enable these investments. Further additions to the capital to labor ratio yields smaller and smaller increases in GDP and hence also in

the savings rate. In conclusion, the decreasing marginal productivity principle implies that additional saving, above the steady state level, pay of less and less.

As mentioned earlier this basic version of the model, assumes that there is no per capita growth at the steady state of the economy. Output, Y , is growing but only at the rate of population growth. The notion that per capita growth is at a standstill contradicts stylized facts which have shown that economies in general exhibit sustained per capita income growth. (Jones, 2002) To deal with this problem technological progress needs to be considered in the model. As mentioned earlier technology, A , is exogenous and is assumed to develop at a constant rate depicted in the parameter, g_a . To see how technological development affects per capita growth the capital accumulation and production functions needs to be slightly altered:

$$\frac{K - K_{t-1}}{K} = s \frac{Y}{K} - d \quad (10)$$

Taking logs of the per capita production function and differentiating we get:

$$\frac{y - y_{t-1}}{y} = \alpha \frac{k - k_{t-1}}{k} + (1 - \alpha) \frac{A - A_{t-1}}{A} \quad (11)$$

Where $\frac{y - y_{t-1}}{y} = g_y$, $\frac{k - k_{t-1}}{k} = g_k$. The altered or generalized version of the capital accumulation function shows us that if K is constant $\frac{Y}{K}$ will also be constant, this implies that $\frac{y}{k}$ is constant and that y and k grows at the same rate $g_y = g_k$. If substituting this equality into equation (11) then by definition the equality of $g_y = g_k = g_a$ must also hold. This implies that since we know that technology, A , grows at a constant rate, g_a , the output per labor ratio and capital to labor ratio must also grow at the same rate. One of the main conclusions of the Solow model with technology is hence that y and k grows at the rate of technological change. This notion implies that the capital accumulation function also takes technological progress into consideration:

$$k - k_{t-1} = sy - (\delta + n + g_a)k_{t-1} \quad (12)$$

To ensure steady state growth in GDP the level of the savings rate needs to be sufficient enough to finance investment at a level that covers both the cost of depreciation, population growth and take technological growth into consideration:

$$sy = (\delta + n + g_a)k_{t-1} \quad (13)$$

At this savings rate enough investment can be raised to ensure a sufficient level of the capital stock to enables GDP to grow along a balanced steady state growth path (Sorensen, 2010).

The predictions of the Solow model, a lower growth rate of the labor force and a low depreciation rate combined with a higher savings or investment rate tend to increase GDP per capita, have been shown to be consistent with cross-country empirical evidence. Furthermore it has been shown that the steady state level predictions of the Solow model performs well compared to real macro-data. These facts combined with the Solow models relative simplicity makes it an appealing model to use when trying to establish necessary levels of savings to secure long-run growth in GDP (Sorensen, 2010).

4.2 Empirical use of the Solow model

In our empirical application of the model we use expression (6) to solve for K the capital stock. For all the other variables in the expression there is available historic data 1980-2009 and forecasts 2010-2060. Where has been found is presented in table 2. By using algebra we solve for K and find an estimate of the capital stock for the years 1980-2009 according to the Solow model. The size of α , which illustrates a factors contribution, is presumed to be $\frac{1}{4}$ (Jones, 2002).

$$k = \left(\frac{y}{A^{1-1/4}} \right)^{1/4} \tag{14}$$

Expression (14) illustrates how data for the capital stock has been created. We assume that the capital stock is a function of investment.

$$k = f(I) \tag{15}$$

Even though Greece would want to invest as much as possible to accumulate more capital and spur economic growth it is not possible, since private savings have to be enough to finance both debt servicing and investment. If the savings are not enough it would result in more debt accumulation, i.e. if there is anyone willing to provide the funds. This leads to the next section where the different identities that make up a nation’s total output are presented.

4.3 Key accounting identities

According to economic theory the decomposition of GDP can be set up in the following matter:

$$Y = C + I + G + X - Z \tag{16}$$

The GDP identity (Y) consists of the variables consumption(C), investment(I), government expenditure(G), exports (X) and imports(Z).

Furthermore GDP can be described as net incomes earned by factors of production:

$$Y = C + S + T \quad (17)$$

The total income of the economy is then described as the sum of consumption (C), savings (S) and net taxes (T). By equating the two different decompositions of GDP and rearranging the terms we get the key identity of the current account:

$$CA = (X - Z) = (S - I) + (T - G) - rD \quad (18)$$

By definition the current account is the difference between an economy's income and spending, it conveys whether the country is a net borrower or net lender. If a country earns more than it spends it is a net lender. If the spending exceeds the earnings the country needs to borrow to cover its costs. This is the case in expression (18) where a negative term D has been added to account for the interest a country has to pay on its debt. The more the country borrows the more debt it accumulates. The right hand side of the equation shows how the economy's income and spending is divided between different private and public sector variables (Burda, 2005). These variables are all the potential sources that can be used to finance private investment, which in turn adds to the capital stock of the economy. If rearranging (18) we get:

$$I = S + (T - G) + (Z - X) - rD \quad (19)$$

Since savings plays such an important role in our model, providing funds for both investment and debt servicing, we wish to create a regression to examine how savings is affected by other economic variables.

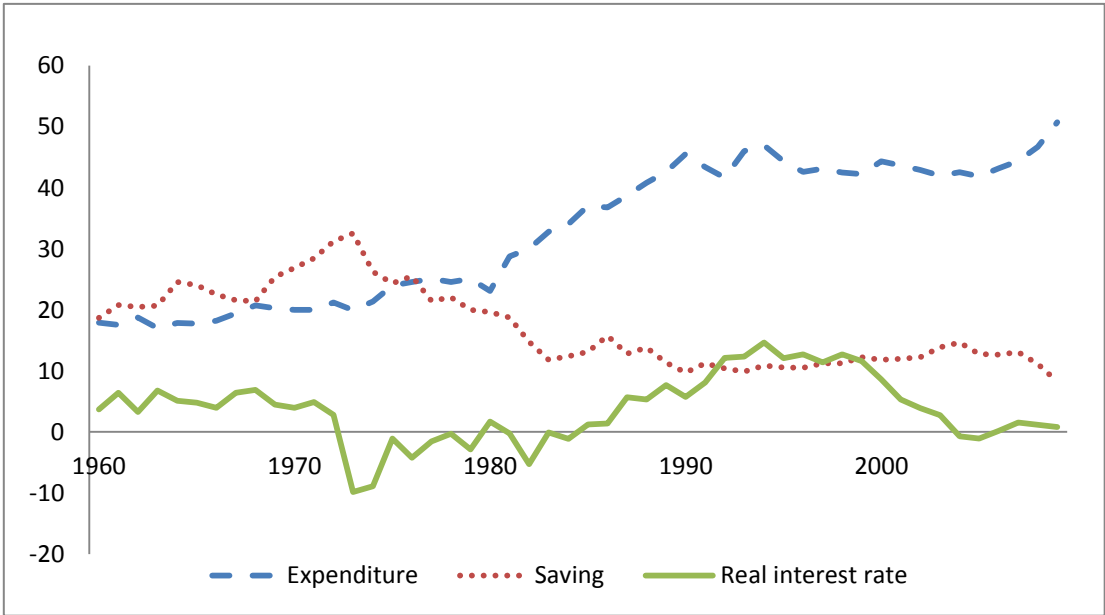
4.4 Regression for saving

In our regression we use private savings as our dependent variable which is explained by the real interest rate and government expenditure. The effect of the real interest rate on savings is well documented both theoretically and empirically. We expect it to have a positive effect on the private savings as a higher interest makes saving more profitable. The effect of government expenditure is somewhat more uncertain. Some empirical studies have found that increased spending causes savings to go up, a case of Riquardian equivalence discussed more below and other studies have found the opposite (Burda, 2010). No matter the effect, government expenditure provides us with an important link showing the effect of the policies of the public sector on the private sector. Expression (14) illustrates the point well.

The testing procedure uses yearly time series data for the period 1960-2010. The data has been collected from several different suppliers. Data for private savings has been brought from Penn World Tables (PWT). PWT only contains data for private and government expenditure as percentages of GDP, but savings can be created by subtracting the previously mentioned variables from 100. The used data series from PWT are measured in PPP, but since they are both in percentage of GDP all variables are equally affected compared to if they were nominal or real. The Government expenditure data has been supplied by the International Financial Statistics yearbooks 1990 and 1995 for the years 1960-1994. Later dates have been brought from World Development Indicators. The reason why we do not use the government expenditure data from PWT is that the database does not contain government revenue data. International Financial Statistics yearbooks contain both revenue and expenditure and therefore we use their data to minimize discrepancies between measuring methods. Finally data for the real interest rate has been supplied by World Development Indicators 1960-2006 and by Eurostat for the last 4 years. Eurostat only provided the deposit interest rate, but by using inflation data and the Fisher equation¹, real interest rate data could be created. The econometric testing is done in the Eviews 6 software.

Below our three variables are plotted in figure 4.1. All values are in percentage with savings and expenditure being in percentage of GDP.

Figure 4.1



¹ $r=i-\pi$ where r is the real interest rate, i is the nominal interest rate and π equals the inflation rate.

The figure clearly illustrates how government expenditure has rapidly increased from the early 1980s in Greece peaking at nearly 50% of GDP in 2010. Private saving has slowly decreased after a peak in the early 1970s reaching its minimum in 2010. Judging by the graphics there seems to be a slight negative correlation between the savings rate and government expenditure. The real interest has kept inside of an interval of approximately +/-10. No clear correlation can be seen between the savings rate and the real interest rate.

Continuing with the estimation we set up the following regression and study its result.

$$savings_t = \beta_1 + B_2 expenditure_t + \beta_3 real\ interest\ rate_t + \varepsilon_t$$

Dependent variable: Saving				
n=50	Coefficient	Std, Error	T-statistic	P-value
Constant	33,34657	2,458798	13,56214	0
Expenditure	-0,477031	0,059458	-8,02301	0
Real interest rate	-0,183427	0,113922	-1,61011	0,1141
R-squared	0,812281			
Durbin-Watson stat	0,43905			

$$savings = 33,35 - 0,48 * expenditure - 0,18 * real\ interest\ rate \quad (20)$$

Presented above are the results of our regression*. Expenditure has proven to have a negative effect on the private saving indicating that the theory of Riquardian equivalence does not hold for our selected period in Greece. Somewhat surprising is that the effect of the real interest rate also is negative. With these estimated values we are now able to estimate the level of private savings for future time periods. Since we know this we can estimate investment and therefore the future capital stock as well.

*What our econometrically inclined reader probably already has noted is that we have both a high r-squared value and a low Durbin-Watson value, perhaps indicating one or more unit roots in our series and/or autocorrelation. This is however not a factor to us since we are not out to make inference, but only need the coefficients for our model. We make the assumption that these coefficients are correct. We have however still estimated the model with Newey-West consistent standard errors for the interested to observe.

5. Data

5.1 Variable explanation

At this point of our thesis we have shown how economic growth is generated as estimated by the Solow model. The capital stock which we have solved for plays a prominent role in the model and it depends on the level of investment to sustain and grow. Investment in turn depends on savings which must be high enough to cover both the investment and debt servicing. Our regression illustrated the relationship between saving and other economic variables and also provided a link between the public and private sectors. We will now use what we have learned so far to create a model in Excel where we will attempt to optimize exogenous values like government expenditure and revenue to allow endogenous variables as the capital stock and private savings to reach the different economic goals that have been stipulated by our two scenarios. The optimization will be made with help from the Solver software in Excel. A full list of our variables and how they have been collected or created is provided in the table below.

Variable	Source/created-pre 2010	Source/created-after 2010
Population	Penn World Tables	EU "Ageing report"
GDP	Penn World Tables	Workers*GDP/worker
Technology	"Productivity differences across OECD countries"	EU "Ageing report"
Capital stock	Equation (14)	Equation (14)
Labor force	World Development Indicators	EU "Ageing report"
GDP/worker	GDP/worker	GDP/worker
Investment	Penn World Tables	Savings-interest on public debt
Savings	Penn World Tables	Regression (20)
Real interest rate	World Development Indicators+Eurostat	Marginal productivity of capital see equation (21)
Revenue	International Financial Statistical Yearbook 1990, 1995	Optimized by solver
Expenditure	International Financial Statistical Yearbook 1990, 1995	Optimized by solver
Expenditure on pensions	World Development indicators	EU "Ageing report"
Budget	Revenue-expenditure	Revenue-expenditure
Interest on public debt % of GDP	World Development Indicators(only 2005-2009)	"Hellenic stability program"-assumes 5% constant
Public Debt	World Development Indicators	Equation (22)

Most of the variables in the model are self-explanatory, but some might need a closer description. The capital stock was as explained in section 4 solved algebraically since data was available for all other variables. It is presented here again in the form of expression (14).

$$k = \left(\frac{y}{A^{1-1/4}} \right)^{1/4} \quad (14)$$

We forecast future private savings using our the coefficients from our regression

$$savings = 33,35 - 0,48 * expenditure - 0,18 * real interest rate \quad (20)$$

The real interest rate is assumed to equal the marginal productivity of capital. An assumption often made in growth studies. It is derived by differencing expression (6).

$$r = MPK = \frac{dy}{dk} = \alpha Ak^{1-\alpha} \quad (21)$$

Finally public debt evolves according to expression (22). It is taken from the Hellenic Stability and Growth Program (Hellenic Republic Ministry of Finance,2011) and therefore used by the Greek government to create forecasts. R is the interest on public debt as a percentage of GDP. It is assumed to be constant at 5% which is the level also used by the Greek government. G is the GDP growth and $budget_t$ is the government budget.

$$public\ debt_t = (r - g)d_{t-1} + /-budget_t \quad (22)$$

As an example how the model works: If government expenditure were to rise in Greece it would cause two effects:

- a) It will affect the private sector since savings would decrease as expression (20) shows. This would lead to a lower investment-level affecting the capital stock. The capital stock in turn is an important part of the production function (6). If investment is not enough to curtail the depreciation of the capital stock, output will fall as a consequence. If the capital stock decreases the real interest rate will increase leading to perhaps even lower saving (21) and (20). Since output falls the burden of public debt will worsen as shown by (22)
- b) The public sector will be affected since it will ceteres paribus increase the budget deficit. This in turn causes the total public debt to increase further (22).

5.2 Data scenarios: different future scenarios based on fiscal policy targets

5.2.1 Scenario 1: Following the outline of the EAP and taking into account the long –run debt level target set by the European Commission

In this scenario we implement the medium term policy targets given in the EAP setting the revenue and expenditures until 2015 as they are given in table 2.2. To get a long-run sustainability perspective we combine these targets with the European Commission’s long-run debt target level of a 60% debt to GDP ratio in 2060.

5.2.2 Scenario 2: What would happen if Greece would adopt the fiscal policies of Switzerland?

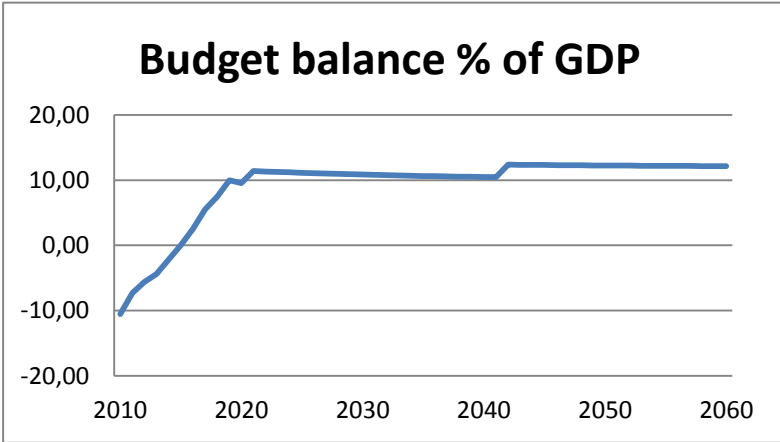
In this alternative scenario we will forecast what would happen if Greece slowly implements the policies of Switzerland for their fiscal budget. In Switzerland both government expenditure and revenues fluctuate around 20%. We also set up a goal of total public debt at 90% of GDP in the year 2060.

6. Analysis

Scenario 1: Following the outline of the EAP and taking into account the long –run debt level target set by the European Commission

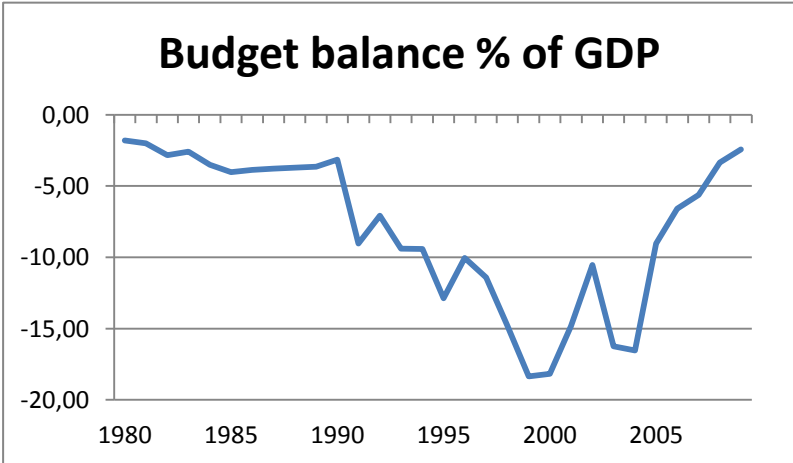
In Scenario 1 we set the values of revenue and expenditure to the values presented in the EAP medium-term prospects and we set the target of the debt level in 2060 to 60% of GDP. When implementing the scenario in our model a budget balance development depicted in figure 6.1 is seen.

Figure 6.1



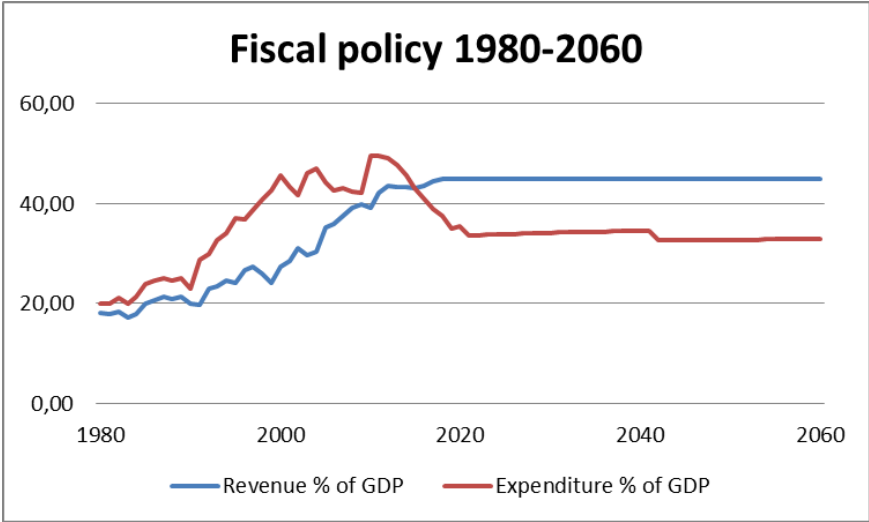
We can clearly see that to meet up with the target debt level for the year 2060 substantial budget surpluses must be carried over the next decade. After reaching a budget surplus of 10% around the year 2020 and Greece is expected to keep their balance at this level or slightly above for the rest of the period. This can be set in contrast to the budget balances seen in previous years. Figure 6.2 presents the development of the Greek budget balance from 1980 and onwards, where one can see that the country historically have been exhibiting deficits over a long period of time.

Figure 6.2



In figure 6.3 it can be seen how the expenditure has increased in Greece up until the financial crisis 2008 and the following debt crisis. The gap has also grown since the EU membership.

Figure 6.3



Even though saving (figure 6.4) returns to early 80s levels in this scenario, it is still not enough to keep the capital stock from shrinking due to depreciation. Focusing on the capital stock we see that Scenario 1 will have negative effects on the future capital accumulation. Figure 6.5 exhibits a capital stock that continues to shrink until the target date. Comparing to historical levels of capital in 6.6 the negative trend is even more significant.

Figure 6.4

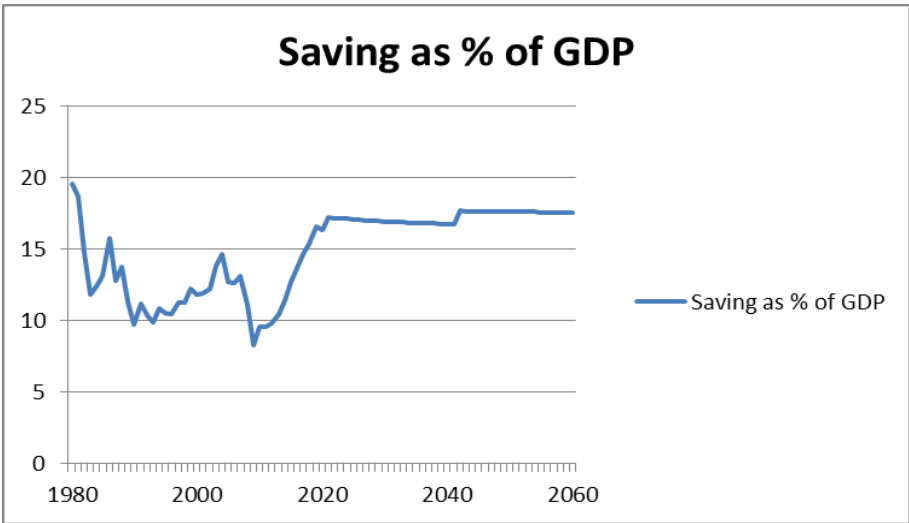


Figure 6.5

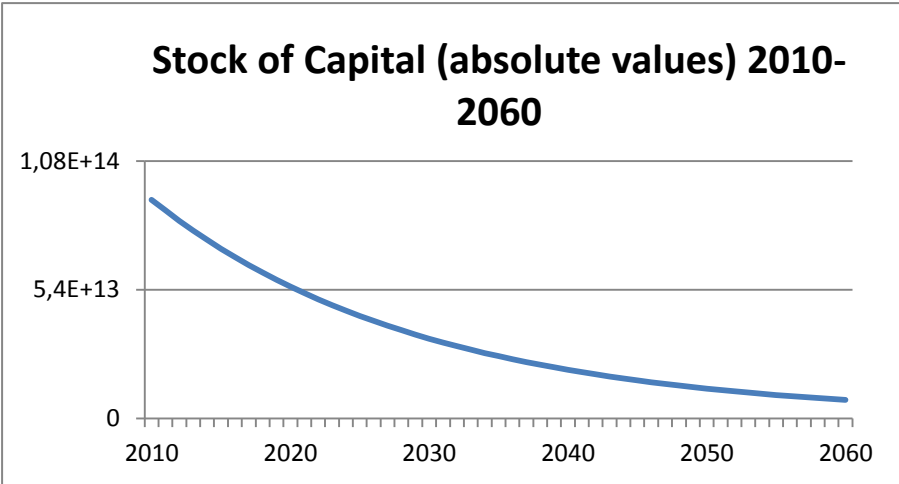
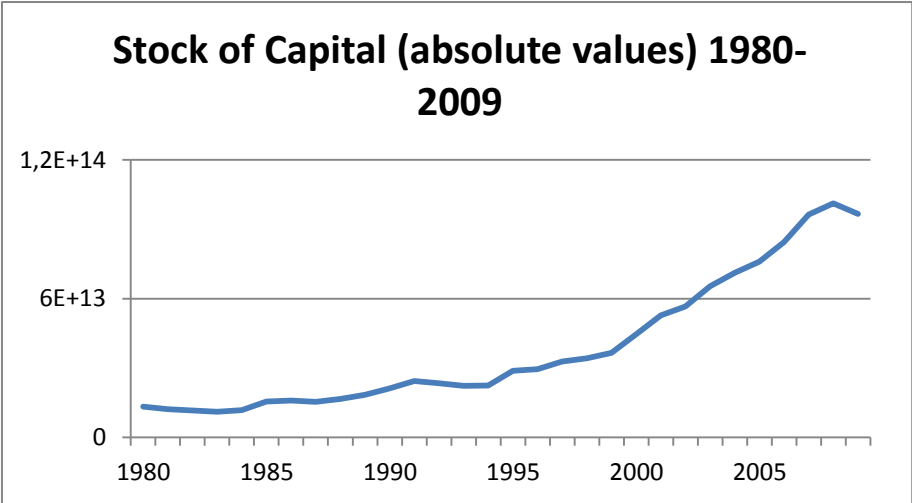


Figure 6.6



Furthermore Scenario 1 contributes to a negative growth in GDP which is displayed in figure 6.7. The GDP growth becomes negative because the level of investment is not high enough. Since government expenditure plays such an important role in the outcome of private savings it would have to decrease further to generate more investment which would increase the capital stock and thus output. Another problem for the economy is the aging population which leads to less capable workers and more people who need help to manage their daily activities. The extra cost due to the aging population is presented in table 6.1 taken from the Hellenic stability programs forecasts. Figure 6.6 also shows how the number of workers declines in the economy. Fewer will have to support more.

Figure 6.7:

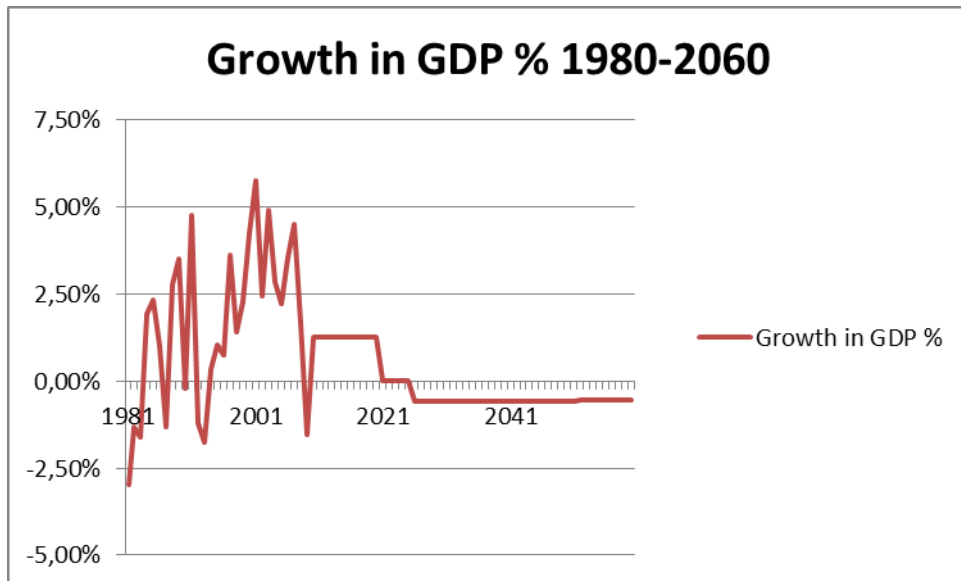


Figure 6.8

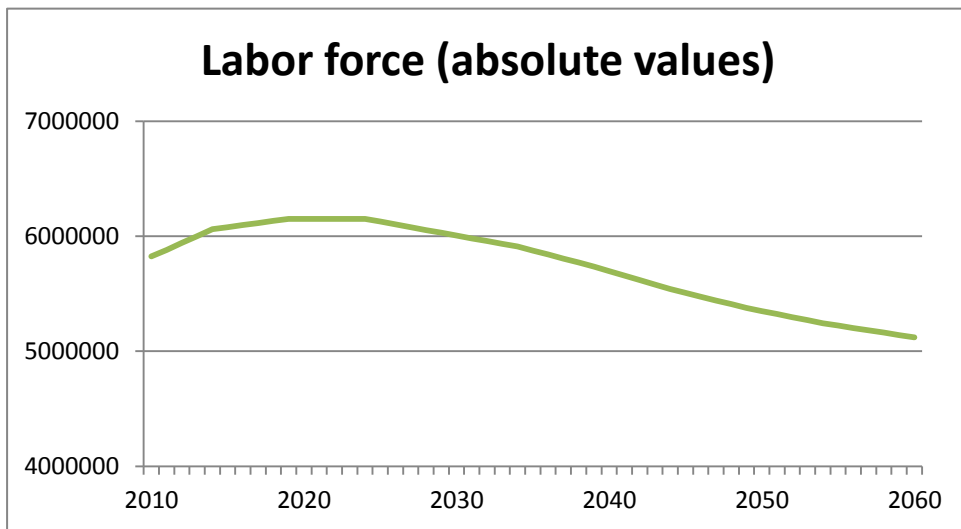


Table 6.1

Long-term sustainability of public finances							
% of GDP	2000	2007	2020	2030	2040	2050	2060
Pension expenditure	10.82	11.7	11.2	10.9	12.1	13.1	12.5

Source: Hellenic Republic Ministry of Finance, 2011

Conclusions scenario 1:

The Greek fiscal consolidation program is ambitious and if they are to attain sustainability in public finances large budget surpluses are needed. According to medium term prospects, stated in the EAP, a balanced budget will be attained around 2015. But to attain the threshold level of a debt to GDP ratio of 60% in 2060 our model have shown that they need to produce a surplus of more than 10% over a long period of time. Skepticism about the feasibility of this can be raised especially when looking at the historical data which are characterized by deficits. According to the OECD Economic Survey for Greece (2011) large surpluses have been seen in countries like Belgium, Denmark and New Zealand implying that the same could be achieved in Greece, although it is also concluded that the levels of the deficits were all well below 10% of GDP. Furthermore, in contrary to Greece these countries were at the time not part of a monetary union and could therefore benefit from exchange rate devaluations to ease their adjustments (OECD, 2011).

The Greek fiscal consolidation program and its projects are dependent on its future growth prospects. GDP must increase by more than 3% in 2013 and in the long run the aim is an average growth of between 1.75 and 2,5% over the next few years.(Hellenic Republic Ministry of Finance,2011) A factor that is likely to dampen the long run growth trend is demographic ageing as we have not been able to achieve positive output growth in our model. Positive output growth is assumed by the Greek officials in their forecasts. As mentioned in the introduction an ageing population will lead to higher costs associated with services such as pensions and healthcare, but it will also lead to lower economic growth as the share of working individuals in the economy fall (ECOFIN, 2009). This can also clearly be seen in figure 6.8 which shows the decrease of the labor force over our time interval. Furthermore table 6.1 shows the increasing costs for the public sector when the population is ageing.

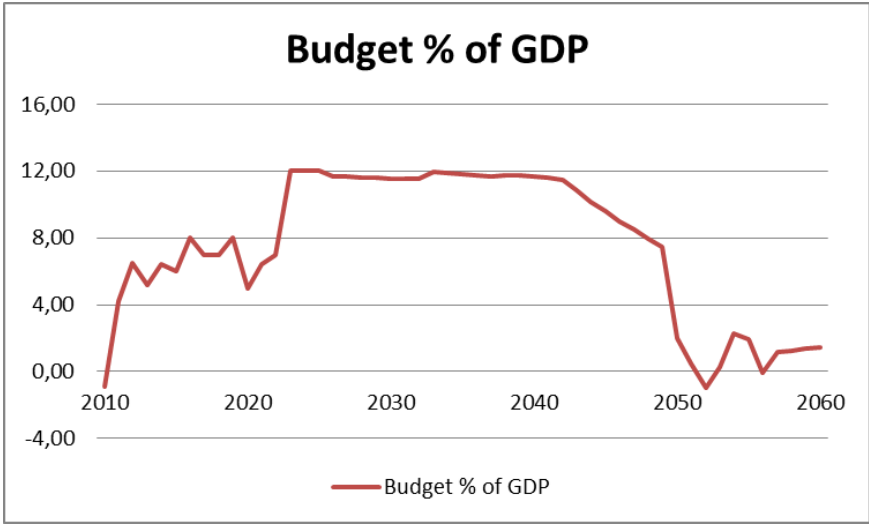
This situation clearly illustrates the dynamics of the government's budget constraint discussed in the theoretical section. To achieve large enough fiscal surpluses (if even feasible) higher taxes have to be paid to increase government revenue, while less government expenditure will results in less resources for education, medical care and pensions. The somewhat irresponsible policies of earlier decades become costly for those having to pay for it plus accrued interest today and tomorrow.

Scenario 2 – Greece implements the polices of Switzerland

In this scenario we forecast what would happen if Greece slowly adopts the policies of Switzerland for their fiscal budget. Switzerland has for past decade had a fiscal budget which has fluctuated around zero. Both the public expenditure and the revenue has hovered around 20% of GDP (WDI). We realize that Switzerland and Greece are two fundamentally different countries (Switzerland is not an EU member for one), but both are European countries of similar size and with scenario 1 in mind we do not feel that we are the ones being overly optimistic by placing Swiss fiscal policy as a role model for Greece. Greece fiscal policy was also at this level in the early 80s but has increased rapidly since then (International financial statistics yearbook, 1990). Using Switzerland we also show that an OECD country can keep expenditure and revenues at lower levels than what they currently are in Greece.

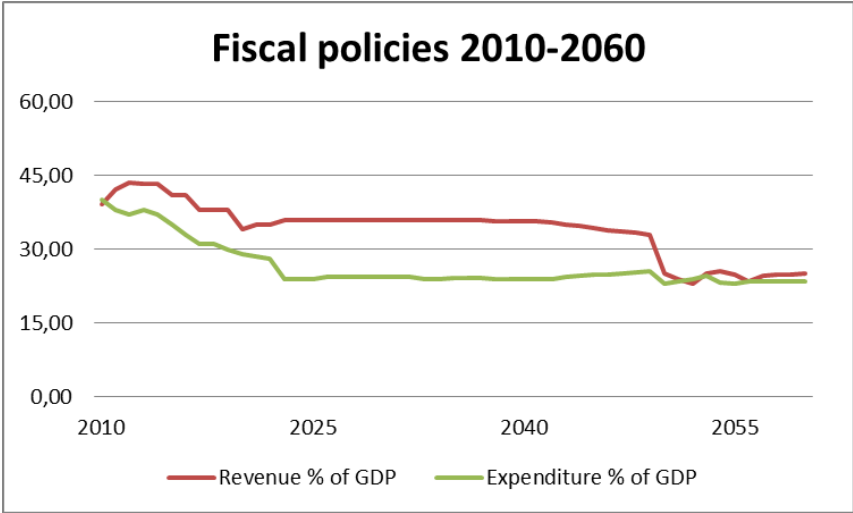
Our primary target for this simulation is for Greece to have brought down both fiscal expenditure and revenue to Swiss levels by the year 2060. By doing this they will also have reached the goal of a public debt level of 90% of GDP by 2060. We feel that a debt level of 90% is an acceptable level common among other European countries and it also does not demand the extreme and prolonged surpluses of scenario 1. It does however still make some quite strong assumptions since the only European country that has achieved the fiscal surpluses demanded in this scenario during the previous decade is Norway (we do not account for any undiscovered oil reserves in the Mediterranean). To allow the fiscal policies to slowly adjust to the target level we let the solver optimize 15 years at a time, gradually increasing the constraints to converge with Swiss levels. Since Greece like many other western countries will be struggling with an aging public the coming decades, we keep fiscal expenditure at a level above the Swiss level of today by a few percent to allow the cost of pensions to increase somewhat.

Figure 6.9



As can be seen from the figure this scenario also requires that the fiscal budget achieves large surpluses for a few decades. In this case the surpluses start to decrease to more normal levels in the middle of the 2040s. The levels of government expenditure and revenues are also different in line with the target to have them adjusting to Swiss levels at somewhat achievable levels. This can be seen in figure 6.10 below.

Figure 6.10:



The capital stock declines in this scenario as well but at a somewhat slower rate due to the increase in savings around the year 2020 when government expenditure begins to decrease.

Figure 6.11

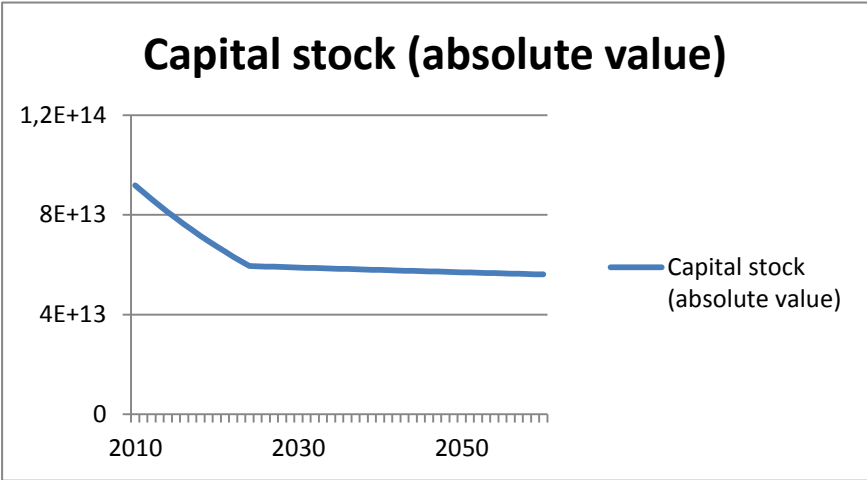
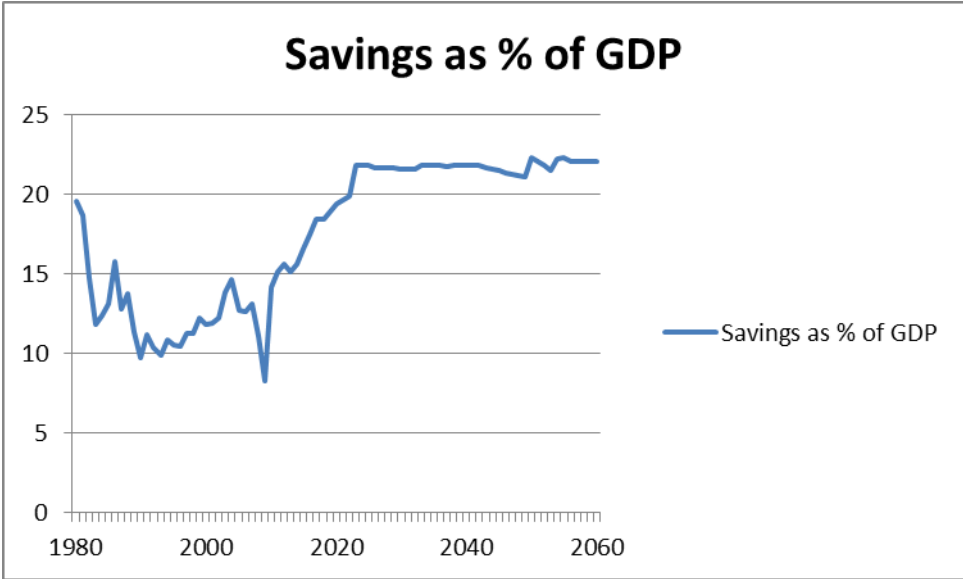


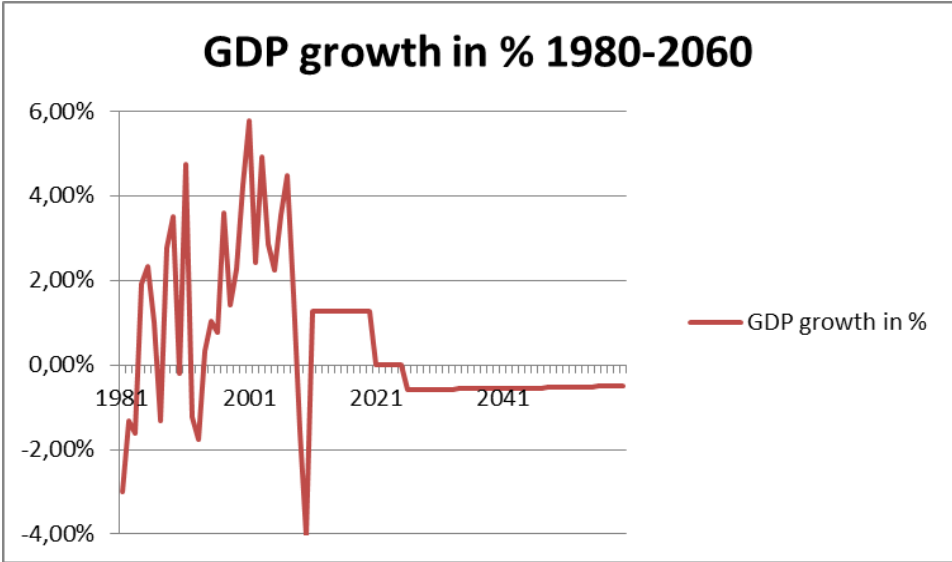
Figure 6.12 illustrates how savings increases following the decrease in expenditure during the 2020s.

Figure 6.12



The effect of the increased fiscal surplus can be seen in figure 6.11 below. The reduced expenditure leads to increased savings spurring investment and output growth in the first decade. As the surplus level stabilizes GDP starts to slowly decline due to an aging population with fewer workers.

Figure 6.13:



Conclusions scenario 2:

Attempting to adopt Swiss fiscal policy leads to a better result according to our model. Even though it may seem unlikely that Greece would be able to lower their fiscal expenditure and eventually also revenues to Swiss levels, both their expenditure and revenue were at a level of around 20% of GDP at the beginning of the 1980s. It is quite certainly more painful for the population of a country to adapt to lower expenditures leading to less money for education and healthcare, than it was to adjust to the increases following the European Union membership. It has to be done however for Greece to reach fiscal sustainability and avoiding leaving the problem for future generations. This scenario also puts a less strict demand on the public debt level in the year 2060 at 90% instead of 60% as in scenario 1. This scenario also allows a higher savings level since expenditure is sinking. This helps to dampen the decline of the capital stock. Finally GDP is a little less negative due to the higher savings and consequently investment. The decline in GDP is again explained partially by the aging workforce with less workers being available as input in future decades.

7. Concluding remarks

In our study we have used the Solow model to attempt simulate two different future economic scenarios for the Greek economy. In both cases we have attempted to attain both output growth and fiscal sustainability and our results have gathered that it is not feasible to achieve both at the same time. In our analysis of the scenario influenced by Greek and EU forecasts (scenario 1) we have found that this scenario makes very strong assumptions on both fiscal balances and future economic growth. We have simulated fiscal surpluses needed to achieve a debt –to-GDP ratio of 60% by 2060 and the values are higher than what Greece has been anywhere near during previous decades making this scenario rather unlikely. In our other scenario (scenario 2) we have provided a somewhat “easier” plan for the Greek economy to adjust to. According to this scenario Greece will slowly decrease its fiscal expenditure and later also revenue to the levels of the early 80s which are approximately the same as those of Switzerland today. This scenario allows for more savings which causes the capital stock to decrease at a much slower rate. We have however not been able to achieve output growth since the aging of the Greek population means there will be fewer workers in the future.

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