Ex-post Social Cost-Benefit Analysis of Austerity

Abstract – This study performed a social cost-benefit analysis of austerity as a policy measure. Austerity, the combined name for tax increases and government spending cuts, was introduced in many parts of the world after the economic recession of 2008 to improve financial fundamentals. The arguments of supporters and opponents of austerity are described and evaluated based on theory and empirical evidence. Then a social cost-benefit framework is constructed to calculate the social cost-benefit balance for eleven countries. Four of the eleven countries pass the social cost-benefit analysis and seven countries do not. Negative multipliers caused by the doom loop have led to positive net present values for austerity. For the other countries, large fiscal multipliers due to a binding zero lower bound and existing hysteresis have driven up the costs of austerity, while the benefits are negligible due to low interest rates on government debt.

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Chapter 1: Introduction

1.1 Austerity in a recession

The study of macroeconomics has always followed the flow of the economy, the push and pull of the business cycles with economic upturns and downturns. The field of macroeconomics evolved out of the desire to control these business cycles, by studying and influencing them. At the very least, macroeconomists try to avoid economic downturns. However, downturns are a natural part of the economy, as they are a natural part of life. Therefore an important aspect of macroeconomics is to retroactively study such events and learn how to react to economic downturns and recessions. Like historians, economists learn by studying the past. The Great Depression, although millions became unemployed and many died of starvation, provided economists with a rich study opportunity. The most notable book was published by Friedman and Schwartz (1965) who studied the Great Depression and drew lessons from the event. Bernanke (1983) wrote a paper on the subject and later used the lessons learned as Chairman of the FED to combat the Great Recession of 2008. However, as pointed out by Eichengreen (2015) not all the lessons learned from the Great Depression were well-remembered.

When the economic crisis struck in 2008 almost every country introduced a stimulus programme, either increasing government spending and/or cutting taxes. This fiscal expansion is a textbook response to boost the economy when lowering interest rates is insufficient to boost private spending. Increase government spending to create jobs and partially offset the reduction in private spending and cut taxes to boost private spending. Naturally, governments are likely to run a budget deficit, but this wasn't a big problem in 2008 because government bond rates were so low. Eventually the stimulus programmes should be reversed, but only when the economy has fully recovered (or at least when monetary policy has regained its grip on the economy).

However, from the start of the crisis there were some who opposed the idea of fiscal stimulus. The then Republican leader John Boehner stated in an interview: 'It's time for governments to tighten their belts.' Obama in his 2010 State of the Union speech drew the same comparison: 'Families across the country are tightening their belts and making tough decisions. The federal government should do the same.' The comparison between state finances and households is wrong on many levels. The largest difference being that a government can never go broke as long as control is kept over its own currency. These statements show the inability of politicians to explain monetary economics to the population. On the other hand there were politicians who argued that high debts and deficits would lead to extremely high government bond rates resulting in the default of entire countries. David Cameron, the former Prime Minister of the United Kingdom, stated: 'Greece stands as a warning of what happens to countries that lose their credibility, or whose governments pretend that difficult decisions can somehow be avoided.' The Labour party in the United Kingdom even dedicated the entire first page of their election manifesto to the 'Budget Respondibility Lock', promising to cut deficits every year (Stewart, 2015).

There was a problem for these 'Austerians' (the term used for supporters of Austerity) however, the increase in government bond rates did not occur. Alan Greenspan, the former chairman of the Federal Reserve stated: 'Inflation and long-term interest rates, the typical symptoms of fiscal excess, have remained remarkably subdued. This is regrettable, because it is fostering a sense of complacency that can have dire consequences.' But then Greek crisis happened. The Austerians saw in Greece the perfect example to prove the point that high debts and deficits were dangerous. Even though most advanced economies were growing again, they had far from recovered from the recession.

Unemployment was still high and output below 2008 levels. Influenced by papers written by Alesina and Ardagna (1998) the Austerians argued that the reversal of fiscal stimulus wouldn't deepen the recession because spending cuts would inspire confidence in the population. And the increase in confidence would cancel out the negative effects of the spending reversals. Even the then President of the European Central Bank, Jean-Claude Trichet, agreed: 'I firmly believe that in the current circumstances confidence inspiring policies will foster and not hamper economic recovery, because confidence is the key factor today.' (Trichet, 2010) Backing up the confidence argument was the threat of the 90% debt-to-GDP threshold. The 2010 paper 'Growth in a Time of Debt' written by Reinhart and Rogoff (2010) claimed that growth would significantly deteriorate if debt reached the 90% mark. And thus in 2010 the age of austerity began.

Although research on the subject was scarce at the time, the introduction of fiscal austerity has encouraged study on the subject and a broad range of literature has since been published. Nine years have passed since the start of the crisis, enough time to gather the data and learn from the literature that has since been written. The evaluation of austerity as a policy measure is the main focus of this thesis. The research question is: *"Do the austerity policies enacted during the 2008 economic recession pass an ex-post social cost-benefit analysis for the eleven countries in the sample?"* This question will be answered in several steps. First the arguments of austerity supporters and opponents are listed and evaluated on the basis of the latest literature. Then a social cost-benefit framework is constructed based on DeLong and Summers (2012) to answer the research question. A cost-benefit analysis is a systemetic approach to analyze all costs and benefits attached to a decision (or policy in this case). The costs in the present are added to the discounted costs in the future and subtracted from the benefits in the present added to the discounted benefits in the future. This yields the net present value, a measure that is often used to compare different alternatives. A social cost-benefit approach , as used in this thesis, is slightly different from a private cost-benefit analysis. A social cost-benefit does not only account for the financial consequences of the policy but also for the effects on society. Some examples of such effects on society are: pollution, environmental damages, travel times, health. A social cost-benefit analysis (SCBA) is suitable to analyze austerity as a policy measure for two reasons. The first reason is because the net present value is an easy to interpret measure. If the net present value of austerity is negative, the policies were damaging. If the net present value of austerity is positive, the policies were beneficial. The second reason is that the costs and benefits are separately calculated, making it easy to examine what the costs and benefits of austerity were. The benefits of austerity are threefold. First, there are the lower interest rate payments on debt. Because government spending is reduced the financial fundamentals will improve, which lowers the government bond rates. Second, the value of debt will decline which directly lowers the value of interest payments. Third, because the value of debt will decline, GDP growth will improve, as assumed in chapter 4. The costs of austerity are twofold. First there are the effects of austerity on present GDP through the multiplier. Secondly there are the effects of austerity on potential GDP through hysteresis.

The net present value for austerity is calculated for eleven countries, namely the Netherlands, Germany, France, the United Kingdom, Finland, Spain, Italy, Ireland, Greece, the United States and the Eurozone as a whole. These countries were chosen for several reasons. The main reason is that these countries all practiced austerity in the aftermath of the economic recession of 2008. The second reason was that these countries all differ significantly in terms of size, population, amount of debt, tax rates, exchange rate regime, openness of the economy and amount of austerity implemented, thus adding to the robustness of the findings. The United States was added to see if the results also hold outside the Eurozone. The Eurozone as a whole was added to check for country-spillovers. For each country specific multiplier values and hysteresis coefficients are calculated in the literature section. A

margin around these values will be used in the SCBA analysis as a robustness check and to strengthen the results of this thesis.

1.2 Main Findings

This paper adds to the existing literature by settling the debate between economists and policy makers about the effects of austerity. In a situation with positive fiscal multipliers and existing hysteresis the costs of austerity outweigh the benefits. The damaging effects of austerity on present GDP and future potential GDP are far larger than the benefits of lower interest rate payments and increasing GDP growth by decreasing debt-to-GDP. It can also be concluded that the confidence-fairy is not real. Austerity failed to inspire the confidence in the population that was supposed to offset the decrease in government spending. However, in some countries, the existence of the doom loop between sovereigns and domestic banks led to negative values of the multiplier. In these cases austerity helped avoid rising interest rates on loans in the broader economy, which would have hurt GDP growth. In these countries austerity took on an expansionary character.

The sensitivity analysis provides some insight into the robustness of the findings. A country passes the SCBA as long as the multiplier is larger than 0. Only in certain special cases does the multiplier fall lower than 0. The sensitivity analysis also shows that the benefits of austerity are so small they have to be multiplied by a factor of 3.000 to 10.000 for the benefits to become larger than the costs. Such a factor will never be found in the real world.

1.3 Structure of this thesis

The rest of this thesis is divided as follows. In chapter 2 the relationship between debt-to-GDP and deficit-to-GDP and government bond rates is examined. In chapter 3 the doom loop between national banks and their sovereigns is explained. In chapter 4 the relationship between debt-to-GDP and GDP growth is examined. In chapter 5 the interaction between austerity, confidence channels and output is examined. In chapter 6 the fiscal multiplier and its relationship to output is explained after which country specific multipliers are estimated. In chapter 7 hysteresis is explained and country specific hysteresis coefficients are estimated. In chapter 8 the methodology of the social cost-benefit framework is explained. The results can be found in chapter 9. In chapter 10 a sensitivity analysis is performed for the most important variables. A discussion can be found in chapter 11. Chapter 12 concludes this thesis.

Chapter 2: Financial Fundamentals and Government Bond Rates

To judge austerity as a policy measure introduced during the economic recession as objectively as possible, the first step must be to list the arguments used by proponents and opponents of the policy. The theoretical basis will be discussed for each argument after which the empirical literature is reviewed to determine if the theory holds up in reality. After each argument is discussed a social cost-benefit framework will be constructed based on the methodology of DeLong and Summers. This framework will then be used to calculate the social costs and benefits for each of the countries in the sample. The aim of these calculations is to provide clarity on how the economic circumstances have affected austerity and to better understand when austerity is beneficial and when it is hurtful.

2.1 Theory Financial Fundamentals and Government Bond Rates

Financial fundamentals such as the deficit-to-GDP and debt-to-GDP ratios have an impact on government bond rates. This chapter examines what the role of financial fundamentals was during the crisis and what the correct policy response was to bring government bond rates down. During the economic crisis the government bond rates of some countries soared to extreme heights (Schuknecht, Wolswijk, & von Hagen, 2011). Measures needed to be taken to decrease the government bond rates and avoid the default of members of the Eurozone. There were those who argued that government bond rates are based on the underlying financial fundamentals of a country. The common indicators to measure the financial health of a country are the debt-to-GDP and deficit-to-GDP ratios. These indicators are used because the debt-to-GDP ratio provides information about the financial history of a country and the deficit-to-GDP ratio provides information about the financial future of a country. Together they show the financial health of a country in a simple but comprehensive way. Supporters of austerity argued that to bring down government bond rates the fundamentals needed to improve (Gray, 2016). Austerity was the right medicine in their opinion. Budget cuts and tax increases were designed to reduce government spending and increase government income. This dual approach aimed to decrease the debt-to-GDP and deficit-to-GDP ratios, improve the financial fundamentals, which should have led to decreasing government bond rates. Opponents of austerity argued that during the economic crisis in Europe market sentiment ruled the government bond rates, not financial fundamentals (De Grauwe & Yi, 2013). This argument is based on a weakness in the design of the Eurozone as a monetary union, namely the absence of a lender of last resort (LOLR) (Praet, 2016). The absence of a lender of last resort is so dangerous that in an economic recession it can even lead countries from a liquidity crisis into a solvency crisis.

In 2002 the Eurozone countries dropped their own currency and introduced the euro. Control over the euro was given to an independent institute, the European Central Bank (ECB). From 2002 onwards the debt for each country in the Eurozone was denominated in the euro, a currency over which an individual country had no control. In economic benevolent times this lack of control over the currency is not a problem. However, in economic stressing times the absence of a LOLR can result in the default of a member country. If a country does not control the currency in which their debt is denominated, it cannot guarantee that there will always be enough liquidity to pay off its bondholders. In a country that has control over its own currency this is not a problem because the government can guarantee that bondholders will always be paid. This is because the central bank can always step in to provide liquidity to the government, and there is no limit to the amount of liquidity that can be provided (lender of last resort) (Tucker, 2014). When bondholders fear that a country might have difficulty repaying their debts, for example in a recession, they will sell their bonds. The government bond rate will increase because the investors will look for a safer place to invest which means that they

will not repurchase their previously held government bonds. As a result the country has problems rolling over their debt, except at higher interest rates. The increase in government bond rates caused by this sudden stop of liquidity is likely to push a country into recession (De Grauwe & Yi, 2013). A recession tends to deteriorate the government budget, resulting in higher deficit and debt levels. This leads to more investors fearing default and selling government bonds. This cycle repeats itself and eventually the interest rates will be so high that a country can no longer roll over its debt except at exorbitant rates. At this point the liquidity crisis has escalated into a solvency crisis. In a sense, this could be labelled a self-fulfilling prophecy. Investors fear that a country might soon become insolvent, they withdraw their funds leading to higher interest rates and eventually leading a country from a liquidity crisis into a solvency crisis, thus confirming their initial fears of default. In this case the correct medicine to reduce government bond rates would be to introduce a Lender of Last Resort mechanism to the Eurozone to prevent market hysteria taking over. In 2012 the European Central Bank announced that it would act as a lender of last resort (LOLR). In the next section empirical evidence will be reviewed to determine if this announcement helped calm the investor markets and reduce government bond rates.

2.2 Empirics Financial Fundamentals and Government Bond Rates

An overview of the studies that are discussed hereafter can be found at the end of this chapter under the heading table A. The study done by Codogno, Favero and Missale (2003) uses a different dependent variable compared to the other studies, namely the relative asset swap. The relative asset swap is calculated as the difference between the yields to maturity of country *i* and Germany and then subtracting the difference between the 10-year fixed interest rates on swaps denominated in currency *i* and Deutsche Mark respectively. Because these authors use a database that predates the Euro they have to account for exchange rate fluctuations. The authors use the SURE (Seemingly Unrelated Regressions Estimation) technique with international risk factors as the independent variable while controlling for financial fundamentals. The authors find a significant positive effect of debt on government bond rates in Austria, Belgium and Spain but not for the other two countries in the sample. The regression equation complicates the interpretation of the coefficients and the authors do not perform any sensitivity analyses. For these reasons this study will not be included in the consensus estimate.

Bernoth et al. (2004) were the first to compare 10-year sovereign interest rates to a benchmark country (Germany in almost all subsequent studies). This yield spread is used as the dependent variable in a reduced-form framework and several fiscal variables such as the debt-to-GDP and deficit-to-GDP ratios are used as dependent variables. The authors control for many additional variables such as the liquidity risk premium, the maturity to yield and EMU membership. The liquidity risk premium is assumed to be proportional to the ratio of the debt of a country denominated in euro to the total debt of a country. It compensates an investor for the risk that he may not be able to liquidate his investment. They find that a 1% increase in debt-to-GDP will increase the bond spread with 1 to 2 basis points. As for deficit-to-GDP, an initial 1% increase in deficit compared to Germany will increase the government bond spread with 3.39 basis points. An additional 1% increase in deficit compared to Germany increases bond spreads with 5.33 basis points, suggesting a non-linear relationship between deficit-to-GDP and sovereign bond spreads. The results of these authors will be included in the consensus estimate.

In contrast with the previously discussed studies that used data from the European Union, Laubach (2009) uses data from the United States. The author investigates the effects of government debt and deficits on US treasury yields using OLS estimations. The panel data are rich, covering a period of 30

years, but the author only uses expected inflation as a control variable in the basic regression. The author did test whether the exclusion of additional macroeconomic control variables had been justified and found that the inclusion of these variables did not significantly change the results. Laubach finds that a 1% increase in debt-to-GDP will increase the bond spread with 3 to 4 basis points and a 1% increase in deficit-to-GDP will increase the bond spread with 20 to 30 basis points.

Attinasi, Checherita and Nickel (2009) study the drivings factors behind the widening of sovereign bond yields compared to Germany during the period July 2007 – March 2009 by using a dynamic panel approach. The authors employ a Feasible Generalised Least Squares (FGLS) estimation technique that corrects for homoscedasticity and autocorrelation. They use a 10-year government bond spread relative to Germany as the dependent variable, the expected fiscal position of the government as the independent variables (debt-to-GDP and deficit-to-GDP) while controlling for the announcement of bank rescue packages, the size of recapitalization and the availability of government liquidity. The authors perform many sensitivity checks such as different estimation techniques, additional control variables and adjusting the model to account for autocorrelation and heteroscedasticity. They find that a 1% increase in debt-to-GDP will increase the bond spread with 1 to 8 basis points and a 1% increase in deficit-to-GDP will increase the bond spread with 7 to 16 basis points.

The first study that incorporated data from the Euro crisis was done by Schuknecht et al. (2011). These authors estimate an OLS regression with the 10-year sovereign bond spread relative to Germany and the USA as the dependent variable, the debt-to-GDP and deficit-to-GDP ratios as independent variables along with several control variables. Although they use a slightly larger panel of 13 European countries the number of observations for each country in this study is relatively low. The authors distinguish two periods; one period of financial turmoil between August 2007 and September 2008 and a period of financial crisis between September 2008 and May 2009. After checking for structural breaks in the data the authors find significantly higher coefficients for debt-to-GDP and deficit-to-GDP during the crisis than before the crisis. The authors find that a 1% increase in debt-to-GDP will increase the bond spread with 0.16 basis points prior to September 2008 and 1.25 basis points after September 2008. They also find that a 1% increase in deficit-to-GDP increased bond spreads with 3.49 basis points prior to September 2008 and 12.64 basis points after September 2008. They conclude that fiscal performance indicators had a subdued effect on sovereign interest rates prior to the crisis. However, there were not many control variables added and the sensitivity analysis was superficial.

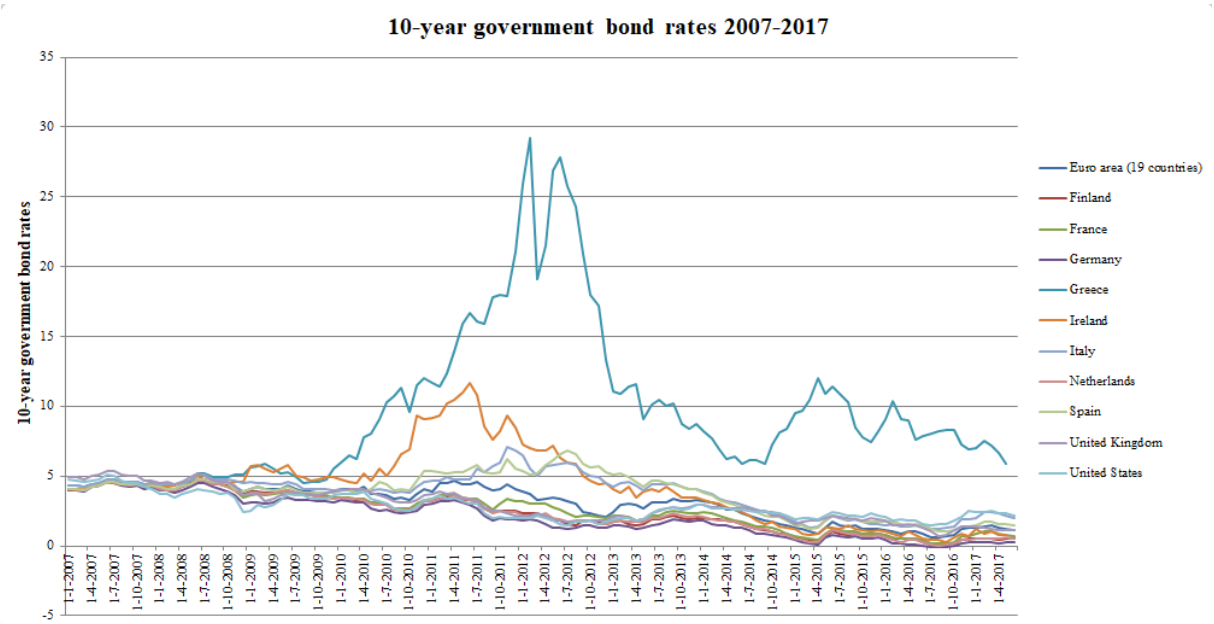
Afonso, Ardhyrou and Kontonikas (2015) investigate the drivers behind sovereign bond yield spreads before, during and after the financial crisis. They compare the 10-year government bond rates of 10 European countries to the 10-year government bond rates of Germany. The authors then estimate an OLS regression with the sovereign bond spread as the dependent variable, an international risk factor and bond market liquidity conditions as the independent variables while adding several macroeconomic control variables, contagion effects and country-specific variables. The S&P's 500 stock market volatility index serves as a proxy for international risk and the 10-year bid-ask spread is used as a measure to determine bond market liquidity conditions. The authors also employ a range of sensitivity checks which adds to the credibility of the findings. Like Schuknecht et al. (2011) these authors find a larger coefficient for debt-to-GDP and deficit-to-GDP during the crisis than before the crisis. They find that before March 2009 a 1% increase in debt-to-GDP had no significant effect on sovereign bond yields but after March 2009 a 1% increase in debt-to-GDP will increase the bond spread with 2 basis points. The authors also find that before March 2009 a 1% increase in deficit-to-

GDP increased sovereign bond spreads with 5 to 8 basis points but after March 2009 a 1% increase in deficit-to-GDP increases the bond spreads with 9 to 11 basis points.

2.3 Conclusion Financial Fundamentals and Government Bond Rates

The literature agrees that there is a positive correlation between the financial fundamentals and government bond rates. This positive correlation is, according to the literature, simply the response of the market to the financial fundamentals of a country. If the financial fundamentals deteriorate the risk of default for a country goes up. To compensate for this, the country must pay a higher interes rate to convince lenders to continue providing funds. However, the literature also shows that during the recent economic crisis government bond rates increased much more than financial fundamentals. This suggests that during the crisis financial fundamentals were not the only determinant of government bonds rates. As propositioned in the theory section of this chapter, the lack of a lender of last resort during a period of crisis may have fueled fear of default in the Eurozone during the economic crisis. If this hypothesis is true, bond rates should have decreased after the announcement by the ECB in 2012 that it would act as a lender of last resort (Draghi, 2012). This is exactly what occurred in the Eurozone, as can be seen in Graph 1.

Graph 1: 10-year government bond rates 2007-2017



Source: OECD (2017)

Because there is now a lender of last resort for every country in the sample, it will be assumed that financial fundamentals are the only determinants of government bond rates. This implies that any increase in debt-to-GDP or deficit-to-GDP will lead to higher government bond rates. Vice versa, any decrease in debt-to-GDP or deficit-to-GDP will lead to lower government bond rates. Since austerity directly influences the debt-to-GDP and deficit-to-GDP, this will be accounted for in the social cost-benefit analysis. To calculate the social costs and benefits consensus estimates for both debt-to-GDP and deficit-to-GDP must be reached. Judging by the coefficients found in the literature intervals are appropriate. A progressive estimate would be that a 1% increase in debt-to-GDP leads to a rise in sovereign interest rates of 2 basis points. A more conservative estimate would be that a 1% increase in debt-to-GDP leads to a rise in sovereign interest rates of 4 basis points. As for deficit-to-GDP, a

progressive estimate would be that a 1% increase in deficit-to-GDP leads to a rise in sovereign interest rates of 8 basis points. A more conservative estimate would be that a 1% increase in deficit-to-GDP leads to a rise in sovereign interest rates of 15 basis points.

Table A: The effects of Financial Fundamentals on Government Bond Rates

Author(s) and year of publication	**Data**	**Estimation technique, dependent variable, independent variable**	**Coefficient**	**Control variables used**	**Robustness checks performed**	**Extra remarks**
Codogno, Favero and Missale (2003)	Panel data on Germany, Italy, Netherlands, Finland, Portugal, Greece, France, Spain, Belgium, Austria and Ireland from 1999 to 2002.	SURE method, Relative asset swap, debt-to-GDP ratio	Only significant effects of debt found for Austria, Belgium and Spain.	The spread between 10-year fixed interest rates on US swaps and the yield on 10-year US government bonds, spread between the yield on US corporate bonds and the yield on US government bonds	None	Study was performed 4 years after the creation of the European Monetary Union. Essentially performed during great moderation. Did not account for deficit of the countries.
Bernoth et al. (2004)	Panel data on Austria, Belgium, Denmark, Finland, Greece, Italy, Ireland, Portugal, Spain, Swezen and the UK from 1991 to 2002.	Reduced-form estimation, 10 year government bond compared to Germany, debt-to-GDP ratio/deficit-to-GDP ratio	Debt: 1*** to 2*** basis points Deficit: 3.39** to 5.33**	Time fixed effects, deficit-to-GDP, debt service-to-GDP, liquidity, corporate bond spread, maturity to yield, business cycle dummy and EMU membership dummy.	Multicollinearity.	Few sensitivity checks performed.
Laubach (2009)	Data on the US from 1976 to 2006.	OLS, 10 year sovereign yield, debt-to-GDP/deficit-to-GDP	Debt: 3** to 4** basis points Deficit: 20* to 30* basis points	Expected inflation, dividend yield and trend growth.	Tested whether the usage of long-term dependent variable justified the omission of cyclical control variables. Tested for structural breaks in the time-series data.	Isolated the effects of business cycles and monetary policy interventions.

Attinasi, Checherita and Nickel (2009)	Panel data on Austria, Belgium, Finland, France, Greece, Ireland, the Netherlands, Portugal and Spain from July 2007 to March 2009.	Feasible Generalized Least Squares, 10 year government bond spreads compared to Germany, expected fiscal position (debt-to-GDP and deficit-to-GDP ratios).	Debt: 1** to 8** basis points Deficit: 7*** to 16*** basis points	Expected budget balance, whether a country had rescued banks, a proxy for international risk aversion and a proxy for liquidity of countries.	Checked the robustness of the results for different time frequencies, different estimation techniques and the inclusion of additional control variables. The model is corrected for heterogeneity and autocorrelation.	The data used in this study did not include the Euro crisis which started in 2010.
Schuknechts, Von Hagen and Wolswijk (2011)	Panel data on Belgium, Germany, Greece, Ireland, Spain, France, Italy, Luxembourgh, the Netherlands, Austria, Portugal and Finland from 1991 to May 2009.	Reduced-form estimation, sovereign bond yield compared to Germany, debt-to-GDP /deficit-to-GDP	Debt: 0.16** to 1.25*** basis points Deficit: 3.49*** to 12.64** basis points	Fiscal balance, time to maturity, short-term interest rate and time fixed effects.	Estimated the regressions with many interaction variables, time fixed effects, squared variables to test for non-linearity and year dummies.	There were no country fixed effects added to the regressions. Low number of observations.
Afonso, Ardhyrou and Kontonikas (2015)	Panel data on Austria, Belgium, Finland, France, Greece, Ireland, Italy, the Netherlands, Portugal and Spain from 1999 to December 2012.	2SLS, 10 year sovereign bond spread compared to Germany, debt-to-GDP /deficit-to-GDP	Debt: No effect prior March ’09, 2** basis points after Deficit: 5** to 11** basis points	International risk factor, liquidity conditions, macroeconomic and fiscal fundamentals and country fixed effects regarding contagion	Accounted for heterogeneity, estimated the model without lagged dependent variable, added more control variables and used different estimation methods.	Low number of observations in this study.

Chapter 3: Austerity and Doom Loops

3.1 Theory Austerity and Doom Loops

Related to financial fundamentals is the policy reaction to the economic recession. In the Eurozone the economic recession consisted of three interlocking crises. As Shambaugh (2012) explains, there was a banking crisis; banks were undercapitalized and faced liquidity constraints. The second crisis was the sovereign debt crisis; several countries faced problems of rising government bond rates and had difficulties funding themselves. The third crisis was the growth crisis; slow economic growth in the Eurozone overall and growth differences across countries. Shambaugh (2012) argues that economic policies aiming to solve these crises should not be designed to solve one crisis at a time but solve all three simultaneously, a very difficult task. To explore this argument each of the three crises first need to be identified.

The first crisis was the banking crisis. Starting in 2007, but especially in 2008, banks started having liquidity problems. After housing prices started dropping in the U.S. the assets on banks' balance sheets that were based on U.S. mortgages became questionable in value. Banks in the U.S., but also in Europe, took large losses and uncertainty about the quality of their assets made it increasingly difficult for banks to borrow. For some banks this liquidity crisis even escalated into a solvency crisis. A vulnerability of banks must be examined to explore this argument, namely the maturity mismatch between the assets and liabilities of banks. The assets of a bank (loans) are long-term and illiquid while the liabilities of a bank (deposits) are short term. Because information is imperfectly shared depositors and creditors can have difficulty knowing if a bank is solvent. If they fear a bank may default they will withdraw their funds. If too many people withdraw their funds at once even a healthy bank will have problems meeting the demand for liquidity. This is known as a bank-run (Diamond & Dybvig, 1983). In a bank-run scenario banks simply cannot liquidate long-term assets quickly enough to pay the bankrunners. Given this vulnerability, a problem in the banking sector can thus be one of liquidity (banks are essentially solvent but have problems attracting or retaining funds) or one of solvency (banks do not own enough assets to pay off their debts entirely). In an attempt to raise the needed liquidity, banks sold their assets at continually lower prices or borrowed at extremely high interest rates. The value of the assets on the balance sheet of the bank dropped dramatically while the value of the liabilities increased, leading banks from a liquidity crisis into a solvency crisis. The FED and ECB stepped in to solve the liquidity problems in several ways. First they decreased the interest rates charged to banks, making it cheaper to borrow. Secondly they vastly increased the size of loans made to the banking sector. These measures helped solve the initial liquidity crunch and calmed the markets. But there were some banks in the Eurozone that took such heavy losses that they became insolvent. Unlike the liquidity problems that were addressed by the ECB on a supranational level, the solvency problems were treated as a national matter. Almost every Eurozone member used fiscal resources to stabilize its banking system. These resources were mostly used to bail-out national banks and give off state guarantees of bank liabilities (e.g. deposit insurance). The amount of capital used was substantial. In Greece and Belgium 6% of GDP was injected in the financial system. In the Netherlands and Germany 13% and 14% of GDP was injected respectively. In Ireland the government injected 41% worth of GDP into their financial system. Thus, the national nature of the response to the solvency crisis meant that banks and sovereigns became intertwined.

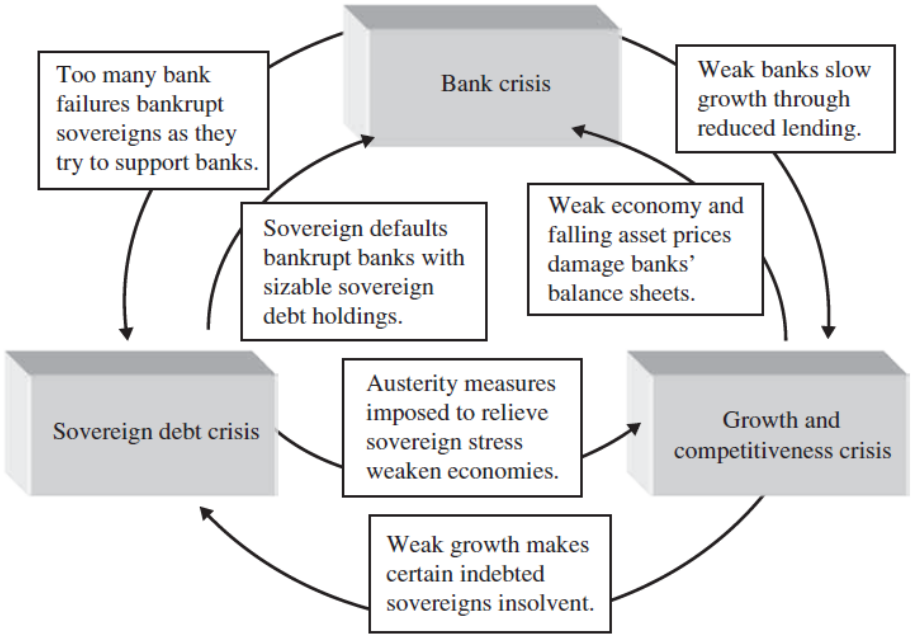
The second crisis was the sovereign debt crisis. As Shambaugh (2012) reiterates, the basic equation for debt sustainability is given by:

$$\Delta D_t = (r_t - g_t) \times D_{t-1} + primary$$

With *D* denoting the debt-to-GDP ratio, *r* the nominal interest rate, *g* the growth rate of the economy and *primary* denoting the primary deficit scaled to GDP. The primary deficit denotes the difference between government spending and tax revenue. Note that this is a different measure than the total deficit, which is equal to the primary deficit plus interest payments on the debt. If this equation holds the debt-to-GDP ratio will be stable. If, for example, the interest rate paid on debt becomes larger than the growth rate of the economy the debt-to-GDP ratio will increase, even when the primary budget is in balance. The opposite scenario also holds. A country with a budget deficit of 2% can have a decreasing debt-to-GDP ratio when the growth rate of the economy is larger than the interest rate paid on government debt. In the years prior to the economic crisis the 10-year government bond rates of the Eurozone members followed each other closely. At the start of the crisis however they diverged and for many countries the interest rate paid on government debt overtook the growth rate of their economy. This increase in government bond rates pushed the debt levels of many economies onto an increasing path introducing fears among investors concerning the solvency of these countries (Shambaugh, 2012). These fears of insolvency eventually culminated when in 2009 Greece revealed that its previous government had misreported government budget data. After this, market sentiment took over and government bond rates soared to unsustainable levels. With already high debt-to-GDP and deficit-to-GDP levels, the higher bond rates meant that some countries would soon default without external help. These problems were exacerbated by the third crisis.

The third crisis was called the growth crisis. Most Eurozone countries emerged from the recession in 2009 (Shambaugh, 2012). However, it soon became apparent that the economic crisis had hit some countries harder than others and a disparity appeared within the Eurozone. In Germany confidence was on the rise, unemployment was dropping and the economy was growing. However, in the GIIPS countries (Greece, Ireland, Italy, Portugal and Spain) unemployment was not dropping, confidence was not improving and the economy was shrinking. The performance of these countries weighted down the rest of the Eurozone and eventually GDP dropped in Germany, the Netherlands, Belgium and Austria as well. In essence there were two problems. The first problem was that growth levels were too low in the Eurozone to support existing debt levels and decrease unemployment levels. The second problem was the existence of large differences in growth levels between Eurozone countries. Even if the immediate liquidity problems were solved via a liquidity injection of sorts, the GIIPS countries needed growth to become solvent and escape the recession.

Graph 2: The Three Crises in Europe



Source: Shambaugh (2012)

Shambaugh (2012) created an excellent summary on how these crises are linked, see Graph 2. The sovereign debt crisis has impacted the banking crisis because banks hold substantial portions of their own sovereign's debt (Shambaugh, 2012). Van Wijnbergen and van der Kwaak (2014) also show that banks suffer from home bias. Next Van Wijnbergen and van der Kwaak (2014) explain how the bailouts and capital injections completed the doom loop. The bailouts and state guarantees increased public debt substantially. The size of the bailouts varied across countries. The average bailout size was 40% of GDP across the Eurozone, but there were outliers like Ireland with 365%. As shown in the previous chapter, the debt-to-GDP ratio has a significant positive effect on government bond rates. The increase in debt-to-GDP caused by the bailouts and state guarantees had a negative impact on bond prices. The increasing government bond rates and lower government bond prices led to substantial capital losses for the domestic banks. These capital losses decreased the net worth of banks, which led banks to increase credit spreads and interest rates in an attempt to offset a part of the losses with higher revenues. The increased interest rates leads to lower borrowing by the private sector with potential harmful consequences for private investment, tax revenue and long-term growth. Lower tax revenue and lower growth increased deficits further, leading to even higher debt-to-GDP levels and further government bond price drops. This negative amplification mechanism caused by the feedback loops between weak banks and weak sovereigns severely limited the ability of the sovereigns to help their distressed financial sector. This became known as the doom loop.

The banking crisis also impacted growth. If banks are weak they are unlikely to lend to the broader economy. Instead they will hoard liquidity that is available to cover losses. It is well known that a well-functioning financial sector is important for the growth of a country. If banks no longer provide credit both consumers and producers will reduce investments and consumption. Vice versa low growth has also impacted the banking crisis. In an economy with weak growth people may not be able to repay their loans to the bank, resulting in losses for the banks. Similarly, in a weak economy asset prices are likely dropping also resulting in losses for the banks. In addition, weak economic growth

also affects the banking crisis through the sovereign debt crisis. Low growth means weaker sovereigns, which in turn damages banks.

So how does austerity fit into the picture here? The answer lies in the connection between the sovereign debt crisis and the growth crisis. If the sovereign debt crisis not occurred, slow growth would have been less of a pressing problem. The reason being that slow growth is sustainable over a longer period when debt levels are low compared to when debt levels are high (Shambaugh, 2012). However, the main link between the sovereign debt crisis and growth stems directly from the policies chosen to fight the sovereign debt crisis: austerity. In an attempt to lower budget deficits and bring down debt levels, increase market confidence and lower government bond rates many countries embarked on austerity. Austerity was also used in an attempt to break the diabolical loop between the banks and sovereigns. If the financial health of a sovereign improved, so would the value of the government bonds on the banks' balance sheets, improving the health of the banks. Some countries did not have a choice, if the markets would not lend them any more money they had to cut their deficits or go bankrupt. Unfortunately the sovereign debt crisis and the banking crisis were only two pieces of a three-piece puzzle. The fiscal contractionary policies that were introduced slowed down growth even more. This meant that a part of the budget improvements made by austerity were undone by lower tax revenue (since GDP growth is slowing down). If austerity caused GDP to contract even more than it cuts the deficit the policy is not only futile, it is actually exacerbating the situation it was meant to remedy. In short, the theory suggests that austerity would have a detrimental effect on the growth crisis, the sovereign debt crisis and indirectly also the banking crisis.

Most of the evidence provided by Shambaugh is narrative-based so the empirical literature on several subjects will be reviewed to determine if there is empirical evidence that the doom loop existed and if so, how austerity affected the doom loop.

3.2 Empirics Austerity and Doom Loops

Mody and Sandri (2012) investigated the increase and divergence of sovereign spreads to describe the escalation of financial tensions within the Eurozone. The authors estimate an OLS regression with sovereign spreads as the dependent variable, a measure for stress in the sovereign's financial sector as the independent variable while adding many control variables. The authors find that after the introduction of the euro, markets judged the probability of default near zero and the sovereign bond spreads converged. This changed as the economic crisis broke out. Under the assumption that sovereigns would rescue the domestic banks, the markets started to link the projection of a Eurozone member's debt to the domestic financial vulnerabilities. This is clearly visible from 2008 and onwards. Sovereign spreads increased as the perceived weakness of domestic banks increased and in countries where the needed fiscal space to help the domestic banks became narrower, the doom loop became stronger.

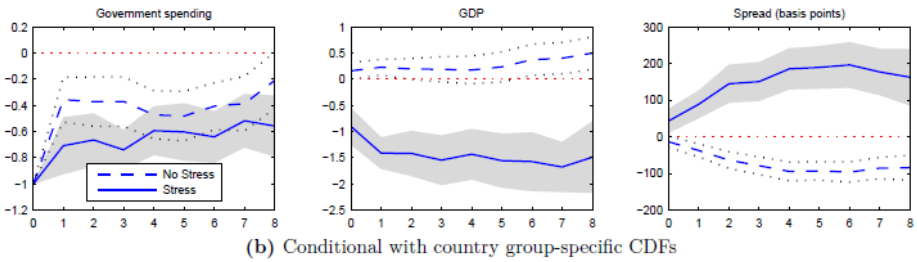
Acharya, Drechsler and Schnabl (2014) investigated the doom loop and related bailouts in the European Union. They estimate an OLS regression using the pre-bailout debt levels and the pre-bailout level of financial sector distress as the independent variables, and sovereign CDS spreads as the dependent variable. They find a significant relationship between debt-to-GDP and sovereign CDS spreads after the bailouts while there was no significant effect between the two variables before 2008. In addition, the authors find that the effect on sovereign CDS spreads was larger for countries with a banking sector more distressed prior to the bailouts. In addition, the authors found a positive relation between sovereign CDS spreads and the size of the needed bailouts. In other words, if the financial sector of a country was in more distress, bigger bailouts were needed (in terms of GDP) which led to

larger increases in the sovereign's CDS spreads. The authors then estimate an OLS regression with sovereign CDS spreads as the independent variable, bank CDS spreads as the dependent variable while adding several control variables. The authors found no significant relation between bank CDS spreads and sovereign CDS spreads before 2008 but did find a signicicant relationship between the two variables after the bailouts. A 10% increase in sovereign CDS spreads correlated with a 2.21% increase in bank CDS spreads. This evidence suggests that banks and sovereigns became intertwined through the bailouts enacted during the financial crisis.

These papers provide evidence that the doom loop was indeed present during the recent economic crisis, as Shambaugh (2012) suggested. The next question that needs answering is whether austerity helped alleviate this doom loop. As mentioned before, the goal of austerity was to lower budget deficits, bring down debt levels, increase market confidence and lower government bond rates. Since market fundamentals and confidence indicators are a determinant of government bond rates, the effect of austerity on government bond rates will be examined.

Born et al. (2015) investigate the effect austerity had on sovereign interest rates by creating a dataset for 31 developed and emerging countries from the early 1990s until 2014. The authors employ a VAR approach with the response of sovereign interest spreads as the dependent variable, the reduction in government expenditure as the independent variable and a set of control variables. They find that sovereign interest rates can increase or decrease as a response to a reduction in government spending depending on the state of the economy. The authors estimated the model under economic benevolent and stressing times. The results of these estimations are plotted in Graph 3. During economic *benevolent* times (see the dotted line in the graph) a 1% cut in government spending resulted in a GDP increase of 0.5% over a period of 8 years, while the spread on sovereign bonds decreased by approximately 100 basis points. This could be viewed as evidence that leaning against the wind is effective fiscal policy. In economic benevolent times the multiplier is likely close to zero so changes in government spending do not affect GDP much. However, tax decreases enabled by a decrease in government spending may boost the economy leading to a positive effect on GDP. During economic *stressing* times (see the uninterrupted line in the graph) a government spending cut of 1% resulted in a decrease in GDP of 1.5%, which indicates a multiplier of 1.5 (see more in chapter 6), while sovereign bond spreads increases peaked at approximately 200 basis points. In summary, Born et al. find that in economic stressing times austerity results in a reduction in GDP and a rise in government bond rates.

Graph 3: The effects of a 1% cut in government spending in economic neutral, benign and stressing times



(b) Conditional with country group-specific CDFs

Source: Born et al. (2015)

Cottarelli and Jamarillo (2013) investigate CDS spreads in 31 advanced countries using a cross-section analysis. They regress 5-year sovereign CDS spreads on various variables with several control variables to explain the variation in CDS spreads. The authors find that current fiscal variables are

important, both debt-to-GDP and deficit-to-GDP are significant and have a positive influence on CDS spreads. Short-term growth is also found to have a significant effect on CDS spreads, with higher growth leading to lower CDS spreads. The authors add that, if the multiplier is sufficiently large, the positive effects of austerity on debt and deficits will be overshadowed by the reduction in growth. Especially in countries will low growth and high debt-to-GDP ratios austerity will have an adverse effect on spreads causing them to rise.

3.3 Conclusion Austerity and Doom Loops

The theoretical basis provided by Shambaugh (2012) suggested that austerity can be counterproductive in alleviating the doomloop, forsaking short-term growth in favor of improving the debt and deficit-to-GDP ratios. If austerity was effective in improving the financial fundamentals and raising confidence then sovereign spreads should have decreased. In reality the sovereign spreads increased since contractionary fiscal policies is just that: contractionary. GDP growth decreased, lowering tax revenue for the government in the future, undoing a significant portion of the initial gains in reducing debt and deficit ratios. Although the doom loop was decidedly real and a serious problem, austerity was simply not the right policy measure to alleviate it. Because the severity of the doom loop was different across countries, it is logical to adjust the fiscal multiplier accordingly. How the doom loop affects the multiplier is discussed in chapter 6.

Chapter 4: Debt and Growth

4.1 Theory Debt and Growth

The next argument used by supporters of austerity is that high levels of debt significantly hamper economic growth (Reinhart, Reinhart, & Rogoff, 2010). Therefore, austerity must be practiced to bring down debt levels and increase growth. Theoretically there are two mechanisms through which high levels of debt can slow down economic growth. The first mechanism is that the four historical responses to high debt episodes, default, financial repression, inflation and currency devaluation, all reduce private investment, which in turn reduces growth. Whenever a country defaults uncertainty concerning the future increases (Gornemann, 2014). The precautionary savings motive (see chapter 5) states that the population will increase savings and reduce consumption and investment as a response to the increased uncertainty. Financial repression refers to policies that result in savers earning interest rates below the rate of inflation. This allows banks to provide cheap loans to the population and the government. As such it is often used to liquidate government debt denominated in domestic currency, decreasing the debt-to-GDP ratio. Financial repression crowds out private investment because the interest rate is so low, leading to lower growth in the future. Inflation reduces the real value of money and thus decreases the real value of any future earnings for businesses and investors. Currency devaluation decreases the value of domestic currency with respect to foreign currency, increasing the value of investments abroad and decreasing domestic investments. To summarize, the four historical responses to high debt episodes negatively affect private investments and therefore GDP growth rates. The second theoretical mechanism is that high debt overhang will lead to higher future taxes, which decreases the value of future earnings. Assume the population is forward looking and internalizes the government budget constraint when deciding whether to consume or to save. When the debt-to-GDP ratio is high, the population realizes that the government will bring down debt levels by increasing taxes in the future. If taxes in the future are increased, a smaller part of future earnings will remain after taxation, lowering the net present value of any investment. A decrease in the net present value of investments will lower private investments and thus growth.

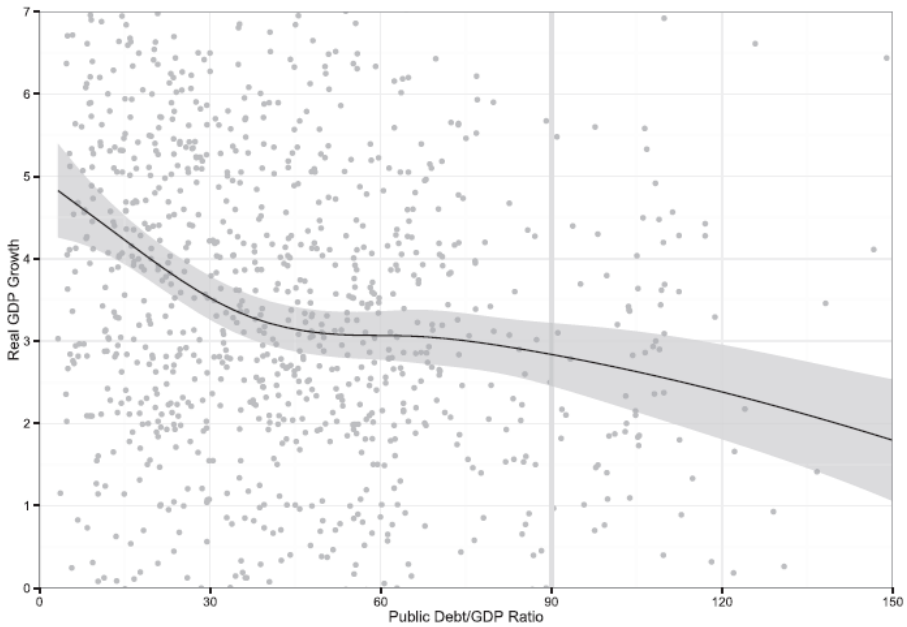
Opponents of austerity argue that the causality does not run from high public debt to low growth but vice versa from low growth to high debt (Pescatori, Sandri, & Simon, 2014). There are two theoretical mechanisms through which low growth can lead to high debt-to-GDP ratios. The first is that weak economic performance places upward pressure on the debt-to-GDP ratio since GDP is the denominator of this ratio. Secondly, low growth tends to deteriorate public budgets due to automatic stabilizers. Low growth leads to lower incomes for households who pay lower income taxes which decreases tax revenue for the government. Additionally the government has to pay out higher benefits since unemployment rises in times of slow economic growth. Both mechanisms increase debt in a time of weak economic performance. According to these theories, the priority should lie on increasing growth levels, rather than decreasing the real value of debt. In order to find a decisive answer and settle the debate on the direction of causality and size of the effect, the next paragraph will review the available empirical literature on the subject.

4.2 Empirics Debt and Growth

An overview of the studies that are discussed hereafter can be found at the end of this chapter under the heading table B. Herndon, Ash and Pollin (2014) replicated Reinhart and Rogoff's (2010) study and find that the results are neither accurate nor robust due to: 'selective exclusion of available data,

coding errors and inappropriate methods for the weighting of summary statistics' (Herndon, Ash, & Pollin, 2014). The authors recreated the analysis done by Reinhart and Rogoff while fixing these errors and conclude that there is not a clear threshold after which growth deteriorates at high debt levels. Moreover, as can be seen from Graph 4, there is a wide range of growth performances at each debt level. This argues against the stylized fact that growth deteriorates at high debt levels presented by Reinhart and Rogoff.

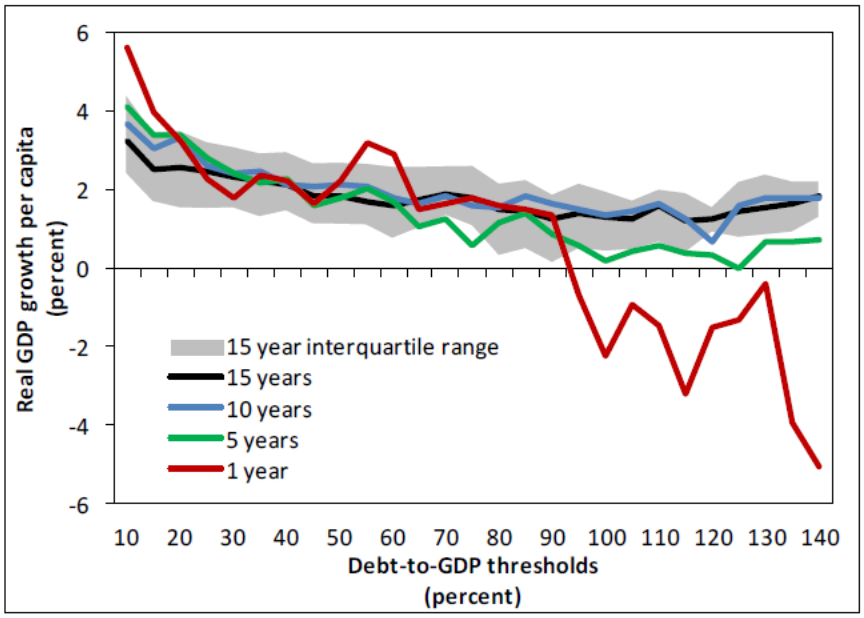
Graph 4: Public debt/GDP Ratio and Real GDP Growth



Source: Herndon, Ash and Pollin (2014)

Pescatori, Sandri and Simon (2014) investigate the relationship between debt-to-GDP ratios and economic growth by examining debt episodes of IMF states from 1875 onwards. The authors first establish periods during which gross public debt rose above a threshold. They then examined the growth rates of the countries several years later. The authors find that after high debt-to-GDP epiodes the growth rates are negative on the short term. The red line in Graph 5 depicts this. The growth rates are shown 1 year later for each debt level. The authors then extend the horizon and examine the growth rates of countries 5, 10 and 15 years later. The findings suggest that on the medium- and long-term there is no longer a discernible threshold where growth deteriorates heavily. However, higher debt is still associated with lower average growth levels, even many years into the future. In addition to these arguments, Dafermos (2015) uses the Reinhart and Rogoff dataset to show that the data also supports the hypothesis that low growth episodes lead to higher public indebtedness.

Graph 5: Debt and Growth over the short-, medium- and long-term



Source: (Pescatori, Sandri, & Simon, 2014)

Kumar and Woo (2010) have investigated the impact of high public debt on growth rates using an OLS approach. They deal with reverse causality by using initial debt level as the explanatory variable and subsequent growth rates as the dependent variable. They use panel data on advanced and emerging economies stretching from 1970 to 2008. The authors add many control variables and the sensitivity analysis performed is thorough. The findings suggest that a 10 percent increase in initial debt is associated with a slowdown in GDP growth of about 0.2 percentage points.

Baum, Rother and Checherita (2012) have analyzed the impact of high public debt on growth using a dynamic threshold panel of 12 EU countries with data spanning a period of 20 years. They take a different approach by which they use the data to find threshold values where the effect of debt-to-GDP on GDP growth becomes significantly different. They identify a threshold at 95.6% debt-to-GDP ratio and conclude that for low debt levels the impact of additional debt on growth is positive, for medium levels the impact of additional debt on growth is not significant while for high debt levels the impact of additional debt on growth is significantly negative. These findings suggest that taking on additional debt has a non-linear effect on growth rates.

After using an OLS method, Panizza and Presbitero (2014) estimate the effects of debt-to-GDP on growth using an instrumental variable approach to deal with the reverse causality problem. They use the interaction between foreign currency debt and exchange rate movements as the instrument. The idea is that random movements in exchange rates can affect debt levels if at least a portion of public debt is denominated in foreign currency. The authors show that the instrument is indeed strong but concede that it is not fully exogenous. First the authors estimate an OLS regression with debt-to-GDP as the independent variable, growth as the dependent variable along with several control variables. The authors find a significant negative effect for debt, a 10% increase in debt implies a reduction in growth of 17 basis points. Next the authors estimate the effect of debt on growth using the IV approach and find that the coefficient for debt is no longer significant and positive. The authors also search for a threshold of debt after which growth significantly deteriorates but are unable to find evidence for such a break.

4.3 Conclusion Debt and Growth

Correctly assessing the relationship between public debt and economic growth is challenging. Many studies on the subject apply no econometrics or simply estimate an OLS regression with debt-to-GDP as the independent variable and GDP growth as the dependent variable. A first point of concern is the fact that the relationship between the two variables is not necessarily linear. Secondly, even adding a full set of control variables is unlikely to eliminate bias in the model as both the dependent and independent variable could be influenced by a third omitted variable. A candidate for such a variable could be the occurrence of recessions because growth is significantly reduced in such a period (the definition for a recession is 'a prolonged period of reduced growth'). The occurrence of a recession will also put upward pressure on the debt-to-GDP ratio via automatic stabilizers. Theoretically, using an instrumental variable that is highly correlated with the independent variable but not with the dependent variable can solve the omitted variable bias. If the instrument is strong, we can estimate the true effect of the independent variable on the dependent variable. However, finding an instrument that is both strong and exogenous has proven difficult. From the reviewed empirical literature it can be concluded that while some papers show that public debt is negatively associated with economic growth, no paper provides convincing evidence for a negative causal link between public debt and economic growth.

Because many papers do provide evidence for a negative association between debt-to-GDP and economic growth this interaction is incorporated in the social cost-benefit analysis. To strengthen the conclusions of this paper the worst-case scenario will be accounted for: the assumption that higher debt levels cause lower growth. Or in other words: if austerity lowers debt levels, growth will increase. Using the dataset of Reinhart and Rogoff debt can be made a function of debt. The details of this function are explained in the methodology because other variables need to be discussed first.

Table B: The effect of debt-to-GDP on growth

Author(s) and year of publication	**Data**	**Estimation technique, dependent variable, independent variable**	**Coefficient**	**Control variables used**	**Robustness checks performed**	**Extra remarks**
Reinhart and Rogoff (2010)	Panel data on 44 OECD countries, data over 200 years	None, authors averaged GDP growth during 4 different debt ranges.	≤30% 4.1% 30-60% 2.8% 60-90% 2.8% >90% -0.1% Left-hand side is the debt level, right-hand side is the average growth	None	Authors argue that their results are robust because they used data from many countries over a long period of time. Also used different measurement techniques and ways to categorize data.	The conclusions of this paper were challenged by Herndon, Ash and Pollin. In a response, Reinhart and Rogoff wrote a 2012 paper in which they defended their findings.
Pescatori, Sandri and Simon (2014)	Panel data on 38 IMF member countries from 1870-2010.	None, the authors identified debt episodes and examined subsequent growth rates on the short-, medium- and long-term.	See Graph 5.	None	Compared the growth rate of a high debt country to the average growth rate of the same time period. To address reverse causality, the authors investigated the growth performance 5 to 15 years after a high debt period, instead of 0 to 15 years.	Only a small number of episodes per country.
Herndon, Ash and Pollin (2014)	Panel data on 20 advanced economies (a part of Reinhart and Rogoff dataset)	None, authors averaged GDP growth during 4 different debt ranges.	≤30% 4.2% 30-60% 3.1% 60-90% 3.2% >90% 2.2% Left-hand side is	None	Use data on many countries over a long period of time. Added another high debt category.	This paper is a critique of Reinhart and Rogoff's 2010 paper.

	from 1946-2009.		the debt level, right-hand side is the average growth. See also Graph 4.			
Kumar and Woo (2010)	Panel data on 38 advanced and emerging economies from 1970-2008.	OLS, Growth rates, initial debt-to-GDP level.	0.024***	Country fixed effects, time-fixed effects, GDP, human capital, government size, trade openness, liquidity, inflation, trade growth rates, fiscal deficit and a dummy for banking crisis.	Alternative specifications, addition of more control variables, usage of different samples and periods. Authors accounted for reverse causality, endogeneity and outliers.	Although the use of econometrics to estimate the effect of debt-to-GDP on growth is excellent, the data only ranges from 1970 onwards which is not long.
Baum, Rother and Checherita (2012)	Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourgh, Netherlands, Portugal and Spain from 1990-2010.	Dynamic panel estimation, GDP growth, debt-to-GDP ratio	≤67% 0.035% 67-96% not sign. >96% -0.059% Left-hand side is the debt level, right-hand side is the average growth	Lagged GDP growth, gross fixed capital formation/GDP, trade openness and a dummy for EMU membership.	Heteroscedasticity adjusted standard errors. Added several control variables such as initial GDP level per capita, population growth, secondary education level, unemployment rate, short- and long-term interest rates. Added the period 1980-1989.	Data ranges van 1990-2010, which is not long. Only 12 countries.
Panizza and Presbitero (2014)	Panel data on Australia, Austria, Belgium, Canada, Germany, Denmark, Spain, Finland, France, United Kingdom, Italy, Japan, the Netherlands,	IV, GDP growth, deb-to-GDP with the interaction between foreign currency debt and exchange rate movements as the instrument.	OLS: 10% increase in debt-to-GDP is associated with 18*** basis point reduction of average growth. No causal effect found in IV	OLS: Lagged values for debt-to-GDP ratio, initial GDP per capita, national gross savings, population growth, average years of education, trade openness, inflation, age dependency ratio,	Extensive tests to determine the strength of the instrument. Checked the correlation of the instrument with the error term. Dealt with autocorrelation, used an alternative measure of debt, used a different sample	Instrument is strong but not fully exogenous.

	Norway, Portugal, Sweden and the United States from 1980-20015.		estimation.	a banking crisis dummy and the ratio of liquid liabilities to GDP.	and outliers.	

Chapter 5: Austerity and Confidence Levels

5.1 Theory Austerity and Consumer Confidence

Supporters of austerity argued that austerity would not deepen the recession because spending cuts would inspire confidence in the population. The increase in private consumption and investment, inspired by higher confidence, would offset the decrease in government spending. Theoretically there are three mechanisms through which austerity can influence output via confidence channels. The first mechanism is based on the Ricardian equivalence proposition (Ricardo, 1820; Barro, 1996). The basis of this theory is that the population is forward looking and thus internalizes the government budget constraint when deciding whether to save or to consume. Assume a government aims to boost aggregate demand by increasing spending. The government can finance such spending either through higher taxes or selling bonds. This choice is often called 'tax now or tax later'. In the situation where spending increases are financed through tax increases the population has to pay higher taxes, has lower current disposable income and therefore consumes less. The positive effect on aggregate demand caused by higher government spending is thus offset by lower consumption on the side of the population. In the situation where an increase in government spending is realized by selling bonds the government is taking out loans. According to the Ricardian Equivalence theorem the population realizes that the loans must be repaid in the future and that the government will do so by raising taxes. To smooth their income over time the population starts saving now to pay for the expected increase in taxes in the future. This reduces their current consumption. Like the situation where the government would have chosen to 'tax now' the positive effect of an increase in government spending is offset by lower consumption on the side of the population. In essence, this argument is used against Keynesian fiscal stimulus measures. It should be noted that this theory has received criticism in recent times. According to Krugman (2011) it is difficult to satisfy the assumptions of perfect foresight, perfect capital markets and perfect rationality. Perfect foresight is only possible if there is no uncertainty. Uncertainty describes a situation where the probabilities of outcomes are unknown. Uncertainty is by definition different from risk, where the probabilities are known (Knight, 1921). Kahneman and Tversky (1974) show that economic agents face uncertainty when making decisions and agents often reduce the complex task of assessing probabilities to simpler judgemental operations, thereby increasing the probability of errors. In addition to this, Keynes (1936) argued that agents with perfect foresight do not exist, as it assumes that such an agent would need a perfect understanding of economic forecasting and macroeconomics. Tversky and Craig (1995) challenged the assumption of perfect rationality by empirically showing that investors have a tendency to make risk-averse decisions in gains and risk-seeking decisions in losses. Capital markets imperfections arise often due to asymmetric information. Two common examples of asymmetric information are moral hazard and adverse selection. Moral hazard occurs when an economic agent takes on more risk because another agent bears the costs of those risks (Arrow, 1963; Pauly, 1968). An example of moral hazard in capital markets can be found in the recent economic crisis. Bailouts of banks by central banks or governments can encourage risky investments in the future, because banks may believe they won't have to carry the full burden of the potential losses. Adverse selection can also lead to capital market failures. If some investors possess more information concerning certain bonds than the majority, they may buy those bonds while other investors do not. This can result in an advantage for the investors that bought the bonds. The majority of investors can withdraw from the market because they feel disadvantaged. In such a case the capital market will stop functioning (Myers & Majluf, 1984). However, in theory, the Ricardian Equivalence theory suggests that when austerity is practiced in a world where all these

assumptions are met; a reduction in government spending will not lead to lower aggregate demand because it will be offset by increases in consumer spending caused by lower taxes now or in the future.

The second mechanism through which austerity can influence via output involves Animal Spirits. This term was first used by Keynes (1936). It is a collective term for the emotional mindset of humans. Keynes argued that the 'rational agent' often used in economic modelling does not exist and that humans often make economic decisions based on intuition and emotion. Keynes argued that it is impossible to exactly calculate the benefits and costs of investments many years into the future and that such uncertainty would prevent many long-term economic decisions. Yet such decisions are still being made. He concluded that 'they can only be taken as a result of animal spirits' (Keynes, 1936). He proposed that Animal Spirits influence our views on the economy and thus our confidence, pessimism and fears. If animal spirits are low the population is unlikely to invest and consume which will drive down even a promising market. Vice versa if Animal Spirits are high the population is likely to consume which can drive a market upwards. Such collective movements were observed during the economic crisis in 2008 when confidence among investors dropped, financial institutions stopped lending money, fire-sales ensued and the markets sharply declined. Even on an individual level Animal Spirits can be observed. People for example believe that their saving accounts retain their value even when inflation increases or they may resist taking pay cuts even when it may cause them to lose their job (Akerlof & Shiller, 2010). This is also known as the money illusion. According to proponents of austerity, the policies can be used to lift the animal spirits of the population via inspiring trust and raising confidence. Such movements may lead the population to increase their consumption, which results in higher aggregate demand and higher output, eventually leading countries out of the economic recession.

The third argument is called the precautionary savings motive (Skinner, 1988). This theory states that consumers and producers increase savings when uncertainty about future income is higher and there is an incomplete insurance market. Assume a situation where there is uncertainty about the future. In normal circumstances a rational agent would like to buy insurance against a bleak future because the agent rationalizes that if this bleak future is realized, future income will decrease. In a situation where it is not possible to buy insurance against an event that causes income to decrease (insurance market incompleteness) the agent will decrease consumption and increase savings in the present to avoid the negative consequences of future income decreases. These savings can then be used in the future to offset any decreases in income and income is smoothed over time (Friedman, 1957; Skinner, 1988). According to this argument, if austerity is practiced, confidence in the government will increase, uncertainty about the future will decrease, savings in the present will be lowered and spending in the present will increase. This leads to higher aggregate demand and higher output.

In order to examine the effect austerity has on output through confidence the mechanism will be split in two. First the effect of austerity on confidence will be examined. Next the effect of confidence on output will be studied. Hereafter the empirical literature on both subjects is discussed.

5.2 Empirics Austerity and Confidence

An overview of the studies that are discussed hereafter can be found at the end of this chapter under the heading Table C.1. Kalbhenn and Stracca (2015) investigate the effect austerity has on confidence in 26 European countries. The authors estimate an OLS regression with confidence as the dependent variable, austerity (as a % of GDP) as the independent variable while controlling for several macroeconomic variables. Initially the authors find that austerity has a significant negative effect on confidence, but this relationship disappears once macroeconomic control variables are added. The

authors argue that the significance disappears because austerity only affects confidence through its effect on macroeconomic variables. In other words, if austerity decreases GDP and increases unemployment it will have a negative influence on confidence. Besides this, austerity does not affect confidence.

Beetsma et al. (2015) investigate the effect fiscal contractionary policies had on confidence in 17 OECD countries. They estimate an OLS regression with austerity as the independent variable, confidence as the dependent variable while controlling for macroeconomic variables and forward-looking metrics like the stock market index. As a solution for the endogeneity problem the authors use confidence indicators that were measured at the end of the year while austerity was implemented throughout the year. The authors find that a 1% increase in austerity is associated with a drop in confidence of approximately 0.12%. They furthermore find that the drop in confidence is more pronounced when the austerity measures are unannounced.

5.3 Empirics Confidence and Output

An overview of the studies that are discussed hereafter can be found at the end of this chapter under the heading Table C.2. Matsusaka and Sbordone (1995) study the effect of consumer confidence indicators on output using US data from 1953 to 1983. The authors employ a VAR approach with GDP as the dependent variable and confidence as the independent variable while controlling for many macroeconomic variables. They state that the expectations of the population, expressed as a confidence measure, can take on the character of a self-fulfilling prophecy. If bad times are expected, consumption will stagnate and aggregate demand will drop, leading to economic decline. Because the direction of causality is difficult to determine the authors use the Granger causality test. They find that confidence has a significant positive effect on output and consistently prove Granger causality.

Mourougane and Roma (2002) investigate the effect consumer confidence has on real GDP growth on the short term. The data used originates from 6 EU countries and spans a period of 1995 to 2000. The authors use an OLS approach with real GDP growth as the dependent variable, a confidence indicator as the independent variable while controlling for macroeconomic variables that may also affect GDP. The confidence indicators used by the authors are the European Commission Economic Sentiment Indicator (ESI) and the Industrial Confidence Indicator (ICI). They find a significant positive relationship between consumer confidence and GDP. To test the validity of their findings the authors employ a wide range of sensitivity tests and find that their results are robust.

McNabb and Taylor (2007) also study the effects consumer confidence has on GDP, using data from the UK, France, Italy and the Netherlands from 1983 to 1998. They use a VAR approach with confidence indicators as the independent variable, GDP as the dependent variable while controlling for time and country fixed effects. The authors also investigate a possible link between confidence indicators and the business cycle. They find a significant positive relationship between consumer confidence and GDP in the United Kingdom. They also find a significant positive relationship between business confidence and GDP in France and Italy. No significant relationship between confidence and GDP was found in the Netherlands. These results are robust to different estimation techniques.

Utaka (2003) studies the effect of consumer confidence on GDP in Japan. He uses a VAR approach with a confidence measure as the independent variable, GDP as the dependent variable while controlling for variables that may also affect GDP such as business conditions. He decomposes the forecast variance and finds that between 9 and 11% of GDP variance can be explained by consumer

confidence and the author concludes that Granger causality is proven. Overall the study finds a positive significant relationship between the confidence indicators and GDP.

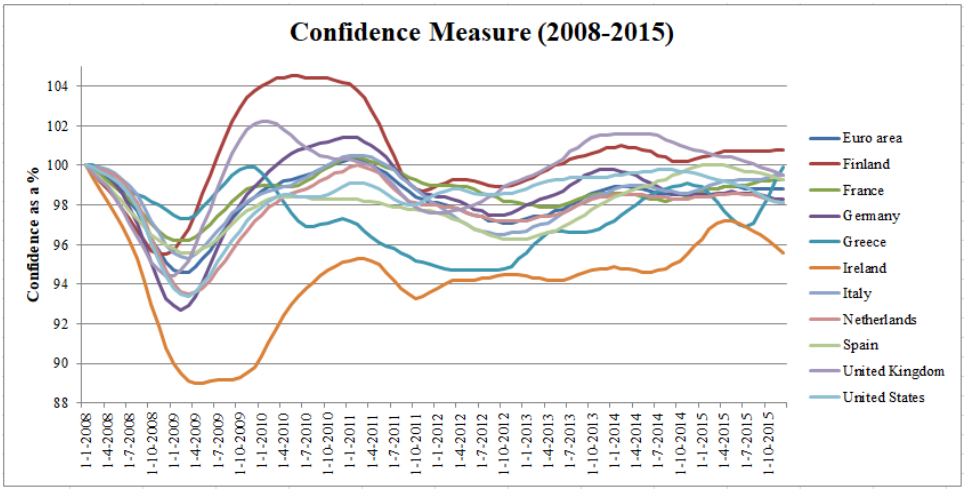
5.4 Conclusion Austerity, Confidence and output

Unfortunately research that examines to what extend austerity influences confidence measures is scarce. A plausible explanation for this is that the economic crisis and subsequent rounds of fiscal contractionary policies have only recently sparked interest in the subject, which has led to investigative studies. The studies that are available however provide a clear conclusion: Austerity has a negative influence on confidence measures. Although the size of the effect varies, the evidence discredits the notion that austerity in times of recession can positively influence consumer confidence. The studies that investigated the effect of consumer confidence on output show that consumer confidence has a positive effect on GDP. However, since the effect of austerity on confidence is negative, the effect of austerity on output via the confidence channels will be negative.

When calculating the effect austerity had on output the confidence argument needs to be incorporated into the social cost-benefit analysis. The best way to do this is to incorporate the confidence argument into the fiscal multiplier (see more in chapter 6). Theoretically, if confidence among the population increases, uncertainty decreases which weakens the precautionary savings motive. If there is less uncertainty about the future, the savings ratio of income decreases which means that the consumption ratio of income must increase. If the population consumes a larger portion of its income, output will increase. Therefore, if confidence is higher, the multiplier must be higher. In essence, the change in government spending increases output more because the population spends a larger part of its income. This argument also works in reverse, if confidence is lower, the multiplier must be lower. It should be noted that although this relationship is far from robust, it is included for the sake of completeness. It is the aim of this thesis to accurately account for all the arguments of supporters and opponents and for that reason the confidence argument will be included in the SCBA.

Data are needed on the confidence levels for the eleven countries in our sample to estimate the effect confidence has on the multiplier. Data collected from the OECD are plotted in Graph 6 (OECD, 2017). The benchmark taken is the confidence level in each country several months prior to the start of the crisis, Januari 1st 2008. A clear drop in confidence can be seen as the crisis developed in 2008 and early 2009. Although the drop is quite significant, confidence levels in almost every country seemed to recover quickly until early 2010. As the Eurocrisis started to emerge confidence took another drop. The consequences of this double-dip recession left its marks on confidence levels, which have struggled to recover since. Averages are calculated for each country and shown in Table 1. These averages are used to adjust the fiscal multiplier.

Graph 6: Confidence Measure for each country



Source: OECD (2017)

Table 1: Average confidence levels (2008-2015)

Country	Averages
Euro area	98.26%
Finland	100.42%
France	98.63%
Germany	98.51%
Greece	97.37%
Ireland	94.16%
Italy	98.38%
Netherlands	97.87%
Spain	97.94%
United Kingdom	99.51%
United States	98.32%

Source: OECD (2017)

Table C.1: The effects of fiscal contractionary policy on confidence

Author(s) and year of publication	**Data**	**Estimation technique, dependent variable, independent variable**	**Coefficient**	**Control variables used**	**Robustness checks performed**	**Extra remarks**
Kalbhenn and Stracca (2015)	Panel data on 26 European countries from 1973 to 2013.	OLS, confidence measure, austerity.	No significant effect found for austerity on confidence once macroeconomic control variables are added.	Real GDP growth, CPI inflation, unemployment rate, dummies for fiscal consolidation episodes, current account balance and interaction terms.	Estimated the regression with control variables and interaction terms. Results were robust to these tests.	Barely any sensitivity analysis.
Beetsma, Cimadomo, Furtuna and Giuliodori (2015)	Panel data on 17 OECD countries from 1978-2009.	OLS, confidence measure, austerity.	1% of GDP increase in austerity reduces consumer confidence with 0.12* percentage points.	Country fixed effects, time fixed effects, GDP growth, public debt, unemployment, inflation, long-term interest rate, real asset price and a lag of the dependent variable.	Heteroscedasticity and autocorrelation robust standard errors. Checked for Nickell-bias.	The effect is stronger and more significant for unannounced austerity measures.

Table C.2: The effect of confidence on output

Author(s) and year of publication	**Data**	**Estimation technique, dependent variable, independent variable**	**Coefficient**	**Control variables used**	**Robustness checks performed**	**Extra remarks**
Matsusaka and Sbordone (1995)	US data from 1952-1983.	VAR, Confidence measure, GNP.	0.215**	Index of leading indicators, such as money supply, asset prices, government expenditures and unemployment.	Added extra control variables.	Not many sensitivity checks performed. Omitted variable bias is still possible.

Mourougane and Roma (2002)	Data on Belgium, Germany, France, Italy and the Netherlands from 1995-2000.	OLS, real GDP, Confidence measure.	0.78*	None in the original equation.	Used the level of the confidence indicator as independent variable. Added a set of macroeconomic control variables. Checked whether additional lags added explanatory power, both for the dependent and independent variable. Checked for heteroscedasticity and autocorrelation.	The sensitivity analysis was done well. Although there are no control variables in the OLS, the authors ran the regressions with and found no significant difference in the size and significance of the coefficient.
McNabb and Taylor (2007)	Data from UK, France, Italy and the Netherlands from 1983-1998.	VAR, GDP, Confidence measure.	Consumer confidence is significant for the UK (4.172*), business confidence is significant for Italy (4.328*) and France (5.483*).	The real wage, employment, consumer expenditure, government expenditure, money supply, interest rate and real effective exchange rate.	Used different estimation techniques.	Few countries in the sample, the sensitivity analysis is lacking and the results are ambiguous. The authors do check for reverse causality.
Utaka (2003)	Data on Japan from 1982-2000.	VAR, GDP, Confidence measure.	Between 9 and 11% of the GDP variance can be explained by consumer confidence.	Index of business conditions which consist of money supply, inventories, orders and asset prices.	Added several control variables, used a different consumer confidence measure and decomposed the forecast variance.	Granger causality proven. Like Matsusaka and Sbordone, omitted variable bias is still possible.

Chapter 6: The Fiscal Multiplier

6.1 Theory General Fiscal Multipliers

A change in government spending, and thus austerity, affects GDP through the fiscal multiplier. The size (and sometimes even the sign) of the fiscal multiplier (or simply 'the multiplier') has been the subject of debate among economists since the advent of the crisis in 2008 (Krugman, 2009). The fiscal multiplier denotes the ratio of change in which the output of a country is affected by the change in government spending or taxation. The existence of the multiplier was first acknowledged by Keynes (1936). He argued that in an economy that is operating below full employment, stimulus provided by the government in the form of a tax decrease or government spending increase does not crowd out private activity because the economy is operating below capacity. This means that any increase in government spending will boost the income of those who receive government contracts or benefits. These people will spend their newfound income equal to their marginal propensity to consume. The receipients of this spending will also spend their newfound income equal to their marginal propensity to consume and so forth. The initial increase in government spending ripples through the economy. If the propensity to save is higher, the population will consume a smaller portion of the extra income and there will be less of an immediate impact on the economy, resulting in a smaller multiplier. If the propensity to consume is higher, the population will consume a larger portion of the extra income and there will be a larger impact on the economy, resulting in a larger multiplier. If the change in output is larger than the initial increase in government spending, it is called 'the multiplier effect' and the value of the multiplier is larger than one. If the resulting change in real GDP is smaller than the initial investment, the multiplier is smaller than one. Note that this only works when the economy is operating below capacity. The multiplier is influenced by many variables, e.g. the openness of a country, the economic climate (upturn/downturn), the zero lower bound on nominal interest rates and exchange rate regimes. The openness of a country affects the multiplier through the export leak. If a large part of government stimulus leaks to foreign countries, the multiplier will be lower. If the economy is in a downturn it is likely operating below capacity and the multiplier will be larger. If the zero lower bound (ZLB) on nominal interest rates binds, monetary policy will lose its effectiveness and the multiplier will be larger. If a country is a part of a monetary union or maintains a fixed exchange rate, the central bank will increase the money supply to offset an appreciation of the exchange rate, minimizing the export leak. How these variables influence the size of the multiplier will be discussed in more detail in subsequent parts, but first the various methods used by multiplier studies will be discussed.

6.2 Empirics General Fiscal Multipliers

It is difficult to empirically determine the size of the multiplier because of the endogeneity of government spending due to automatic stabilizers and counter-cyclical spending policies. To determine the size of the multiplier, the first step is to identify fiscal policy. However, a change in government finances does not always follow from a change in fiscal policy. The state of the economy also affects government finances through automatic stabilizers. The question thus becomes: 'Which changes in government finances are caused by the economy and which are caused by fiscal policy?' The reaction of the population to a change in fiscal policy can also affect the estimation of the multiplier. The Ricardian Equivalence theorem, see chapter 5, states that the population will increase savings and reduce consumption when government spending increases, thereby affecting the estimation of the multiplier. Currency appreciation can also affect the estimation of the multiplier,

under a fixed exchange rate regime multipliers are likely larger than under a flexible exchange rate regime. See sections 6.8 and 6.9 for a detailed discussion. The studies that investigate the size of the multiplier can be broadly sorted into four categories, based on the type of identification strategy of fiscal policy: VAR approaches, DSGE models, narrative based estimates and local multiplier studies. The specifics of each type will now be discussed.

The Standard Vector Autoregression (SVAR) approach attempts to disentangle the effect the economy has on government finances and the effect government finances have on the economy by making assumptions. An example of such an assumption is that shocks in the economy do not directly affect government spending and taxation, but three months later. Any unexpected changes in government finances during those three months are then the result of policy making, which can be used to identify government policy. A regression is then estimated to determine the effect of government policy changes on GDP, which results in a value for the multiplier. An advantage of the SVAR approach is that it models changes in fiscal policy as a shock, similar to DSGE models, which means that the empirical approach of SVAR complements the theoretical basis of DSGE models. A disadvantage of the SVAR approach is that fiscal policy is never fully exogenous, meaning that fiscal policy always reacts to the economy. These studies include the reaction of the central bank, Ricardian households and appreciation of the exchange rate.

The Dynamic Stochastic General Equilibrium (DSGE) approach builds a model based on micro economic foundations that reflects the economy as closely as possible. It usually incorporates rational, forward looking agents, rational expectations and assumes that all agents in the model follow optimal plans to maximize lifetime expected utility, subject to the budget constraint. In addition to this, the government must satisfy the budget constraint and businesses maximize profits subject to the available technology. Once all variables are in place, simulations are run to solve the model. Fiscal ‘shocks’ are then introduced, which consists of tax changes or government spending changes. The model is then calibrated to determine how the fiscal shock affected the economy. This results in an estimation of the multiplier. An advantage of a DSGE model is that it is easy to incorporate special circumstances into the model, like the zero lower bound. A disadvantage of a DSGE model is that fiscal policy can affect the behavior of the population, which is difficult to account for in the model. These studies include the reaction of the central bank, Ricardian households and appreciation of the exchange rate.

Narrative based studies use information from alternative sources to identify a change in fiscal policy. Because fiscal policy is now identified, it becomes possible to estimate a regression to find how the change in fiscal policy affected GDP and thus find the multiplier. An example of a narrative study is Ramey and Shapiro (1998) who used information about wars to identify changes in fiscal policy. If a war broke out, military spending would increase, which had an effect on GDP. An advantage of this approach is that the multiplier is easy to interpret; it is the effect of a particular fiscal policy on GDP. A disadvantage is that the multipliers found in narrative based studies are difficult to generalize. As Lukkezen (2013) argues, it is not even clear if multipliers found in times of war can be used in time of peace, let alone other spending increases. These studies include the reaction of the central bank, Ricardian households and appreciation of the exchange rate.

Local multiplier studies focus on the United States and the difference between states. These studies estimate the effect of a change in government spending in one state, holding national effects constant. To illustrate this, assume that the federal government redistributes one dollar more to one particular state. The effect on GDP in that state, *relative* to the other states, can then be estimated to find the local multiplier. An advantage of local multiplier studies is that there are fewer distortions that affect the estimation of the multiplier. Because monetary policy is the same for all states, there will be no

counter-cyclical policy to dampen the effects of an increase in government spending. In addition, because every state in the United States uses the dollar, there will be no currency appreciation, which would have led to lower net exports. A disadvantage of this method is that the Ricardian Equivalence argument is not accounted for. The population of the state in which government spending is increased will not expect tax increases because tax is collected at the federal level across all states. Because these studies exclude the reaction of the central bank and the exchange rate appreciation, they are the best estimates. In addition to this argument, the local multiplier studies essentially estimate the multiplier in a small open economy in a currency union, similar to the countries in the Eurozone, which means these studies provide an excellent baseline for the country-specific multipliers later discussed in this chapter.

6.3 Theory Multipliers in a Liquidity Trap

One of the variables that have an effect on the value of the multiplier is the liquidity trap. How the liquidity trap affects the multiplier will be discussed in this section. An overview of the studies that are discussed hereafter can be found at the end of this chapter under the heading table D. Hoping to discourage saving and boost consumption, the ECB has stated that it intends to keep its benchmark interest rate at zero (Jolly, 2016). This threshold has been reached in the middle of 2012 (Allen, 2016). Under the assumption that nominal interest rates cannot become negative, since markets have the option of hoarding cash, the zero lower bound has thus been attained. In modern macroeconomics, the liquidity trap is a situation in which monetary policy fails to boost the economy because nominal interest rates are at or close to zero. In a normal situation, the central bank can buy bonds with newly created cash to lower interest rates, giving households and firms an incentive to save less and consume and invest more which boosts aggregate demand. But when the nominal interest is at the zero lower bound (ZLB), bonds are effectively the equivalent of cash. Since there are no longer any benefits to holding bonds, any increase in the money supply will be absorbed at unchanged asset returns. In short, expansionary monetary policy in a liquidity trap fails to lower interest rates and boost aggregate demand because the nominal interest rate simply cannot fall any lower.

The zero lower bound becomes a pressing problem when a government practices austerity to improve the sustainability of government finances. Austerity produces deflationary pressures since aggregate demand drops when government spending decreases. Usually, lowering nominal interest rates to offset the deflationary pressures solves this problem. But when the zero lower bounds binds this is no longer possible. Moreover, when the nominal interest rate is zero, deflation raises the real interest rate, which increases the real value of debts and increases desired savings. As a result, output contracts more than in normal times. Through this mechanism, austerity takes on a self-defeating character because it further deteriorates the fiscal position of the government, rather than improving it since an increase in the real interest rate raises the real value of government debt (Christiano, Eichenbaum, & Rebelo, 2011; Eggertsson, 2010; Farhi & Werning, 2012; Erceg & Lindé, 2012). In theory, the multiplier in a liquidity trap is likely larger than in a normal economic situation because the normal ‘crowding out’ of fiscal stimulus is absent. The empirical literature on the subject will be reviewed subsequently to test this hypothesis.

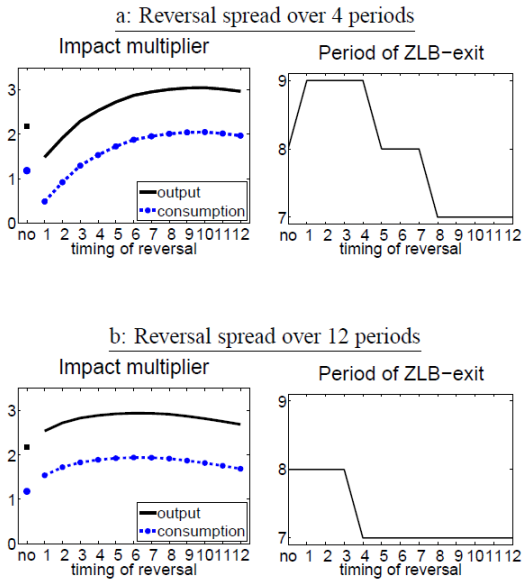
6.4 Empirics Multipliers in a Liquidity Trap

Christiano, Eichenbaum, Rebelo (2011) investigate the size of the multiplier in a zero-bound state using a DSGE model. They model a recession as an unexpected and drastic change in the discount factor of the population. This increases the propensity to save, reduces the propensity to consume and thus leads to a fall in output. The authors consistently find that the multiplier is larger in situations

where the liquidity trap binds. In addition, they find that the government-spending multiplier depends positively on the expected length of the liquidity trap. For example, when government spending increases for 3 years, while the economy remains in the liquidity trap, the multiplier is estimated to be 1.6 and peaks at 2.3. The authors do stress that the timing of the increase in government spending is important. The multiplier is much larger when the bulk of the boost in government spending enters the economy when the zero lower bound still binds. This should be of no concern for the point of this study as the EU is still facing a binding zero lower bounds as of spring 2017 which would have given governments ample time to use the benefits of increasing government spending.

Corsetti, Kuester, Meier and Müller (2010) use a standard new Keynesian model to show that the anticipation of short- and medium-term spending cuts lead to higher multipliers. This conclusion still holds under the assumption that monetary policy is constrained by a binding zero lower bound on interest rates. The authors find that expansionary fiscal policies financed with higher taxes in subsequent years are not successful in boosting private consumption and aggregate demand because the Ricardian equivalence applies. However, expansionary fiscal policy financed by a spending reversal in subsequent years is successful in boosting private consumption. When accounting for the zero lower bound, the authors find that the timing of the reversal is essential. If the expansionary policies are reversed too soon the zero lower bound may bind again which adds to the existing deflationary pressures. This causes a rise in the real interest rate which delays or even prevents the escape from the zero lower bound. Although the authors explicitly state that their calculations should be taken as a qualitative example and that quantitative figures should not be taken at face value, they do show that multipliers in a scenario where the zero lower bound constrains monetary policy are much larger than in a normal recession, see graph 7. The left column shows the fiscal multipliers for consumption and output. The right column shows the time monetary policy is constrained by the zero lower bound, measured in quarters of a year. The right column also shows that if government spending is reversed too quickly the zero lower bound will not be escaped.

Graph 7: Fiscal multipliers for consumption and output



Source: Corsetti, Kuester, Meier and Müller (2010)

These two papers find larger multipliers in a liquidity trap. This raises the question of why most governments would want to limit the size of the fiscal stimulus. In their 2012 paper, Erceg and Lindé

(2012) note the existence of a liquidity trap to answer this question. The authors estimate a New-Keynesian DSGE model to examine the effects of an increase in government spending on the real interest rate, inflation, output gap and government debt. The length of the liquidity trap is then determined endogenously, depending on the size of the fiscal stimulus. The authors show that the multiplier for government spending is indeed initially very high, but decreases as government spending increases. More precisely, the authors find that a large increase in government spending enables the economy to escape the liquidity trap more quickly after which the multiplier returns to normal values. The estimates for the multiplier in the liquidity trap range between 1 and 4, peaking at a government spending increase of 1% of GDP and the liquidity trap duration of 8 quarters of a year.

6.5 Theory Multipliers and Doom Loops

As described in chapter 3, during the economic crisis sovereigns and domestic banks became entangled in a 'doom loop'. This doom loop has negative consequences for the value of the multiplier. In a situation with high debt-to-GDP and deficit-to-GDP ratios a deficit financed fiscal expansion will increase government bond rates and lower government bond prices. Decreasing government bond prices cause capital losses for domestic banks, restricting the flow of credit to the broader economy. This leads to higher prices for new and renewed loans, lowering private investments, which negatively impacts growth and eventually output. The reduction in output decreases tax revenue for the government further, forming an amplification cycle and lowering the multiplier. If sovereign default risk is then added, a deficit-financed fiscal expansion will lead to even higher government bond rates and even lower government bond prices. In such a case the multiplier will approach zero or can even become negative (Van Wijnbergen & Van Der Kwaak, 2015).

6.6 Empirics Multipliers and Doom Loops

Corsetti et al. (2012) investigate the effect of fiscal policy on economic stability when government finances are weak. They build a DSGE model with several additions. First they allow sovereign risk premia to change depending on the fiscal outlook of a country. Second they allow the interest rates of loans to the broader economy to rise with government bond rates, because the domestic banks suffer capital losses when the government bond rates rise, which increases the costs of financial intermediation. The autors find that these two mechanisms amplify the doom loop unless monetary policy can lower the nominal interest rate to offset the negative effects on private investment. When monetary policy is ineffective due to a binding zero lower bound this is impossible however. The authors then show that under severe fiscal strains and a binding zero lower bound the multiplier can become negative, suggesting that austerity in such circumstances can take on an expansionary character. This occurs because austerity decreases funding costs in the broader economy, which offset the negative effects on output. The multipliers in this case ranged from -0.5 to -1.0. These authors also show that the correlation between sovereign and non-financial CDS spreads were highly correlated in Spain, Ireland, Italy and Greece, suggesting that the doom loop was stronger in these countries.

Wijnbergen and van der Kwaak (2015) investigate how fiscal stimulus affects an economy where the banks are balance sheet constrained and may suffer capital losses when government bond prices fall due to large holdings of government debt. They build a DSGE model that incorporates balance sheet constrained banks that provide loans to the broader economy and the government. They add price stickiness to more accurately model output and inflation dynamics. The authors find that fiscal multipliers fall significantly when domestic banks that finance the government are balance sheet constrained and suffer capital losses when government bond rates rise. They find even stronger effects

when they add sovereign default risk to the equations. The authors estimated a multiplier of -0.5 in this study.

6.7 Multipliers and Balance Sheet Problems

The nature of a crisis can also affect the multiplier. Borio (2012) argues that the recent economic crisis was characterized by decreasing housing prices. This had a negative effect on the balance sheets of households and financial institutions who prioritized on recuperating from the losses suffered. This increased the marginal propensity to save and decreased the marginal propensity to consume. Any attempt at fiscal stimulus will have a smaller effect when the marginal propensity to consume is lower. The findings of Borio (2012) suggest that the multiplier will be smaller in a recession characterized by balance sheet problems, but there is no further empirical evidence for this hypothesis. Because of a lack of empirical evidence, this argument will not be taken into account when calculating the country-specific multipliers.

6.8 Theory Multipliers with a Fixed Exchange Rate

Indirectly related to the zero lower bound is a situation in which the exchange rate of a country is fixed. A fixed exchange rate can be the result of monetary policy by a government or by a central authority in a currency area like the ECB in the Eurozone. The Mundell-Fleming model (Fleming, 1962; Mundell, 1963) predicts that with a fixed exchange rate expansionary fiscal policy can be effective in increasing output. The goal of expansionary fiscal policy is to increase output via an increase in government spending and/or lowering taxes. This creates an increase in aggregate demand which threatens to raises the nominal interest rate. If the interest rate increases capital will flow into the country looking for a good investment. This capital inflow threatens to increase the exchange rate. With a fixed exchange rate the central bank will increase the money supply to offset an appreciation of the exchange rate. This suggests large multipliers under a fixed exchange rate regime. Under a flexible exchange rate regime the central bank will not increase the money supply and thus allows the appreciation of domestic currency. An appreciating currency will result in a less favorable trading position and net exports will be reduced. In the Mundell-Fleming model this decrease in exports exactly offsets the increase in output caused by fiscal policy, which suggests a multiplier of zero. The empirical literature will be consulted to determine if multipliers are indeed affected by the exchange rate regime.

6.9 Empirics Multipliers with a Fixed Exchange Rate

Ilzetski, Mendoza and Végh (2013) use a SVAR approach similar to Ramey (2011) to investigate (among other things) the influence of exchange rate regimes on the fiscal multiplier. They use a dataset comprised of 44 countries, mostly OECD members but also several Latin American countries. The authors use quarterly data with lags because an essential assumption behind the SVAR model is that it takes some time for fiscal policy to have an effect. The results show that under a fixed exchange rate regime the impact multiplier is 0.09 and as time progresses the multiplier increases to 1.5. Under a flexible exchange rate regime however, a multiplier of zero is found. These findings confirm the predictions of the Mundell-Fleming model.

Corsetti, Meier and Müller (2012) also investigate the influence of exchange rate regimes on fiscal multipliers. Their approach is slightly different than the previously discussed study because they first created a fiscal policy variable that is used as a regressor to estimate the impact of government expenditure on dependent variables like output, the trade balance, private consumption and

investments and the real exchange rate. This approach gives the authors some extra flexibility such as the means to incorporate time-dependent variables, most notably the presence of financial crises and accounting for the consequences of government expenditure shocks under different exchange rate regimes. The dataset is comprised of annual data from 1975 to 2008 stemming from 17 OECD countries. The authors find that fiscal expansionary policy is more effective in raising output and investments dropped less under a fixed exchange rate regime compared to the same situation under a flexible exchange rate regime. This implies that the fiscal multiplier is larger under a fixed exchange rate regime, in line with the predictions made by the Fleming-Mundell model. The authors also find that in the occurrence of a financial crisis, the fiscal multiplier is quite large, approximately 2.3 on impact and 2.9 at its top. These strong effects remain over all horizons.

Born, Jüßen and Müller (2013) employ a panel VAR approach to examine the effect that exchange rate regimes have on the fiscal multiplier. They use a dataset that consists of semi-annual data on OECD countries between 1985 and 2011. A key feature of their dataset is that it contains a semi-annual forecast variable for government expenditure, which allows the authors to control for anticipated changes in this variable. They estimate the effects of a 1% of GDP increase in government expenditure on output, the nominal and real interest rates, inflation and net exports. The authors find fiscal multipliers of around 1.25 under a fixed exchange rate while under a flexible exchange rate multipliers of around 0.75 are found. These findings are consistent with the Fleming-Mundell model, but contrast somewhat with the findings of Ilzetski, Mendoza and Végh, particularly the multipliers found under a flexible exchange rate regime.

A second finding of Ilzetski, Mendoza and Vegh (2013) that is of particular importance for the Eurozone involves the relative openness to trade of a country and the effect it has on the fiscal multiplier. In theory, if a country is very open to trade a boost in aggregate demand caused by an increase in government expenditure will be met by an increase in imports, instead of by an increase in domestic production. This implies that if a country is very open to trade the fiscal multiplier will be lower. Ilzetski, Mendoza and Vegh (2013) investigate this by giving countries the label open or closed based on the ratio of trade to GDP. If the imports plus the exports exceed 60 percent of GDP, a country is labelled open. If the ratio is less than 60 percent, the country is labelled closed. The authors use an SVAR approach with 44 countries in the dataset and quarterly data points with lags. The authors find that if a country is relatively open to trade significantly lower (and sometimes even negative) multipliers are found. For countries that are relatively closed to trade multipliers of 1.3 to 1.4 are found. The authors experiment with variations of this threshold and find no significant differences in the results. This is of particular importance for the Eurozone because it has a single currency (the euro) and is composed of relatively open economies.

Nakamura and Steinsson (2014) study the effects of an increase in government spending in a monetary union. They focus on the United States and employ an instrumental variable approach with military spending as the instrument. They identified that whenever the government of the U.S.A. increases military spending, the subsequent changes in military spending vary considerably for each state. The authors then use the relative variation between states to estimate what effect the increase in military spending had on output. They find that when government spending in a state increases with 1%, GDP increases with 1.5%. They authors then conclude that the open economy multiplier is 1.5, an estimate consistent with the findings of Ramey (2011).

As previously discussed, local multiplier studies estimate the effect of a change in government spending in one state, holding national effects constant. States are essentially small, open economies and a member of a currency union (because the entire United States uses the dollar). Because there are

no distortions from monetary policy or exchange rate appreciation, the estimates found in these studies come very close to the true value of the multiplier. This makes them excellent to use as a baseline estimate for the Eurozone countries. Chodorow-Reich (2017) has created an excellent summary of the recent empirical literature on local multiplier studies. After surveying the available empirical literature his initial estimate of the local multiplier is 1.8. He then uses existing theoretical work to convert these local multiplier estimates to aggregate multiplier estimates. As discussed previously, local multiplier estimates do not account for the Ricardian Equivalence argument because the increase in government spending originates from the federal level. In short, this argument states that if a government increases spending, households will realize that future taxes must increase and therefore they reduce consumption and increase savings. Chodorow-Reich (2017), using a theoretical framework supported by empirical evidence, argues that outside financing raises the multiplier by less than 0.1. Thus a deficit-financed multiplier of 1.2 would become a multiplier of 1.25 if it were outside financed. To address this argument he revises his initial estimate of 1.8 towards 1.7. Another notable difference between aggregate multipliers and local estimates is monetary policy. Local multiplier studies do not account for any changes in monetary policy because monetary policy is maintained at the federal level. For local multiplier studies it is as if monetary policy does not react to a change in fiscal policy. Chodorow-Reich (2017) argues that there is another case where monetary policy does not react to a change in fiscal policy, when the zero lower bound binds. Therefore, whenever the zero lower bound is attained, local multipliers can be used as aggregate multipliers.

The literature suggests that fiscal multipliers in a currency union or with a fixed exchange rate are likely larger than under a flexible exchange rate, as is the case in the Eurozone. On the other hand the literature suggests that fiscal multipliers in relatively open countries are likely smaller. However, the estimates found for large closed economies are similar to estimates for small open economies, so apparently these effects offset eachother.

6.10 Estimation of Country-Specific Multipliers

To establish country-specific multipliers a baseline of 1.7 is taken, the estimate of Chodorow-Reich (2017). This estimate was chosen because it incorporates many of the arguments discussed in this chapter: The liquidity trap, Ricardian equivalence and fixed exchange rate. Because the United Kingdom, the United States and the Eurozone are not part of a monetary union their currency can appreciate, leading to a reduction in net exports. For this reason a value of 0.5 is deducted from the baseline estimate. This value is based on the difference between fixed exchange rate multiplier and flexible exchange rate multipliers found by Born et al. (2013). The arguments that still need to be accounted for are the doom loop, and confidence effects. The literature finds negative multipliers of -0.5 to -1.0 for countries that are experiencing a doom loop (Corsetti G. , Kuester, Meier, & Mueller, 2012; Van Wijnbergen & Van Der Kwaak, 2015). Taking the average of these numbers yields a value of -0.75. To find what value to subtract from the baseline multiplier the doom loop multiplier average will be compared to the Ramey estimates, in an attempt to not overstate the effects of the doom loop. The difference between the Ramey average (1.15) and the doom loop average is 1.9. Therefore, a value of 1.9 will be subtracted for the countries that experienced a doom loop during the economic crisis. As shown by Corsetti et al. (2012) the countries that experienced a doom loop were Greece, Ireland, Spain and Italy. As discussed in chapter 5, the relationship between austerity and output via confidence is not very strong, but it is included for the sake of completeness. As discussed in chapter 5, if confidence is higher the population will consume more. Another way of stating this is that the marginal propensity to consume is higher. Therefore it is possible that a change in confidence affects the marginal propensity to consume. Because there is no available empirical evidence to support a

conversion rate, it will be assumed that a 1% change in confidence will result in a 1% change in marginal propensity to consume. The textbook formula for the multiplier can then be used to estimate the effect of confidence on the multiplier. Given that the mpc is on average 0.85 (Vladova, 2005), the change in the multiplier of a 1% change in confidence is 0.06. Again, this approach is highly experimental. The resulting country-specific multipliers can be found in table 2.

Table 2: Country-Specific Multipliers

Country	**Baseline**	**Doom Loop**	**Confidence Effects**	**Conclusion**
The Netherlands	1.7	1.7	1.57	1.57
Germany	1.7	1.7	1.61	1.61
France	1.7	1.7	1.62	1.62
United Kingdom	1.2	1.2	1.17	1.17
Finland	1.7	1.7	1.73	1.73
Spain	1.7	-0.2	-0.32	-0.32
Italy	1.7	-0.2	-0.3	-0.3
Ireland	1.7	-0.2	-0.55	-0.55
Greece	1.7	-0.2	-0.36	-0.36
United States	1.2	1.2	1.1	1.1
Eurozone	1.2	1.2	1.1	1.1

Source: Author’s calculations

Table D: The Fiscal Multiplier

Author(s) and year of publication	**Data**	**Estimation technique, dependent variable, independent variable**	**Coefficient**	**Control variables used**	**Robustness checks performed**	**Extra remarks**
Ramey (2011)	US	IV/VAR varies across studies, mostly used military spending as an instrument	0.8 – 1.5 but the data does not reject 0.5 – 2.0 estimates	Varies across studies	Varied across studies	Ramey gathered a large number of studies and the results of aggregate- and state level studies are remarkably similar.
Christiano, Eichenbaum and Rebelo (2011)	N.A.	Medium-size DSGE model, government spending, fiscal multiplier	1.5 – 2.3	N.A.	Added to the model: sticky wages, sticky prices, variable capital utilization and investment adjustment cost specification.	Authors remarked that multipliers can be very large in situations where the zero lower bound binds.
Corsetti, Kuester, Meier and Müller (2010)	N.A.	New-Keynesian model, government spending, fiscal multiplier	1.5 – 2.9	N.A.	Added the binding zero lower bound to the model.	The authors note that it is dangerous to quit expansionary policy too soon because the ZLB will not be escaped.
Erceg and Linde (2012)	N.A.	New-Keynesian DSGE model, government spending, fiscal multiplier	1 – 4	N.A.	Liquidity trap as an endogenous variable added.	The authors found that the multiplier decreases as government spending increases.

Ilzetski, Mendoza an Végh (2013)	44 countries	VAR, government spending, fiscal multiplier.	Fixed exchange rate: 0.09 – 1.5 Flexible exchange rate: 0	Exchange rate regime, level of development, openness to trade, current account balance to GDP and public indebtedness.	Different estimation techniques, added extra control variables.	Authors note that the multiplier depends on country-specific characteristics.
Corsetti, Meier and Müller (2012)	Panel of OECD countries	Two stage least squares, government spending, fiscal multiplier.	Fixed exchange rate: 2.3 – 2.9	Output, the trade balance, private consumption, private investments and the real exchange rate.	Added time dependent variables, also performed the analysis with data up to 2006.	These authors also note that the multiplier depends on a number of factors which vary across countries and with time.
Born, Jüßen and Müller (2013)	Panel of OECD countries	VAR, government spending, fiscal multiplier	Fixed exchange rate: 1.25 Flexibel exchange rate: 0.75	Semi-annual forecast variable for government spending, output, nominal and real interest rates, inflation and net exports.	Alternative specification used, excluded the economic recession from the data, used a different sample (EU only), different cut off values for the exchange rate regime.	-

Chapter 7: Hysteresis and the Permanent Output Loss

7.1 Theory Hysteresis and the Permanent Output Loss

Hysteresis in economics refers to the long lasting effects of an event that persist after the event that caused them has disappeared. The term has regained attention after the economic crisis. In earlier models, growth was seen as an exogenous variable and technology shocks were the driving force behind business cycles. These models predict that if a recession, a war or natural disaster temporarily pushed the economy under its potential output a period of recovery and rapid growth would follow, returning the economy to potential output with no long lasting effects. However, recent evidence from Ball (2014), Haltmaier (2013) and Martin et al. (2015) have called these models into question, observing persistent effects on output after recessions. When assuming growth is endogenous, hysteresis becomes an inevitable consequence of an economic crisis. During a crisis, factors that drive growth such as investments in R&D, adoption of next generation technologies and capital investments are all reduced. Human capital also deteriorates; Blanchard and Summers (1986) found that short-term unemployment can turn into long-term unemployment and that some workers who are unemployed lose a part of their skills and their network deteriorates. If the factors that drive growth are reduced during a crisis, growth itself will also be affected, resulting in a permanent impact on GDP levels. To establish the existence and possible size of hysteresis effects, the empirical literature will be reviewed.

7.2 Empirics Hysteresis and the Permanent Output Loss

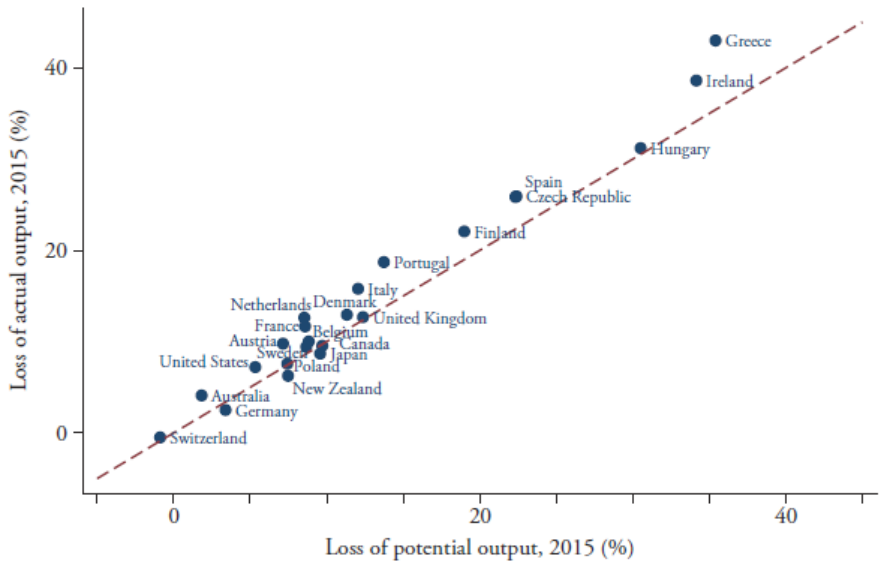
Haltmaier (2013) investigated the long-term effects of recessions (defined as two successive quarters where GDP growth is negative) on potential GDP for 40 OECD countries. To find the effect recessions had on potential GDP the author compared the growth rates two years prior to the recession, two years following the recession and the two years after that. The intention is to first estimate the effect of the recession on output (the difference between the first and the second period) and estimate the long lasting effects of the recession (the difference between the second and third period). Haltmaier finds that recessions have a significant negative impact on potential output, damaging potential output with 1.5% of GDP. The measured effect is significantly larger for advanced economies, averaging a cumulative loss of 3% of GDP. The author also examined the recent economic recession and found that the average loss in potential output was 3% of GDP, after the initial output drop of 7.5% of GDP, implying a hysteresis coefficient of approximately 0.4. Panel regressions were used to investigate the characteristics of recessions but the results were so heterogeneous that no stylized facts could be compiled.

Martin et al. (2015) study the effect recessions have on long-term GDP levels and GDP growth. They use a dataset composed of quarterly data on 23 OECD countries, spanning a period of 40 years which results in 150 identified recessions. The authors start by calculating pre-recession growth levels and compare these with post-recession growth levels. They find that post-recession growth levels significantly lag behind pre-recession growth levels. This implies that there is no ‘catching up’ after a recession with higher growth rates, as assumed in older models, which is convincing evidence for the existence of hysteresis. The authors then calculate the damage to GDP for the U.S., the U.K., the Eurozone and Canada. They find hysteresis coefficient close to 100% for the United States, 60% for Canada and slightly above 100% hysteresis for the U.K. and the Eurozone. Haltmaier (2013) and Martin et al. (2015) provide convincing evidence that hysteresis is not only indeed present, but very

significant. The next step is to determine what part of the damage becomes permanent after a recession.

Ball (2014) investigated the long-term effects of the financial crisis by comparing the real output to 2007 and 2014 potential GDP forecasts of 23 OECD countries. The difference between the real output and the potential GDP forecast was then plotted to investigate the damage done to the 23 countries' GDP and the growth rate of GDP. The results vary considerably, from finding almost no loss in potential output in Australia and Switzerland to over 30 percent loss in potential output in Hungary, Ireland and Greece. This difference is largely due to the initital impact the economic recession had on individual countries. The average loss of potential output, weighted by the size of the economy, was estimated to be 7.2% of GDP in 2013 to 8.4% in 2015. The author argues that this decrease between the two years is caused by the financial crisis also affecting GDP growth rates. Ball finds that hysteresis has been very strong during the financial crisis and that the fall in potential output is almost as large as the actual reduction in output, implying a hysteresis size of 100%. The results per country can be examined in Graph 8. Note that the loss in potential output added to the gap between potential and actual output must equal the loss of actual output. As can be seen in the graph, the losses in Europe were substantial. Greece, Hungary, Ireland and Spain lost 34%, 30%, 33 and 22% respectively. The Czech Republic, Finland, Portugal, France and the Netherlands lost 22%, 19%, 14%, 8% and 8% respectively. As robustness check the author also estimated the effects using IMF's World Economic Outlook estimates, finding even greater effects, implying that these estimates may even be biased slightly downwards.

Graph 8: Actual GDP plotted against potential output



Source: Ball (2014)

Lastly it needs to be determined if a part of hysteresis was caused by fiscal consolidation efforts and if so, how large the effect was.

Fatás and Summers (2016) extend on the paper written by Blanchard and Leigh (2013) by extending the forecast horizon to 5 years and comparing GDP forecasts to actual GDP numbers to find the effect fiscal consolidations had on long-term potential GDP. The authors take three benchmark 5-year forecasts, one created in April 2007 before the start of the crisis, one created in April 2008, in the

middle of the crisis, and one created in April 2010, when the worst of crisis in the US has passed. These forecasts originate from the World Economic Outlook and were created by the IMF. These forecasts are assumed to be a close representative of potential GDP and are compared to actual GDP numbers (also taken from the WEO in 2014). As can be expected, the authors find a large difference between the forecasts made in April 2007 and actual GDP numbers in 2008 the cause being the economic recession. They argue that if this cyclical shock was temporary, GDP levels should revert to the April 2007 forecasted levels over time. However, when examining the forecast errors of the 2007, 2008 and 2010 forecasts, a significant amount of persistence is found, suggesting that hysteresis was indeed present after the Great Recession. The authors also find that the size of the initial shock is highly correlated with the forecast errors over time, suggesting a positive relation between the two variables. After proving that their data supports the hypothesis of hysteresis, the authors continue by replicating the study of Blanchard and Leigh (2013). Like the aforementioned authors, Fatás and Summers argue that if the correct assumptions for the fiscal multiplier are used in the forecasting model, the coefficient for the fiscal multiplier should be zero. This approach allows the authors to identify fiscal consolidation shocks and find the effects of these policies on potential output and GDP. The coefficients found for the fiscal multiplier were negative and significant, suggesting that the 0.5 multiplier used by the IMF in the forecasts was an underestimation. The authors find that actual multipliers in the Eurozone during the height of the crisis were closer to 1.6 and attribute this difference to monetary policy being ineffective due to a binding zero lower bound and the unavailability of exchange rate policies due to the institutions restrictions in the Eurozone area. Finally, in order to find the cyclical effects of fiscal consolidation policies the authors use a two stage least squares approach. They first regress the change in output during 2010-2011 on the planned fiscal consolidation. Next they use these fitted values as the explanatory variable to find the forecast error of potential GDP. Like Blanchard and Leigh (2013), Fatás and Summers (2016) conclude that for every 1% decline in GDP caused by fiscal consolidations potential GDP declined with 1% by 2014 and even more by 2019. These findings are in line with the findings of Ball (2014) and imply a hysteresis of 100%.

7.3 Conclusion Hysteresis and the Permanent Ouput Loss

Judging by the available empirical evidence it must be concluded that hysteresis was indeed present after the recent economic recession. The estimates provided by Ball (2014) and Fatás and Summers (2016) imply that the size of hysteresis was around 100%. The findings of Fatás and Summers also imply that austerity was the wrong policy response during the economic crisis. When austerity is practiced in a liquidity trap when hysteresis is present fiscal contractionary policies reduce the real value of GDP not only on the short term but also on the medium and long term. This places upward pressures on the debt-to-GDP ratio (since the value of the denominator decreases). The goal of austerity was to improve the sustainability of public finances by lowering the debt-to-GDP ratio. However, in the situation where it was implemented, fiscal contractionary policy worsened the very measure it supposed to improve. Note that the the presence of hysteresis is essential for this hypothesis to hold, since without hysteresis GDP will bounce back to its past trend as soon as the sustainability of public finances have improved. The average value for hysteresis of all the discussed studies will be used as a starting point to determine country-specific hysteresis coefficients. This value is 70%. To calibrate the hysteresis coefficient for each country, the findings of Ball (2014) will be used. His findings are remarkably similar across all countries in the sample. For every country in the sample hysteresis is close to 100%. To account for the other studies the average of 70% hysteresis will be used as the main benchmark with 30% bandwith as a robustness check. Thus, for each country the hysteresis coefficients 40%, 70% and 100% will be used.

Chapter 8: Methodology

8.1 Research Method

The research question of this thesis is: "Do the austerity policies enacted during the 2008 economic recession pass an ex-post social cost-benefit analysis for the eleven countries in the sample?" Now that the theoretical and empirical relations have been described the social cost-benefit framework will be constructed which is based on Delong and Summers (2012). A cost-benefit analysis is a systemetic approach to analyze all costs and benefits attached to a decision (or policy in this case). The costs in the present are added to the discounted costs in the future and subtracted from the benefits in the present added to the discounted benefits in the future. This yields the net present value, a measure that is often used to compare alternatives. The social cost-benefit approach used in this thesis is slightly different from a private cost-benefit analysis. A social cost-benefit does not only account for the financial consequences of the policy but also for the effects on society. A social cost-benefit analysis is suitable to analyze austerity as a policy measure for two reasons. The first reason is because the net present value is an easy to interpret measure. The second reason is that the costs and benefits are separately calculated, making it easy to interpret what the costs and benefits of austerity were. The baseline alternative to which the net present value is compared is the scenario where no austerity is practiced. The net present value of this scenario is 0.

The benefits of austerity are threefold. First, there are the lower interest rate payments on debt. Because government spending is reduced, the financial fundamentals will improve, which lowers the government bond rates as described in chapter 2. Second, the value of debt will decline which directly lowers the total value of interest payments. Third, because the debt-to-GDP ratio decreases GDP growth will improve, as assumed in chapter 4. The costs of austerity are twofold. First there are the effects of austerity on present GDP through the multiplier. Second there are the effects of austerity on potential GDP through hysteresis. Let the net present value of austerity be denoted by ΔA, the change in output in the future by ΔY_f as a percentage of GDP, the change in output in the present by ΔY_n as a percentage of GDP, the long-term growth rate of the economy by g and the real government borrowing rate by r. Note that r is the real social rate of time discount, identified here with the real government borrowing rate. The real government borrowing rate is obtained by subtracting inflation from nominal government bond rates. Inflation is assumed to be equal to the 5-year swap rate and the nominal government bond rates are equal to the 10-year government bond yields. The net present value of austerity then becomes:

(1) $$\Delta A=\Delta Y_n+\frac{\Delta Y_f}{(r+\Delta r)-(g+\Delta g)}$$

The effect of a change in government spending is translated to GDP via the fiscal multiplier. Denote the temporary change in government spending by ΔG as a percentage of GDP and the multiplier by μ. The value for the multiplier for each country was discussed in chapter 1, part 5. The change in output in the present, denoted by ΔY_n, is then given by:

(2) $$\Delta Y_n=\mu\Delta G$$

Because austerity aims to improve the financial fundamentals of a country a part of the reduction in government spending will be used to service outstanding debt. Denote the change in debt with ΔD as a percentage of GDP and the tax-and-transfer rate with τ, the change in national debt then becomes equation (3). Note that the change in government spending does not directly translate to a reduction in debt. This is because the government receives lower income from taxes when GDP drops.

(3) $$\Delta D=(1-\mu\tau)\Delta G$$

This equation is needed to implement the interaction between debt and GDP growth, as described in chapter 4. Using the Reinhart and Rogoff dataset and assuming there is a lineair causal relationship between the level of debt and GDP growth a function can be estimated. Denote the change in growth rate with Δg. The change in GDP growth caused by a lower debt level as a result of austerity is then given by:

(4) $$\Delta g=-0.00012*(1-\mu\tau)\Delta G$$

In the same fashion the interaction between financial fundamentals and government rates is implemented. As described in chapter 2, the market rewards better financial fundamentals with lower government bond rates. The size of the effect was taken from the consulted empirical literature. Denote the change in government bond rate with Δr and the change in the deficit-to-GDP ratio with Δd as a percentage of GDP. The change in government bond rate is then given by:

(5) $$\Delta r=0.0003*\Delta D+0.0012*\Delta d$$

To model the effects of austerity on future periods, hysteresis needs to be taken into account. Negative changes to government spending with a positive multiplier have a negative effect on output. Therefore if hysteresis is present a reduction in government spending has long-lasting negative consequences for potential output. Adding hysteresis denoted as η to equation (1) and denoting the change in potential output with ΔY_p:

(6) $$\eta\Delta Y_p=\eta\mu\Delta G$$

Besides the effect of hysteresis there is another aspect for the future that needs to be accounted for, the benefits of lower interest payments on future debt. The benefits are determined by two factors. The first is the size of the change in debt. The second is the the positive effect on potential output that is created by lowering the tax rate. Denote this positive effect with parameter ξ, which represents the deadweight loss. The value for ξ in normal times is assumed to be 0.25 and a value of 0.5 in extreme times. This leads to formula (4).

(7) $$\Delta Y_f=\{\eta\mu-\xi[((r+\Delta r)-(g+\Delta g))(1-\mu\tau)-\tau\eta\mu]\}\Delta G$$

Discounting formula (7) back to the present and adding it to equation (1) and implementing equations (4) and (5) then yields the net effect of austerity on the present value of GDP:

(8) $$\Delta A=\left\{\mu+\frac{\eta\mu}{(r+\Delta r)-(g+\Delta g)}+\frac{\xi}{(r+\Delta r)-(g+\Delta g)}[\eta\mu\tau-((r+\Delta r)-(g+\Delta g))(1-\mu\tau)]\right\}\Delta G$$

The first term within the brackets is the multiplier term and captures the effects of austerity on present day GDP. The second term within the brackets is the hysteresis term and captures the deepened shadow cast by austerity on future GDP. The third term within the brackets shows the impact on future potential output of the net burden of less debt.

Reflecting upon this theoretical model there can already be lessons learned. The costs of austerity are both short-term and long-term. On the short term austerity has a negative impact on GDP, which is caused by relatively high multipliers. In addition, austerity has a negative impact on future GDP through hysteresis. By deepening the downturn the permanent effects are exacerbated which leads to lower potential output in the future and a negative net present value. In addition, whenever the growth rate exceeds the real

Now that all relevant variables are identified and the social cost-benefit framework is constructed, equations (1) through (8) will be used to calculate the net effects austerity had on eleven countries during the recent economic crisis. First data are gathered for the eleven countries in the sample. Next each step will be elaborated on in the results section. Finally the social cost-benefits of austerity are calculated for each country.

8.2 Data Description

To measure the effect austerity had the costs and benefits are calculated for eleven countries, namely the Netherlands, Germany, France, the United Kingdom, Finland, Spain, Italy, Ireland, Greece, the United States and the Eurozone as a whole. These countries were chosen for several reasons. The main reason was that these countries all practiced austerity in the aftermath of the economic recession of 2008. The second reason was that these countries all differ significantly in terms of size, population, amount of debt, tax rates and amount of austerity implemented, thus broadening the scope of this thesis. The United States was added to see if the results also hold outside of the Eurozone. The Eurozone as a whole was added to check for country-spillovers. For each country specific multiplier values and hysteresis coefficient were calculated in the literature section. A margin around these values will be used in the SCBA as a robustness check and to strengthen the results of this thesis. A margin of 30 per cent upward and downward for the hysteresis coefficients is used and a 0.5 margin upwards and downwards for the multiplier is used. The results of these calculations can be found in the results section.

Of all the countries in the sample, Greece and Ireland practiced the largest cumulative amounts of austerity (18.5% and 17.9% respectively). This can be attributed to the conditionality attached to Eurozone rescue packages. The countries that practiced a lower but still significant amount of austerity are Spain, the UK, the US, the Netherlands and Italy with 7.1%, 7.1%, 7%, 6.7% and 6.1% respectively. The countries that practiced the least austerity were France, the Eurozone, Germany and Finland with 4.2%, 3%, 3.1% and 2.6% respectively, which can be attributed by the relatively healthy public finances at the start of the economic recession. These austerity amounts are expressed as a percentage of at that moment current GDP, so although Greece practiced the most austerity the amount in euros is still lower than the austerity measures implemented in Germany (90bln in Germany vs 33bln in Greece) (OECD, 2012).

The 10-year government bond rates across the eleven countries vary. Although the interest rates diverge not as much as during the height of the crisis there are still significant differences between countries. Greece stands out with a government bond rate of 10.50%, which could be explained by the very large amount of public debt in Greece. Next are Ireland with 4.82%, Spain with 4.13% and Italy with 4.11%. The Eurozone as a whole currently pays an interest rate of 3.26% while the United Kingdom pays 2.97%. The countries that pay the lowest interest rates in the sample are the United States, Finland, the Netherlands, France and Germany. These countries pay 2.72%, 2.5%, 2.49%, 2.16% and 2.16% respectively. Data used originates from the November 2016 Global Economic Outlook (2016).

The average tax rate across the nine countries varies considerably. Most countries levy average tax rates between 30 and 40 percent. The UK, Spain, Greece, Germany, the Netherlands and the Eurozone as a whole wield rates of 33%, 34%, 37%, 37%, 38% and 39% respectively. Ireland however levies the low rate of 24%, which can be explained by the relatively low corporate tax rate compared to EU standards. The average tax rate in the United States is also remarkably low with 26%. Italy, France and Finland levy the higher rates of 43%, 44% and 46% respectively. The relatively high average tax rate

in France can be explained by the introduction of additional social security related taxes in the middle of the 1990's. The high rate in Finland can be explained by the VAT rate of 24% on normal goods and 14% on food, which is high compared to other European countries. The high average tax rate in Italy can be explained by the high tax rate of 23% in the first income bracket, which ranges from 0 to 15.000 euros, which is high compared to EU standards. Data used originates from 'OECD Revenue Statistic 2016' (OECD, 2016).

As for the GDP of the countries, all denominated in billion euros, the United States, the Eurozone, Germany, France and the UK unsurprisingly are the largest economies in the sample with 18036, 10391, 3030, 2181 and 1871 respectively. Next come Italy, Spain and the Netherlands with 1642, 1073 and 692 respectively. The smallest economies in the sample are Ireland, Finland and Greece with 247, 202 and 181 respectively. Data used originates from the November 2016 Economic Outlook created by the OECD (OECD, 2016).

The last variable used in the analysis is the growth rate of the economy. The countries that showed the strongest growth in GDP are Ireland, the United Kingdom, Spain and the United States with 3.3%, 2.5%, 2.3% and 2.2% respectively. Next are the Netherlands, Germany and the Eurozone as a whole all with a growth rate of 1.7%. The countries that showed the least growth were France, Greece, Finland and Italy with 1.2%, 1.0%, 0.9% and 0.9% respectively (OECD, 2016).

Table 3: Descriptive Statistics

Country	**Austerity (% GDP)**	**GDP (in billion euros)**	**Average tax rate**	**10-year government bond rates**	**Expected 5-year inflation**	**Growth Rate**
Netherlands	6.8%	652.8	38%	2.5%	1.6%	1.7%
Germany	3.0%	3030.1	37%	2.2%	1.6%	1.7%
France	4.2%	2181.1	46%	2.2%	1.2%	1.2%
UK	7.0%	1870.7	33%	3.0%	2.7%	2.5%
Finland	2.6%	202.3	44%	2.5%	1.5%	0.9%
Spain	7.3%	1073.2	34%	4.1%	1.4%	2.3%
Italy	6.1%	1641.5	43%	4.1%	1.3%	0.9%
Ireland	17.9%	246.7	24%	4.8%	2.0%	3.3%
Greece	18.5%	183.9	37%	10.5%	0.8%	1.0%
US	7.2%	18036.7	26%	2.7%	2.2%	2.2%
Eurozone	3.1%	10391.9	39%	3.3%	1.8%	1.7%

Chapter 9: Results

Using the methodology described in chapter 2 the net present value for austerity is calculated for the eleven countries in the sample. A step-by-step approach is chosen to provide clarity on how each mechanism affects the result. First the change in structural output in the present is calculated using equation (2). The damage to GDP in the present period increases with the multiplier. Next the change in debt is calculated using equation (3). The change in debt decreases with the multiplier because the income loss for the government from lower taxes increases with the multiplier. Or in other words, a portion of the government spending decrease is offset by lower subsequent tax revenue.

Using equation (4) the change in GDP growth is calculated, accounting for the argument of supporters of austerity that high levels of debt negatively impact growth. These values are all positive because debt decreases and thus growth increases. Again, these values decrease with the multiplier because debt reduction decreases with the multiplier. Unfortunately the increase in GDP growth is so small that the effect on the net present value is negligible (more on this in the sensitivity analysis chapter). Using equation (5) the change in government bond rates is calculated. This accounts for the argument of supporters of austerity that improving a country's financial fundamentals will lead to lower government bond rates. These values are all negative which show that government bond rates decrease after austerity is implemented. However, these changes were so small that the effect on the net present value is also negligible (more on this in the sensitivity analysis chapter).

Using equation (6) the change in structural output is calculated. This row shows what percentage of GDP is permanently lost after the implemented amount of austerity. These values increase with the hysteresis coefficient and the multiplier. It increases with the multiplier because a larger part of austerity is translated to GDP. It increases with hysteresis because a larger part of austerity becomes permanent. Next the effect of austerity on future GDP is calculated using equation (7). This consist of two parts, first the decrease in structural output that is calculated in the previous row. Secondly there is a term that captures the lessened pressure on future GDP caused by the decrease in interest rate payments resulting from austerity decreasing debt in period 1. The effect on future GDP also increases with the multiplier and hysteresis.

Finally the net present value of austerity is calculated using equation (8). This equation consists of three parts. The first term within the brackets is the multiplier term and captures the effects of austerity on present day GDP. The second term within the brackets is the hysteresis term and captures the deepened shadow cast by austerity on future GDP. The third term within the brackets shows the impact on future potential output of the net burden of less debt. The net present value of austerity decreases as the multiplier increases. The net present value of austerity also decreases with hysteresis. Or in other words, the larger the multiplier and hysteresis, the more costly is austerity. The last row simply shows the findings denoted in euros. Note that these values are shown in billion euros per year.

As a robustness check the SCBA is performed with three different multipliers. The country specific multiplier estimated in chapter 6 is taken as a benchmark. A value of 0.5 is added and subtracted and serve as a margin of error. In similar fashion three different hysteresis coefficients are used. The country specific hysteresis coefficient estimated in chapter 1, part 6 is taken as a benchmark. A value of 0.05 is added and subtracted and serve as a margin of error.

The main findings for each country are presented now.

9.1 The Netherlands

Country: The Netherlands	Multiplier = 1.07			Multiplier = 1.57			Multiplier = 2.07		
	Hysteresis			Hysteresis			Hysteresis		
	40%	70%	100%	40%	70%	100%	40%	70%	100%
Change in structural output in the present (%GDP)	-7.27%	-7.27%	-7.27%	-10.67%	-10.67%	-10.67%	-14.07%	-14.07%	-14.07%
Change in Debt (%GDP)	-4.02%	-4.02%	-4.02%	-2.72%	-2.72%	-2.72%	-1.42%	-1.42%	-1.42%
Change in growth rate GDP	0.0005%	0.0005%	0.0005%	0.0003%	0.0003%	0.0003%	0.0002%	0.0002%	0.0002%
Change in interest rate on government bonds	-0.0012%	-0.0012%	-0.0012%	-0.0008%	-0.0008%	-0.0008%	-0.0004%	-0.0004%	-0.0004%
Decrease structural output (% GDP)	-2.91%	-5.09%	-7.27%	-4.27%	-7.47%	-10.67%	-5.63%	-9.85%	-14.07%
Effect on future GDP (%GDP)	-3.18%	-5.57%	-7.96%	-4.67%	-8.18%	-11.68%	-6.16%	-10.78%	-15.41%
Net present value of austerity (%GDP)	-4.1	-7.1	-10.2	-6.0	-10.5	-14.9	-7.9	-13.8	-19.7
Net present value of austerity (bln per year)	-26.7	-46.6	-66.4	-39.3	-68.3	-97.4	-51.9	-90.1	-128.3

Variables used:	
Total austerity 2011-2016 (% GDP)	-0.0679
Interest rate on government bonds	0.025
Average tax rate	0.38
GDP 2016	652.8
Growth rate GDP	0.017

Austerity in the Netherlands has been costly. The main estimate, with hysteresis of 70% and a multiplier of 1.57, is that the austerity measures in the Netherlands reduced GDP with 10.5% of GDP. This has mainly been caused by large amounts of austerity and large multipliers.

9.2 Germany

Country: Germany	Multiplier = 1.11			Multiplier = 1.61			Multiplier = 2.11		
	Hysteresis			Hysteresis			Hysteresis		
	40%	70%	100%	40%	70%	100%	40%	70%	100%
Change in structural output in the present (%GDP)	-3.33%	-3.33%	-3.33%	-4.83%	-4.83%	-4.83%	-6.33%	-6.33%	-6.33%
Change in Debt (%GDP)	-1.77%	-1.77%	-1.77%	-1.22%	-1.22%	-1.22%	-0.66%	-0.66%	-0.66%
Change in growth rate GDP	0.0002%	0.0002%	0.0002%	0.0001%	0.0001%	0.0001%	0.0001%	0.0001%	0.0001%
Change in interest rate on government bonds	-0.0005%	-0.0005%	-0.0005%	-0.0004%	-0.0004%	-0.0004%	-0.0002%	-0.0002%	-0.0002%
Decrease structural output (% GDP)	-1.33%	-2.33%	-3.33%	-1.93%	-3.38%	-4.83%	-2.53%	-4.43%	-6.33%
Effect on future GDP (%GDP)	-1.45%	-2.54%	-3.64%	-2.11%	-3.69%	-5.27%	-2.76%	-4.84%	-6.91%
Net present value of austerity (%GDP)	-3.2	-5.6	-7.9	-4.6	-8.1	-11.5	-6.1	-10.6	-15.1
Net present value of austerity (bln per year)	-96.9	-168.9	-240.9	-140.5	-244.9	-349.3	-184.2	-320.9	-457.6

Variables used:	
Total austerity 2011-2016 (% GDP)	-0.030
Interest rate on government bonds	0.022
Average tax rate	0.37
GDP 2016	3030.1
Growth rate GDP	0.017

Austerity in Germany has also been costly. The main estimate, with hysteresis of 70% and a multiplier of 1.61, is that the austerity measures in the Germany reduced GDP with 8.1% of GDP. Although Germany practiced a relatively modest amount of austerity, large multipliers have led to significant damage.

9.3 France

Country: France	Multiplier = 1.11			Multiplier = 1.61			Multiplier = 2.11		
	Hysteresis			Hysteresis			Hysteresis		
	40%	70%	100%	40%	70%	100%	40%	70%	100%
Change in structural output in the present (%GDP)	-4.66%	-4.66%	-4.66%	-6.76%	-6.76%	-6.76%	-8.86%	-8.86%	-8.86%
Change in Debt (%GDP)	-2.08%	-2.08%	-2.08%	-1.12%	-1.12%	-1.12%	-0.17%	-0.17%	-0.17%
Change in growth rate GDP	0.0002%	0.0002%	0.0002%	0.0001%	0.0001%	0.0001%	0.0000%	0.0000%	0.0000%
Change in interest rate on government bonds	-0.0006%	-0.0006%	-0.0006%	-0.0003%	-0.0003%	-0.0003%	-0.0001%	-0.0001%	-0.0001%
Decrease structural output (% GDP)	-1.86%	-3.26%	-4.66%	-2.70%	-4.73%	-6.76%	-3.54%	-6.20%	-8.86%
Effect on future GDP (%GDP)	-2.07%	-3.63%	-5.19%	-3.01%	-5.27%	-7.53%	-3.95%	-6.91%	-9.87%
Net present value of austerity (%GDP)	-2.2	-3.8	-5.5	-3.2	-5.6	-7.9	-4.2	-7.3	-10.4
Net present value of austerity (bln per year)	-48.1	-83.6	-119.0	-69.9	-121.2	-172.6	-91.6	-158.9	-226.2

Variables used:	
Total austerity 2011-2016 (% GDP)	-0.042
Interest rate on government bonds	0.022
Average tax rate	0.46
GDP 2016	2181.1
Growth rate economy	0.012

France has also damaged its economy by practicing austerity, albeit in harshly compared to Germany. The main estimate, with hysteresis of 70% and a multiplier of 1.61, is that the austerity measures in France reduced GDP with 5.6% of GDP.

9.4 The United Kingdom

Country: United Kingdom	Multiplier = 0.67			Multiplier = 1.17			Multiplier = 1.67		
	Hysteresis			Hysteresis			Hysteresis		
	40%	70%	100%	40%	70%	100%	40%	70%	100%
Change in structural output in the present (%GDP)	-4.76%	-4.76%	-4.76%	-8.31%	-8.31%	-8.31%	-11.86%	-11.86%	-11.86%
Change in Debt (%GDP)	-5.55%	-5.55%	-5.55%	-4.40%	-4.40%	-4.40%	-3.25%	-3.25%	-3.25%
Change in growth rate GDP	0.0007%	0.0007%	0.0007%	0.0005%	0.0005%	0.0005%	0.0004%	0.0004%	0.0004%
Change in interest rate on government bonds	-0.0017%	-0.0017%	-0.0017%	-0.0013%	-0.0013%	-0.0013%	-0.0010%	-0.0010%	-0.0010%
Decrease structural output (% GDP)	-1.90%	-3.33%	-4.76%	-3.32%	-5.81%	-8.31%	-4.74%	-8.30%	-11.86%
Effect on future GDP (%GDP)	-2.05%	-3.59%	-5.14%	-3.59%	-6.28%	-8.98%	-5.12%	-8.97%	-12.82%
Net present value of austerity (%GDP)	-4.4	-7.7	-11.0	-7.7	-13.4	-19.2	-11.0	-19.2	-27.3
Net present value of austerity (bln per year)	-82.5	-143.9	-205.3	-144.2	-251.3	-358.4	-205.7	-358.4	-511.1

Variables used:	
Total austerity 2011-2016 (% GDP)	-0.071
Interest rate on government bonds	0.030
Average tax rate	0.33
GDP 2016	1870.7
Growth rate economy	0.025

Austerity was also damaging in the United Kingdom. The main estimate, with hysteresis of 70% and a multiplier of 1.17, is that the austerity measures in the United Kingdom reduced GDP with 13.4% of GDP. Although multipliers were smaller in the United Kingdom, austerity as a % of GDP was more damaging. This is mainly caused by the relatively large amount of austerity practiced.

9.5 Finland

Country: Finland	Multiplier = 1.23			Multiplier = 1.73			Multiplier = 2.23		
	Hysteresis			Hysteresis			Hysteresis		
	40%	70%	100%	40%	70%	100%	40%	70%	100%
Change in structural output in the present (%GDP)	-3.20%	-3.20%	-3.20%	-4.50%	-4.50%	-4.50%	-5.80%	-5.80%	-5.80%
Change in Debt (%GDP)	-1.19%	-1.19%	-1.19%	-0.62%	-0.62%	-0.62%	-0.05%	-0.05%	-0.05%
Change in growth rate GDP	0.0001%	0.0001%	0.0001%	0.0001%	0.0001%	0.0001%	0.0000%	0.0000%	0.0000%
Change in interest rate on government bonds	-0.0004%	-0.0004%	-0.0004%	-0.0002%	-0.0002%	-0.0002%	0.0000%	0.0000%	0.0000%
Decrease structural output (% GDP)	-1.28%	-2.24%	-3.20%	-1.80%	-3.15%	-4.50%	-2.32%	-4.06%	-5.80%
Effect on future GDP (%GDP)	-1.42%	-2.48%	-3.55%	-1.99%	-3.49%	-4.99%	-2.57%	-4.50%	-6.44%
Net present value of austerity (%GDP)	-0.9	-1.6	-2.3	-1.3	-2.2	-3.2	-1.7	-2.9	-4.1
Net present value of austerity (bln per year)	-1.9	-3.2	-4.6	-2.6	-4.5	-6.4	-3.4	-5.8	-8.3

Variables used:	
Total austerity 2011-2016 (% GDP)	-0.026
Interest rate on government bonds	0.025
Average tax rate	0.44
GDP 2016	202.28
Growth rate economy	0.009

Although austerity was also damaging in Finland, the effect is smaller compared to the previous countries. The main estimate, with hysteresis of 70% and a multiplier of 1.73, is that the austerity measures in Finland reduced GDP with 2.2% of GDP. Although multipliers were large, the amount of austerity implemented was reasonably small, resulting in modest damage to GDP.

9.6 Spain

Country: Spain	Multiplier =	-0.82		Multiplier =	-0.32		Multiplier =	0.18	
	Hysteresis			Hysteresis			Hysteresis		
	40%	70%	100%	40%	70%	100%	40%	70%	100%
Change in structural output in the present (%GDP)	5.99%	5.99%	5.99%	2.34%	2.34%	2.34%	-1.31%	-1.31%	-1.31%
Change in Debt (%GDP)	-9.32%	-9.32%	-9.32%	-8.09%	-8.09%	-8.09%	-6.86%	-6.86%	-6.86%
Change in growth rate GDP	0.0011%	0.0011%	0.0011%	0.0010%	0.0010%	0.0010%	0.0008%	0.0008%	0.0008%
Change in interest rate on government bonds	-0.0028%	-0.0028%	-0.0028%	-0.0024%	-0.0024%	-0.0024%	-0.0021%	-0.0021%	-0.0021%
Decrease structural output (% GDP)	2.39%	4.19%	5.99%	0.93%	1.64%	2.34%	-0.53%	-0.92%	-1.31%
Effect on future GDP (%GDP)	2.64%	4.59%	6.53%	1.05%	1.81%	2.57%	-0.54%	-0.97%	-1.39%
Net present value of austerity (%GDP)	1.5	2.6	3.6	0.6	1.0	1.4	-0.3	-0.5	-0.8
Net present value of austerity (bln per year)	16.1	27.6	39.0	6.4	10.9	15.3	-3.3	-5.8	-8.3

Variables used:	
Total austerity 2011-2016 (% GDP)	-0.073
Interest rate on government bonds	0.041
Average tax rate	0.34
GDP 2016	1073.24
Growth rate economy	0.023

Austerity was beneficial in Spain. The main estimate, with hysteresis of 70% and a multiplier of -0.32, is that the austerity measures in Spain increased GDP with 1.0% of GDP. This is caused by the prevalence of the doom loop in Spain, causing negative multipliers.

9.7 Italy

Country: Italy	Multiplier =	-0.8		Multiplier =	-0.3		Multiplier =	0.2	
	Hysteresis			Hysteresis			Hysteresis		
	40%	70%	100%	40%	70%	100%	40%	70%	100%
Change in structural output in the present (%GDP)	4.88%	4.88%	4.88%	1.83%	1.83%	1.83%	-1.22%	-1.22%	-1.22%
Change in Debt (%GDP)	-8.21%	-8.21%	-8.21%	-6.89%	-6.89%	-6.89%	-5.57%	-5.57%	-5.57%
Change in growth rate GDP	0.0010%	0.0010%	0.0010%	0.0008%	0.0008%	0.0008%	0.0007%	0.0007%	0.0007%
Change in interest rate on government bonds	-0.0025%	-0.0025%	-0.0025%	-0.0021%	-0.0021%	-0.0021%	-0.0017%	-0.0017%	-0.0017%
Decrease structural output (% GDP)	1.95%	3.42%	4.88%	0.73%	1.28%	1.83%	-0.49%	-0.85%	-1.22%
Effect on future GDP (%GDP)	2.23%	3.85%	5.47%	0.87%	1.47%	2.08%	-0.50%	-0.90%	-1.31%
Net present value of austerity (%GDP)	0.7	1.3	1.8	0.3	0.5	0.7	-0.2	-0.3	-0.4
Net present value of austerity (bln per year)	12.2	20.5	28.8	4.7	7.9	11.0	-2.7	-4.8	-6.9

Variables used:	
Total austerity 2011-2016 (% GDP)	-0.061
Interest rate on government bonds	0.041
Average tax rate	0.43
GDP 2016	1641.5
Growth rate economy	0.009

Austerity was also beneficial in Italy. The main estimate, with hysteresis of 70% and a multiplier of -0.3, is that the austerity measures in Italy increased GDP with 0.5% of GDP. Like Spain, the doom loop was prevalent in this country, leading to negative values for the multiplier.

9.8 Ireland

Country: Ireland	Multiplier =	-1.05		Multiplier =	-0.55		Multiplier =	-0.05	
	Hysteresis			Hysteresis			Hysteresis		
	40%	70%	100%	40%	70%	100%	40%	70%	100%
Change in structural output in the present (%GDP)	18.80%	18.80%	18.80%	9.85%	9.85%	9.85%	0.90%	0.90%	0.90%
Change in Debt (%GDP)	-22.34%	-22.34%	-22.34%	-20.22%	-20.22%	-20.22%	-18.11%	-18.11%	-18.11%
Change in growth rate GDP	0.0027%	0.0027%	0.0027%	0.0024%	0.0024%	0.0024%	0.0022%	0.0022%	0.0022%
Change in interest rate on government bonds	-0.0067%	-0.0067%	-0.0067%	-0.0061%	-0.0061%	-0.0061%	-0.0054%	-0.0054%	-0.0054%
Decrease structural output (% GDP)	7.52%	13.16%	18.80%	3.94%	6.89%	9.85%	0.36%	0.63%	0.90%
Effect on future GDP (%GDP)	8.05%	14.02%	19.99%	4.25%	7.38%	10.50%	0.45%	0.73%	1.02%
Net present value of austerity (%GDP)	5.4	9.2	13.1	2.8	4.9	6.9	0.3	0.5	0.7
Net present value of austerity (bln per year)	13.3	22.8	32.3	7.0	12.0	17.0	0.7	1.2	1.6

Variables used:	
Total austerity 2011-2016 (% GDP)	-0.1790
Interest rate on government bonds	0.048
Average tax rate	0.24
GDP 2016	246.66
Growth rate economy	0.033

Austerity was particularly beneficial for Ireland. The main estimate, with hysteresis of 70% and a multiplier of -0.55, is that the austerity measures in Ireland increased GDP with 4.9% of GDP. This is mainly caused by large negative multipliers and large amounts of austerity practiced.

9.9 Greece

Country: Greece	Multiplier = -0.86			Multiplier = -0.36			Multiplier = 0.14		
	Hysteresis			Hysteresis			Hysteresis		
	40%	70%	100%	40%	70%	100%	40%	70%	100%
Change in structural output in the present (%GDP)	15.91%	15.91%	15.91%	6.66%	6.66%	6.66%	-2.59%	-2.59%	-2.59%
Change in Debt (%GDP)	-24.35%	-24.35%	-24.35%	-20.95%	-20.95%	-20.95%	-17.55%	-17.55%	-17.55%
Change in growth rate GDP	0.0029%	0.0029%	0.0029%	0.0025%	0.0025%	0.0025%	0.0021%	0.0021%	0.0021%
Change in interest rate on government bonds	-0.0073%	-0.0073%	-0.0073%	-0.0063%	-0.0063%	-0.0063%	-0.0053%	-0.0053%	-0.0053%
Decrease structural output (% GDP)	6.36%	11.14%	15.91%	2.66%	4.66%	6.66%	-1.04%	-1.81%	-2.59%
Effect on future GDP (%GDP)	7.53%	12.74%	17.95%	3.41%	5.59%	7.77%	-0.72%	-1.56%	-2.41%
Net present value of austerity (%GDP)	1.0	1.5	2.1	0.4	0.7	0.9	-0.1	-0.2	-0.3
Net present value of austerity (bln per year)	1.8	2.8	3.8	0.8	1.2	1.6	-0.2	-0.4	-0.5

Variables used:	
Total austerity 2011-2016 (% GDP)	-0.1850
Interest rate on government bonds	0.105
Average tax rate	0.37
GDP 2016	183.9
Growth rate economy	0.010

Austerity was modestly beneficial in Greece. The main estimate, with hysteresis of 70% and a multiplier of -0.36, is that the austerity measures in Greece increased GDP with 0.7% of GDP. This is caused by negative multipliers and large amounts of austerity implemented.

9.10 United States

Country: United States	Multiplier = 0.6			Multiplier = 1.1			Multiplier = 1.6		
	Hysteresis			Hysteresis			Hysteresis		
	40%	70%	100%	40%	70%	100%	40%	70%	100%
Change in structural output in the present (%GDP)	-4.32%	-4.32%	-4.32%	-7.92%	-7.92%	-7.92%	-11.52%	-11.52%	-11.52%
Change in Debt (%GDP)	-6.06%	-6.06%	-6.06%	-5.11%	-5.11%	-5.11%	-4.16%	-4.16%	-4.16%
Change in growth rate GDP	0.0007%	0.0007%	0.0007%	0.0006%	0.0006%	0.0006%	0.0005%	0.0005%	0.0005%
Change in interest rate on government bonds	-0.0018%	-0.0018%	-0.0018%	-0.0015%	-0.0015%	-0.0015%	-0.0012%	-0.0012%	-0.0012%
Decrease structural output (% GDP)	-1.73%	-3.02%	-4.32%	-3.17%	-5.54%	-7.92%	-4.61%	-8.06%	-11.52%
Effect on future GDP (%GDP)	-1.83%	-3.22%	-4.60%	-3.37%	-5.90%	-8.44%	-4.91%	-8.59%	-12.28%
Net present value of austerity (%GDP)	-3.7	-6.4	-9.1	-6.7	-11.7	-16.7	-9.8	-17.0	-24.3
Net present value of austerity (bln per year)	-659.8	-1150.8	-1641.9	-1211.4	-2110.9	-3010.5	-1762.1	-3069.5	-4376.9

Variables used:	
Total austerity 2011-2016 (% GDP)	-0.072
Interest rate on government bonds	0.027
Average tax rate	0.26
GDP 2016	18036.7
Growth rate economy	0.022

Austerity was very damaging in the United States. The main estimate, with hysteresis of 70% and a multiplier of 1.1, is that the austerity measures in the United States reduced GDP with 11.7% of GDP. Although the multipliers is not as large as in some other countries, the United States still practiced a significant amount of austerity.

9.11 Eurozone

Country: Eurozone	Multiplier = 0.6			Multiplier = 1.1			Multiplier = 1.6		
	Hysteresis			Hysteresis			Hysteresis		
	40%	70%	100%	40%	70%	100%	40%	70%	100%
Change in structural output in the present (%GDP)	-1.86%	-1.86%	-1.86%	-3.41%	-3.41%	-3.41%	-4.96%	-4.96%	-4.96%
Change in Debt (%GDP)	-2.38%	-2.38%	-2.38%	-1.78%	-1.78%	-1.78%	-1.19%	-1.19%	-1.19%
Change in growth rate GDP	0.0003%	0.0003%	0.0003%	0.0002%	0.0002%	0.0002%	0.0001%	0.0001%	0.0001%
Change in interest rate on government bonds	-0.0007%	-0.0007%	-0.0007%	-0.0005%	-0.0005%	-0.0005%	-0.0004%	-0.0004%	-0.0004%
Decrease structural output (% GDP)	-0.74%	-1.30%	-1.86%	-1.36%	-2.39%	-3.41%	-1.98%	-3.47%	-4.96%
Effect on future GDP (%GDP)	-0.81%	-1.42%	-2.03%	-1.49%	-2.61%	-3.73%	-2.17%	-3.80%	-5.43%
Net present value of austerity (%GDP)	-0.5	-0.9	-1.3	-1.0	-1.7	-2.4	-1.4	-2.5	-3.5
Net present value of austerity (bln per year)	-55.6	-96.4	-137.1	-102.7	-177.4	-252.1	-149.7	-258.3	-366.9

Variables used:	
Total austerity 2011-2016 (% GDP)	-0.031
Interest rate on government bonds	0.033
Average tax rate	0.39
GDP 2016	10391.9
Growth rate economy	0.017

Austerity was damaging in the Eurozone as a whole. The main estimate, with hysteresis of 70% and a multiplier of 1.1, is that the austerity measures in the Eurozone reduced GDP with 1.7% of GDP. The fact that this number is close to zero is not surprising as austerity was beneficial for some countries in the Eurozone while it was damaging for other countries. These effects average out of the entire Eurozone.

9.12 Comparison to other studies

This thesis is closest related to the study of Delong and Summers (2012). Although the focus of DeLong and Summers mainly lies on fiscal expansionary policy the methodologies are very similar. Therefore this thesis and their study should be comparable. DeLong and Summers find that in a depressed economy with a binding zero lower bound the fiscal multiplier is likely to be substantially larger than in normal times. This finding is given substantial empirical basis in the literature review in this thesis. DeLong and Summers also find that even a small amount of hysteresis has a significant effect on estimates of the impact of fiscal policy. The findings in the previous section show that the costs of austerity grow substantially with the size of the hysteresis coefficient. Additionally, Delong and Summers find that extremely high interest rates are needed for expansionary fiscal policy to fail a social cost-benefit test. This finding is supported by this thesis. If government bond rates are extremely high (in fact, higher than has ever been recorded) austerity is needed to improve the debt-to-GDP and deficit-to-GDP ratios to bring the government bond rate down. In addition, with extremely high interest rates it becomes quite dangerous to attract extra funds as they will weigh heavily on the budget balance. This was observed during the economic recession where the interest rates for Greece became so high the country had no other means of attracting additional funds than reducing government spending and raising taxes. A difference between this study and the study of Delong and Summers is that this study used data from eleven countries to calculate the effects of austerity, giving the theory an empirical basis, while their study mainly rested on theory. As for the findings, this study concludes, like DeLong and Summers, that multipliers are likely larger than initially assumed. However, this study extends this argument and states that multipliers can also be significantly *lower* than initially assumed. Just like DeLong and Summers, this study finds that multipliers needs to be near or below zero for a country to pass the cost-benefit test. A difference between this study and DeLong and Summers is the size of hysteresis coefficients found. While DeLong and Summers use estimates of around 0.25, this study estimated hysteresis coefficients closer to 1.

Chapter 10: Sensitivity Analysis

The aim of the sensitivity analysis is to test the robustness of the findings. For the purpose of the sensitivity analysis a benchmark country is created to examine how changes in assumptions affect the model, see Table 4. This country has a GDP of 1000, GDP growth rate of 2%, average tax-and-transfer rate of 33.33%, practiced austerity worth 5% of GDP and 10-year real government bond rate 3%. These are the benchmark calculations for this fictional country with a multiplier of 1 and hysteresis coefficients 40%, 70% and 100%.

Table 4: Benchmark Estimations

Robustness Check	Multiplier = 1		
	Hysteresis		
	40%	70%	100%
Change in structural output in the present (%GDP)	-5.00%	-5.00%	-5.00%
Change in Debt (%GDP)	-3.33%	-3.33%	-3.33%
Change in growth rate GDP	0.0004%	0.0004%	0.0004%
Change in interest rate on government bonds	-0.0010%	-0.0010%	-0.0010%
Decrease structural output (% GDP)	-2.00%	-3.50%	-5.00%
Effect on future GDP (%GDP)	-2.16%	-3.78%	-5.41%
Net present value of austerity (%GDP)	-2.2	-3.8	-5.5
Net present value of austerity (bln per year)	-22.1	-38.4	-54.7

10.1 Financial Fundamentals and Government Bond Rates

In the literature review I have made a point that financial fundamentals affect government bond rates. A useful robustness check is to see how the results change when the interaction between financial fundamentals and government bond rates change. In the original model the effect of a 1% increase in debt-to-GDP resulted in an increase in government bond rates of 2 to 4 basis points and a 1% increase in deficit-to-GDP resulted in an increase in government bond rates of 8 to 15 basis points. When the interaction is set at zero, the findings are identical to the benchmark findings. The reason being that the effect is so small it is negligible. So what happens when the effect is enlarged? What happens when an improvement in the debt-to-GDP or deficit-to-GDP ratio lowers the government bond rates substantially? Only when the improvements in financial fundamentals cause government bond rates to drop to zero does austerity pass the SCBA, see Table 5. Note that to achieve this result the combined effect of the changes in deficit-to-GDP and debt-to-GDP need to lower government bond rates with 3%. This means that, if the deficit-to-GDP ratio does not change, the effect of debt-to-GDP on government bond rates needs to become 10,000 times larger. So either debt-to-GDP must decrease with 10,000% of GDP, which is impossible because no country has such a large amount of debt, or the coefficient must be 10,000 times larger. This would mean that a 1% decrease in debt-to-GDP will decrease government bond rates with 3%. As for the deficit-to-GDP, if the debt-to-GDP ratio does not change, the effect needs to become 2,500 times larger. This implies that the deficit-to-GDP ratio needs to improve with 2,500% of GDP or that a 1% improvement of the deficit-to-GDP ratio decreases government bond rates with 3%. Although any combination of improvements in debt-to-GDP and deficit-to-GDP is possible, the coefficients need to be so large that it can be concluded that the results are robust to changes in the assumptions concerning financial fundamentals.

Table 5: Robustness Check Financial Fundamentals

Robustness Check	Multiplier =	1	
	Hysteresis		
	40%	70%	100%
Change in structural output in the present (%GDP)	-5.00%	-5.00%	-5.00%
Change in Debt (%GDP)	-3.33%	-3.33%	-3.33%
Change in growth rate GDP	0.0004%	0.0004%	0.0004%
Change in interest rate on government bonds	-3.0000%	-3.0000%	-3.0000%
Decrease structural output (% GDP)	-2.00%	-3.50%	-5.00%
Effect on future GDP (%GDP)	-2.18%	-3.81%	-5.43%
Net present value of austerity (%GDP)	1.0	1.9	2.7
Net present value of austerity (bln per year)	10.4	18.5	26.7

10.2 Debt and Growth

The next assumption under scrutiny is the interaction between debt and growth. As an extreme precaution I have assumed in the analysis that the interaction between debt and growth is causal. So a logical test would be to investigate what would happen if this interaction is not causal. In other words, the debt-to-GDP ratio increased without any negative effects on growth. When the interaction is set at zero the findings are identical to the benchmark findings. This is hardly surprising since the effect is so small it is negligible. But what happens when the interaction is enlarged? What will happen if the growth rate of a country improves significantly when the debt-to-GDP ratio decreases? The net present value for austerity only becomes positive when the interaction between debt-to-GDP and GDP growth is increased 10.000 times, see table 6.

Table 6: Robustness Check Debt and Growth

Robustness Check	Multiplier =	1	
	Hysteresis		
	40%	70%	100%
Change in structural output in the present (%GDP)	-5.00%	-5.00%	-5.00%
Change in Debt (%GDP)	-3.33%	-3.33%	-3.33%
Change in growth rate GDP	4.0000%	4.0000%	4.0000%
Change in interest rate on government bonds	-0.0010%	-0.0010%	-0.0010%
Decrease structural output (% GDP)	-2.00%	-3.50%	-5.00%
Effect on future GDP (%GDP)	-2.19%	-3.82%	-5.44%
Net present value of austerity (%GDP)	0.7	1.2	1.8
Net present value of austerity (bln per year)	6.8	12.2	17.6

10.3 The Multiplier

One of the most important variables in the analysis is the multiplier. Although the empirical literature has shown that multipliers can be large in a depressed economy where the zero lower bound binds, the assumptions should still be tested. As already shown in the results section, the damage austerity does to the economy increases with the multiplier, so this section will focus on lowering the multiplier. Using equation (2) it can already be predicted that when the multiplier drops to zero a change (increase or decrease) will have no effect on GDP. Calculating the effects of austerity with a multiplier of 0 do indeed show that there is no change in structural output in the present or the future. The only remaining effect of austerity is that it lowers the debt-to-GDP ratio leading to lower government bond rates and higher GDP growth, see table 7. The net present value is in this case positive. In an economic recession it is extremely unlikely that the multiplier is at or near zero. In economic benevolent times when the zero lower bound does not bind this is a plausible scenario however. Especially when the

central bank can lower the interest rate to boost private spending to counteract the drop in public spending the multiplier can be zero. This is excellent proof that austerity is not bad policy at all times, in economic benevolent times it can certainly play a role. For our country to pass the SCBA the multiplier needs to fall below 0.2. This is four times lower than the lowest estimates Ramey (2011) found.

Table 7: Robustness Check Multiplier

Robustness Check	Multiplier =	0	
	Hysteresis		
	40%	70%	100%
Change in structural output in the present (%GDP)	0.00%	0.00%	0.00%
Change in Debt (%GDP)	-5.00%	-5.00%	-5.00%
Change in growth rate GDP	0.0006%	0.0006%	0.0006%
Change in interest rate on government bonds	-0.0015%	-0.0015%	-0.0015%
Decrease structural output (% GDP)	0.00%	0.00%	0.00%
Effect on future GDP (%GDP)	0.01%	0.01%	0.01%
Net present value of austerity (%GDP)	0.0	0.0	0.0
Net present value of austerity (bln per year)	0.1	0.1	0.1

10.4 Hysteresis

The second most important variable in our model is hysteresis. Although good evidence is scarce the empirical literature that is published on the subject shows that hysteresis exists and can be quite significant. However, the assumptions should still be tested. As is already shown in the results section, the damage austerity does to the economy increases with the size of hysteresis. This section will focus on decreasing the size of hysteresis. What would happen to the economy in the case where there is no hysteresis present? Or in other words, any negative effect on GDP caused by austerity in the present will have no negative effects on GDP in the future. The results are quite unexpected. Even when there is no hysteresis, austerity does not pass the SCBA, see Table 8. This is because the negative effects of austerity on GDP in the present outweigh the benefits of lower government bond rates and higher GDP growth caused by the change in debt.

Table 8: Robustness Check Hysteresis

Robustness Check	Multiplier =	1
	Hysteresis	
		0%
Change in structural output in the present (%GDP)		-5.00%
Change in Debt (%GDP)		-3.33%
Change in growth rate GDP		0.0004%
Change in interest rate on government bonds		-0.0010%
Decrease structural output (% GDP)		0.00%
Effect on future GDP (%GDP)		0.01%
Net present value of austerity (%GDP)		0.0
Net present value of austerity (bln per year)		-0.4

Chapter 11: Discussion

The answer to the research question: "Do the austerity policies enacted during the 2008 economic recession pass an ex-post social cost-benedit analysis for the eleven countries in the sample?" is: 'Sometimes.' As shown in the Chapter 9, the consequences of practicing austerity in a situation with high fiscal multipliers, low interest rates and present hysteresis is very costly for seven of the eleven countries investigated. For the other four countries, the presence of the doom loop led to negative multipliers and positive net present values for austerity. Some findings can be generalized. For the seven countries that did not pass the SCBA, the larger the size of austerity in terms of GDP the more damage done to the economy on the long run. The damage to the GDP of these countries also increased with the size of the multiplier and the size of hysteresis. As shown in chapter 10 these results are quite robust. The interaction between debt levels and GDP growth and government bond rates needs to be amplified thousands of times to alter the results.

If austerity was a costly as has been argued in this thesis, why did policy makers implement such large amounts of it? There are several answers to this question, some originating from policy makers themselves while other answers can be found in the circumstances. The first plausible explanation for why policy makers in the Eurozone embarked so massively on austerity is that they had to conform to the Maastricht Treaty, which prescribed that no government could run deficits of over 3% of GDP while debt could not exceed 60% of GDP. Although no country actually conformed to these standards during the crisis, the core countries used these benchmarks as arguments to convince countries like Greece and Spain to start austerity. And how can they dictate the rules to others while they themselves did not adhere to them? It could be argued that the core countries embarked on austerity to give a good example, whether it was good for their own country or not. A second explanation is that historically debts and deficit are seen as shameful, horrible thing in countries such as the Netherlands and Germany. Or as Krugman (2015) put it: 'Conservatives like to use the alleged dangers of debt and deficits as clubs with which to beat the welfare state and justify cuts in benefits.' Afraid of rising debt and deficit levels, these countries embarked on austerity. A third explanation, related to the second explanation, is that countries feared that financial markets would lose confidence in their sovereign if debt and deficit levels increased. Because financial markets are so key for growth via the funding channel, debts and deficits had to be brought down, no matter the cost. The final explanation was that austerity had to be implemented to preserve the euro. The implosion of the currency union would have been very costly for each member state, perhaps government felt that the costs of austerity were small compared to the costs of reintroducing their own currency.

11.1 Expansionary Fiscal Policy

It should be pointed out that austerity is not a poor policy measure in and of itself but the circumstances in which it was introduced made it the wrong policy at the time. So if austerity was the wrong policy to bring an end to the recession, the next question must be: "What was the right policy to bring an end to the recession?" If monetary policy is ineffective due to the binding zero lower bound, and fiscal contractionary policy is counterproductive an obvious contender is fiscal expansionary policy. During the economic crisis it was often argued that expansionary policy would lead to exploding levels of public debt and was therefore not feasible. DeLong and Summers show that under certain circumstances fiscal expansionary policy can actually become self-financing. This means that the debt-to-GDP ratio does not increase as a result of fiscal expansion. The economic argument behind this statement is as follows. If the multiplier is higher the effect of expansionary policy on GDP is larger. If the coefficient for hysteresis is higher that means that increasing output today increases

future potential output more. Both effects increase future tax revenue, which can be used to service the debt costs incurred by practicing fiscal expansionary policy. In addition, with very low interest rates, the costs of servicing debt will be low. Therefore, with large multipliers and significant hysteresis the benefits of expansionary fiscal policy can outweigh the costs. See table 9 to find the parameters under which fiscal expansionary policy can become self-financing in the European Union.

Table 9: Critical values for real interest rates at which fiscal expansionary policy becomes self-financing in the European Union

	Multiplier			
Hysteresis	0	0,5	1	1,5
0	1,7%	1,7%	1,7%	1,7%
0,1	1,7%	4,0%	7,6%	14,2%
0,2	1,7%	6,2%	13,4%	26,6%
0,3	1,7%	8,5%	19,3%	39,1%
0,4	1,7%	10,8%	25,2%	51,6%
Average tax rate EU	0,37			
Growth rate	0,017			

Source: Author's calculations based on DeLong and Summers framework. Source of data: OECD Economic Outlook November 2016 (2016)

Table 10: Current 10-year government bond yields

Country	10-year government bond yields
The Netherlands	0,37%
Germany	0,23%
France	0,97%
UK	1,13%
Spain	1,74%
Italy	2,23%
Ireland	0,94%
Greece	7,21%
Finland	0,41%

Source: Financial Times (2017)

Table 9 reports the critical values interest rates at which fiscal expansionary policy is no longer self-financing. For example, with a multiplier of 1.5 and hysteresis of 40% the interest rate at which fiscal expansionary policy is not self-financing is 51.6%. This means that if the interest rate on government debt is lower than 51.6% then fiscal expansionary policy improves the long-term budget balance of the government. Even with more modest assumptions, a multiplier of 0.5 and hysteresis of 10% the interest rate at which fiscal expansionary policy is not self-financing is 4%.

11.2 Limitations

A limitation of this study is that the results critically hinge on assumptions made concerning key variables. As extensively discussed, there is not one true value for the multiplier. This also means that any findings are difficult to generalize towards future studies. The circumstances are unlikely to be similar to the recent economic crisis. Another limitation is the relatively simple cost-benefit framework.

Chapter 12 - Conclusion

This thesis evaluated austerity as a policy measure that was introduced after the economic recession of 2008 and the eurocrisis of 2010 to combat rising debt and deficit levels in the European Union and the United States. To form an impartial opinion the arguments of both supporters and opponents of austerity were listed and evaluated based on theoretical knowledge and the empirical evidence available. This led to a social cost-benefit calculation for eleven countries, namely Germany, the Netherlands, France, the United Kingdom, Ireland, Italy, Finland, Spain, Greece, United States and the Eurozone as a whole. Calculations were made based on the framework created by Delong and Summers (2012). From the calculations some stylized facts appeared. The costs of austerity increased with the size of the multiplier and the amount of hysteresis. During the economic crisis of 2008 multipliers were much larger than initially anticipated. This was caused by a binding zero lower bound on interest rates, rendering monetary policy ineffective. Moreover, new findings suggest that hysteresis is not only real but very significantly. Large fiscal multipliers and present hysteresis have significantly raised the costs of austerity. The main benefit of austerity was lower interest payments on government debt. However, since interest rates are at an almost historic low these benefits were very low. With very high costs and low benefits it can only be concluded that austerity as a policy measure has been very costly for seven of the eleven countries in the sample.

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