UHASSELT

KNOWLEDGE IN ACTION

Faculteit Bedrijfseconomische Wetenschappen

master in de toegepaste economische wetenschappen

Masterthesis

Overheidsschulden: hoeveel is teveel

Hanne Desmet

Scriptie ingediend tot het behalen van de graad van master in de toegepaste economische wetenschappen

PROMOTOR :

Prof. dr. Willem VANLAER

2023
2024

UHASSELT

KNOWLEDGE IN ACTION

www.uhasselt.be
Universiteit Hasselt
Campus Hasselt:
Martelarenlaan 42 | 3500 Hasselt
Campus Diepenbeek:
Agoralaan Gebouw D | 3590 Diepenbeek

UHASSELT

KNOWLEDGE IN ACTION

Faculteit Bedrijfseconomische Wetenschappen

master in de toegepaste economische wetenschappen

Masterthesis

Overheidsschulden: hoeveel is teveel

Hanne Desmet

Scriptie ingediend tot het behalen van de graad van master in de toegepaste economische wetenschappen

PROMOTOR :

Prof. dr. Willem VANLAER

Preface

With this thesis I conclude my master's in business economics. I have been a student for many years due to my athletic endeavours, this thesis gave me the opportunity to delve deeper into my interests in the economic world. I had the chance to study a highly relevant topic: the economic consequences of government debt. Researching this subject has taught me a lot. I have a lot of perseverance when trying to reach my athletic goals, this thesis posed a very different kind of challenge. I am proud to be able to conclude my education at Hasselt University.

First, I would like to thank my promoter professor Willem Vanlaer for his guidance and expertise. Second, I want to thank everyone at UHasselt and Sport Vlaanderen for the support all these years in combining my career as an athlete and my education. Last, I want to thank my family who has always supported me.

Hanne Desmet

Mechelen, June 2024

Abstract

Government debt lies at the heart of contemporary fiscal policy, shaping the trajectory of nation's stability, growth potential, and societal well-being. Both the financial crisis of 2008 and the COVID-19 crisis of 2020 have caused concerning increases in debt levels. Now many nations fear their elevated debt levels may prove unsustainable and cause adverse effects on their economies. This paper examines the economic consequences of elevated debt levels in developed countries. Despite being a major topic in many national elections across the globe, there is a blatant lack of understanding on how government debt actually relates to a country's economic and social wellbeing. There is a gap between theoretical ideals and practical feasibility, therefore it is very challenging to provide an answer on how to successfully manage sovereign debt. This paper examines and provides insights on the complex dynamics of debt levels and the economy. First, research of relevant literature was conducted to create a broad understanding of when debt becomes unsustainable and what economic consequences this might have. Second, to add to the existing literature, empirical research on a less explored consequence of high debt levels was exerted: public investment, as well as supplementary research on topics that have been studied more extensively: economic growth, private investment, and inflation (CPI). Public investment is vital for a nation's future economic prosperity and societal wellbeing. While debt levels have been increasing drastically over the last decades, academic literature implies that this is not problematic as long as economic growth exceeds the long-term interest rate. This hypothesis will be put into empirical context by examining growth, investment and inflation in periods where growth lies both below and above the interest rate. This research is particularly timely, given that long-term interest rates have recently increased for the first time in two decades.

Contents

1 Introduction

Over the past decades, government debt (or public debt) has drastically increased in most developed countries and has become a highly relevant subject. Global crises have caused disturbing increases in debt levels, highlighting the importance of debt management and understanding the actors at work. The significance of public debt got revived after the 2008 financial crisis, which caused debt levels to reach heights that hadn't been seen since World War II. This is one of the factors that led to Greece defaulting on its sovereign debt a few years later. At the same time, it caused interest rates to rise, which ignited concerns in many countries with high debt levels as to whether their debt would be sustainable in the long run. As a result, fiscal policy guidelines became stricter, to help countries stray away from the risk of default. In 2020, the COVID-19 crisis caused another substantial increase in the debt-to-GDP ratio for most developed countries. This again, raised concerns whether these new levels of debt would be sustainable and what the economic consequences might be if they persist. Debt levels and government budgets are a highly relevant subject within politics, whenever elections are coming up, experts weigh in on what direction government budgets need to go, often disagreeing with one another.

Most of the research on government debt focuses on either sustainable debt levels or the effect of government debt on economic growth. In this paper, the literature on both subjects will be discussed, but this paper will look further. Other economic consequences will be reviewed as well as factors that play important roles on these consequences. Servicing debt could divert investment from vital areas, such as infrastructure, education, and research (McBride et al., 2020). The IMF worries about the global increase of government debt levels and the effects it will have on the economy (Dept, 2012), they developed guidelines on public debt management aimed at reducing debt to a sustainable level, but primary surpluses are hard to obtain, and sustainable debt levels ambiguous. A sustainable debt level is not a general threshold, but a complicated function of country specific parameters (Collard et al., 2015). In addition, the political and economic consequences of fiscal policy need to be considered at every turn. Debt levels in developed countries range from 31% of GDP in Luxembourg to 253% of GDP in Japan (*OECD Data Explorer • Financial Indicators Dashboard: Government*, n.d.), while these countries are different in size, they have well developed economies, and both seem to have found a way to be prosperous with their respective debt levels. The literature study will cover all these topics to provide a full understanding of the effects of public debt.

Besides exploring existing literature on the consequences of economic debt, data analysis will be performed to add to the existing literature. The literature study covered a broad range of consequences of public debt. To contribute to the existing literature, this paper will examine a subject that has not received the attention it deserves in the public debt debate: public investment as well as add updated analyses on some of the topics that have been studied more extensively: economic growth, private investment, and inflation (CPI). Public investment can enhance productivity, promote economic growth, improve societal wellbeing, and support long-term policies, making it a very interesting topic for additional research. The relationship between public debt and public investment is critical for policymakers who need to balance fiscal responsibility with the needs for growth-

enhancing investments. The setup for this research will be based on the groundbreaking paper of Reinhart and Rogoff (Reinhart & Rogoff, 2010), where they use descriptive statistics to show that a threshold of 90 percent for public debt exists where economic growth drops drastically. This framework will be used to study the effect of public debt on public investment, private investment, inflation, and economic growth.

Furthermore, according to academic literature high debt levels are much more problematic when long term interest rates are above growth rates. This hypothesis will be tested in an empirical context. For this study data on public investment, private investment, economic growth, inflation (CPI), and debt-to-GDP ratio was collected for the period 2000 to 2022. Most research includes data over a much longer period, this study focuses on a shorter period to be more representative for the current global economic landscape. The study focuses on developed countries, therefore the data for 23 OECD countries is analysed. These countries represent an interesting, heterogeneous group.

2 Literature Study

This literature study has the goal to examine when and through what channels government debt has a negative impact on the economy. The literature study will be divided into three parts. The first part will examine the sustainability of government debt. This part will survey the literature on when debt becomes unsustainable, establishing what it means for debt to be unstainable, at what point negative consequences are expected to occur, and what a desirable debt level is in theory. This leads to the second part, which will examine the economic consequences of high government debt. The third part will explore the recent development of macro-economic variables relevant for this paper creating a bridge between the literature part and the empirical part. Collectively, these sections aim to provide a comprehensive overview of the implications of government debt.

2.1 Sustainability of government debt

Sustainable debt levels refer to a level of government debt that can be maintained over time without jeopardizing economic stability, fiscal health, or the ability to meet debt obligations. Most countries took years to recover economically from the financial crisis in 2008. Greece defaulted on its sovereign debt in 2012, and it is still picking up the pieces. Public debt management plays an important role in helping countries cope with economic and financial chocks (International Monetary Fund, 2003). Still, a lot of countries keep accumulating debt. This makes it important to answer the question: How much debt is sustainable? And if current debt levels are unsustainable, what fiscal frameworks could be implemented to reach a desirable debt level? When high debt is unsustainable, this does not necessarily mean a country will default, but rather that fiscal or monetary policy changes need to be made. A reoccurring term in the research on debt sustainability is "fiscal fatigue". This term refers to diminishing effectiveness of fiscal stimulus measures in the context of prolonged fiscal deficits. It reflects the challenges associated with sustaining fiscal policies as deficits persist (Ghosh et al., 2013). Even though high debt levels are a big concern in developed countries, governments are currently not taking significant long-term actions to counteract the increase in debt (Beqiraj et al., 2018), this could have many different reasons, decreasing debt is very challenging, especially during global crises like the recent COVID-19 crisis.

This section is dedicated to analysing the literature on the sustainability of government debt. It is important to understand when, why, and through what channels a country becomes at risk of having unstainable debt levels and negative economic consequences kick in, or worse, the country defaults on its debt. A lot of research has been conducted trying to define a sustainable level of debt. It is important to take into account that countries are heterogeneous. A sustainable debt level is dependent on a magnitude of factors. Sustainability does not just depend on the amount of debt but also the composition and many other country specific attributes (Elberry et al., 2023). Governments are dependent on the willingness of lenders, there are a lot of criteria a lender will consider when deciding whether they are willing to lend to a country, and under what terms. Several factors, including a country's fiscal track-record, economic variables, interest rates, and growth prospects, will be considered when assessing a country's suitability for borrowing. Even though vast research

for prudent debt targets has been conducted, these levels are rarely obtained. Fiscal policies are not just theoretical, they are deeply intertwined with politics, and are susceptible to shifts in market perception. The sustainability of debt is a very broad subject, the literature will not provide an unambiguous answer to what a sustainable debt level is, because there is no straightforward answer to this. The goal of this section is to provide an overview as to what factors should be considered when evaluating whether a country's debt level is sustainable.

Theoretic optimal debt levels

To keep debt under control, it is not uncommon for countries to implement a debt ceiling. In 1992, The Maastricht Treaty set 60% as the upper bound for the debt-to-GDP ratios for European member countries. Furthermore, in the USA, public debt is subject to a ceiling that can only be changed by Congress. Cadenillas and Huamán-aguila developed a stochastic debt control model that obtains a theoretical optimal ceiling for government debt (Cadenillas & Huamán-aguilar, 2016). The obtained formula is tailor-made for each country, it is a function of country specific variables such as economic growth, interest rate on debt, marginal cost of debt reduction, debt volatility, aversion to debt, debt characteristics, and other parameters. They consider a government that wants to optimally control their debt ratio. They assume debt generates a cost for the country, and the optimal debt ceiling for a country is where this cost is minimized. The cost of debt is an increasing and convex function of the debt ratio and the cost of fiscal intervention to reduce debt. When the debt-to-GDP ratio is above this ceiling, it is optimal for a government to intervene, below this point fiscal intervention is not required (Cadenillas & Huamán-aguilar, 2016).

Just two years later Cadenillas and Huamán-aguilar published the paper "On the Failure to Reach the Optimal Government Debt Ceiling" (Cadenillas & Huamán-Aguilar, 2018). Here they develop a government debt management model that studies the optimal debt ceiling, when the ability of the government to generate primary surpluses is limited. They improve their model for an optimal debt ceiling by introducing an upper bound for the capability of a government to reduce its debt ratio. They provide a model that allows one to compute analytically the optimal debt ceiling as a function of macro-financial variables, while accounting for the constraint that governments face when reducing their debt ratios. This constraint plays a key role in explaining why many countries fail to reduce their debt ratios. They found that countries with strict constraints on the rate of intervention may not be capable of reducing their debt ratios. On the contrary, countries with less constraints, it is possible to estimate finite times to reach their debt ceilings. Furthermore, governments that succeed in reducing the public debt ratios to the desired level, do not do so immediately (Cadenillas & Huamán-Aguilar, 2018).

The OECD economic policy paper series conducted a study on prudent debt targets and fiscal frameworks to help countries manage their debt (Fall et al., 2015). They present a comprehensive analysis on debt management and the link between debt and economic activity. Notably, the study reveals that debt limits are close to twice GDP in most OECD countries. The difference between debt limits depends strongly on the fiscal behaviour of the governments and potential growth. An increase in growth rate increases the debt limit: a one percent higher growth rate raises the debt limit by approximately 25% of GDP. Another contributing factor is market pressure. Euro area countries are

under pressure to have primary surpluses whereas Japan, which has by far the highest level of debt, is under no such pressure, and therefore might keep increasing its primary deficit. Countries like Greece, Iceland, Ireland, Japan, Portugal, and Spain are on unsustainable paths given their past fiscal behaviour. Japan is an interesting case, it has surpassed its theoretical debt limit, yet there have been no signs of a debt crisis. Some explanation to why the debt limit has not been binding could be the following: the central bank has kept the interest rate close to zero for a long time, the net financial assets position is large, and the economy is characterised by high household savings, low external financing and large amount of external financial assets (Fall et al., 2015). This study argues that growth maximizing dept-to-GDP levels are between 50-80% of GDP. According to empirical cross-country evidence, debt thresholds, defined as the moment when negative economic consequences start to kick in, can be divided into three groups:

- 70 to 90% for higher income countries
- 50 to 70% for euro area countries, as they are not in control of their monetary policy.
- 30 to 50% for emerging economies

These debt thresholds should serve as a reference point when designing a fiscal framework. An effective fiscal framework has the objective to promote fiscal discipline while allowing for stabilisation policies to react to future shocks. Having these guidelines could be useful, but it is important to remember that every country is unique and faces specific challenges to manage their sovereign debt.

Theoretic maximal debt levels

The framework used in most modern research on debt sustainability was introduced by Bohn in 1995 (Bohn, 1995). In his paper "The Sustainability of Budget Deficits in a Stochastic Economy" he develops a stochastic model to examine the sustainability of budget deficits. Before this, deterministic models of the economy were used. A stochastic model is much more empirically significant, especially for dynamically efficient economies in which the interest rate is below the average growth rate. The central result of the paper is that governments must satisfy an intemporal budget constraint, and a transversality condition, regardless of the level of the safe interest rate. Governments that comply with these constraints will be deemed sustainable.

According to (Collard et al., 2015), the amount a lender is willing to provide a country in need of funding, is determined by the country's maximum primary surplus (MPS). The paper constitutes an attempt to estimate advanced economies' maximum sustainable debt ratios based on a country's MPS. The higher and less volatile a countries growth the more it can afford to borrow, while having a lower probability of default. They estimate a maximum sustainable debt level for 23 OECD countries with data from 1980 to 2010. It would be interesting to use this model with data from 2010 to 2022 included. According to their calculations Hungary had a probability of default of 95.45% in 1993, with a debt level of 172% of GDP. By 2010 Hungary's Debt-to-GDP ratio was only 72.60%. While not sole in its existence, this example of a significant reduction in the level of debt could be worth analysing. It might provide insights for other countries who struggle with high debt levels on how to turn effectively reduce their debt levels, and not become stuck in a "debt trap". On top of that, one could study the economic consequences Hungary encountered throughout this experience,

thereby possibly gaining valuable insights on the subject of the economic consequences of high debt levels and fiscal policy.

In the paper "Limits to government debt sustainability in OECD countries" (Fournier & Fall, 2017) aim to calculate state-contingent debt limits to provide insights in assessing debt sustainability in OECD countries (Fournier & Fall, 2017). The model is determined by key elements that shape the public debt dynamic: the real growth rate, the real interest rate, and the primary balance, as illustrated in (Bohn, 2007). The recent sovereign debt crisis in Europe has shown the significance of market reactions, these market reactions are therefore integrated in the model. Greece's default on its debt in 2012 has been associated with a rapid increase of interest rates for a few euro area countries, particularly the ones with high debt levels. Because of this, formerly sustainable debt levels suddenly become risky, triggering consolidation policies and ECB reactions. The debt limit is defined as the level of debt where a country loses market access to borrow and can therefore no longer service its debt. Analysis of 31 OECD countries shows the existence of a non-linear reduced-form relationship between primary balance and (lagged) government debt. The research indicates that at a debt-to-GDP ratio of 120% governments strongly react to debt accumulation, but at around 170%, efforts on primary balance are relaxed. The debt limit varies significantly among countries because it depends on country specific variables like fiscal and monetary policy, market, and growth. In table 1 debt limits as estimated by Fournier and Fall's model is showed for a selection of OECD countries. Where d model is the model-based debt limit, and d market is the debt limit corresponding to the current market interest rate.

	g	r	r*	$\bar{\varepsilon}$	μ	d model	d market
AUS	3.2%	1.4%	0.9%	2.7%	0.6%	250	263
AUT	1.7%	0.1%	−0.5%	3.2%	−0.6%	231	249
BEL	1.5%	0.9%	0.1%	2.7%	2.3%	245	251
CAN	2.1%	0.6%	0.2%	3.6%	−0.4%	217	246
CZE	2.6%	−0.1%	−0.9%	5.8%	−3.3%	203	247
DEU	1.2%	−0.5%	−0.9%	3.1%	0.2%	235	257
DNK	1.1%	0.1%	−0.4%	4.9%	2.1%	224	258
ESP	0.9%	2.2%	1.0%	5.0%	−1.9%	n.s.	175
FIN	1.6%	0.4%	−0.1%	6.6%	0.6%	200	249
FRA	1.7%	0.7%	−0.1%	3.3%	−2.5%	196	211
GBR	2.4%	0.9%	0.5%	4.1%	−2.2%	194	226
GRC	1.1%	7.0%	1.9%	9.2%	−2.3%	n.s.	n.s.
HUN	1.3%	1.5%	−0.7%	5.1%	0.8%	222	219
IRL	1.1%	1.6%	0.7%	11.8%	−2.2%	n.s.	184
ISR	3.4%	1.4%	0.1%	4.8%	−1.2%	235	250
ITA	0.4%	2.2%	0.7%	4.1%	−0.4%	172	180
JPN	0.9%	−1.4%	−2.2%	4.9%	−6.4%	n.s.	194
LUX	2.1%	−0.7%	−1.3%	7.3%	1.7%	253	314
NLD	1.6%	0.9%	0.2%	3.3%	1.0%	223	240

NOR	2.5%	0.6%	0.3%	3.9%	6.1%	297	330
POL	2.8%	1.7%	0.7%	2.6%	−1.7%	219	221
PRT	0.5%	3.1%	0.6%	7.4%	−2.6%	n.s.	n.s.
SWE	2.6%	0.6%	0.3%	4.9%	0.6%	230	272
USA	2.4%	1.0%	0.7%	4.4%	−1.8%	193	229

Table 1 Debt Limits (Fournier & Fall, 2017)

Note: n.s. = no solution. g is the average annual potential growth rate between 2014 and 2017, r is the 10 year interest rate in mid-2014, r* is the 10 year interest rate in mid-2014 minus the risk premium as priced with the corresponding credit default swap, $\bar{\varepsilon}$ is the maximum size of annual macroeconomic shocks considering a triangular distribution of shocks with the same variance as the one found in the baseline estimations, μ is the constant of the primary balance reaction function (Fournier & Fall, 2017).

These results provide a useful insight in the contributing factors on the difference in debt limits for these countries. Namely, the average growth rate, the long-term interest rate, the short-term interest rate, the risk premia, the size of macro-economic shocks, and the primary balance reaction function. Japan is the only country that is currently above the estimated limit, as their debt-to-GDP ratio was 253% in 2022 (*OECD Data* Explorer, n.d.).

The effect of debt composition

Debt management is particularly important during global crises, which has been a reoccurring phenomenon in the last decades. With debt levels at an all-time high after the pandemic, new debt crises are anticipated. Evidence shows that government debt composition can play a crucial role in averting or mitigating sovereign debt crises by influencing lenders' perception of a country's credibility and default risk, debt sustainability, size of public debt burden, and the efficacy of fiscal policy in stimulating economic growth during a crisis recovery period (Elberry et al., 2023). Debt composition refers to debt maturity, interest rate, currency composition, and types of creditors. The practical and theoretical approaches for defining the optimal composition of public debt are not the same. The IMF- World Bank joint guidelines define the optimal debt composition as trade-off between borrowing at a minimal cost, and a judicious degree of risk to minimize a government's vulnerability to macroeconomic shocks and exposure to financial crises. In line with these guidelines, debt management focuses on concepts such as risk and cost, and the inherent trade-off between them. For example, this trade-off arises when a government prefers large volume of short-term or foreign currency debt for minimizing borrowing costs. However, the disadvantage of this, is the higher vulnerability risk due to unanticipated changes in interest or exchange rates. From a theoretical perspective, optimal composition of public debt is analysed using an optimal taxation viewpoint, where debt instruments minimize the welfare costs associated with distortionary taxes.

Under the assumption of exogenous default risk, optimal debt maturity is long, because short-term maturity increases vulnerability to debt crises. If the average maturity of public debt is short, and the public lacks confidence in the government's ability to roll over the maturing debt, they will be averse to buy the newly issued government securities. As a result, the government will not have enough resources to repay the maturing debt; hence, the expectations of the public become self-fulfilling. On the contrary, longer maturities offer more insurance because this reduces the amount of debt maturing at each date. Consequently, the likeliness of having rollover risk and encountering

self-fulfilling or confidence debt crises is reduced. In the context of interest rate risk, investors' shortfall of confidence in a government's ability to repay debt can be translated into higher interest rates (risk premia). This will result in a rapid accumulation of debt and ultimately lead to a self-fulfilling crisis that moves slower than when new debt is not being bought and default is immediate. Long debt maturities can play an important role in avoiding debt crises, considering both roll-over and interest rate risks (Elberry et al., 2023).

Under the assumption of endogenous default risk, meaning a government that can repay its debt might opt to default, justified by the benefits and cost association of this decision. Under this assumption it appears to be the best choice to shorten debt maturity for risky sovereigns, even though it increases vulnerability to a crisis. Short-term debt has an incentive benefit because it provides sovereign inducements for repayment as it does not entail the same dependence and uncertainty on future new debt issuances like long-term debt does. A government under high default risk will thus shift to short maturity because the incentive benefits of short-term debt become more beneficial than the hedging benefits of long-term debt. Another theoretical reason to shorten debt maturities during unfavourable conditions is the price sensitivity of long-term debt during adverse shocks (Elberry et al., 2023).

The second crucial element of public debt choice is currency denomination. Domestic currency debt fulfils a hedging or insurance role through changes in inflation or real exchange rates, while foreign currency debt exposes the government to exchange rate risk and increases the government's vulnerability to financial or debt crises. On the other hand, foreign currency debt, which is denominated in a way that is not controlled by the borrowing government, could solve credibility problems, avoid inflationary costs, and real exchange rate distortions associated with domestic currency debt. Under the approach of implicit contingent, and in the absence of re-commitment to inflation rates, governments can use inflation shocks to reduce the real value of nominal debt denominated in the domestic currency when adverse shocks are experienced. In other words, domestic currency can serve as insurance. On the other hand, in case of a credibility problem, debt denominated in foreign currency serves as an instrument insensitive to inflation, enhancing the sovereign's credibility. Foreign currency debt can aggravate economic crises because its value is countercyclical to the aggregate state of the economy, this causes the value of foreign currency repayment to increase due to the depreciation in the value of the domestic currency. Reserves in a foreign currency provide a hedge against rollover risks. Additionally, these reserves provide the necessary liquidity to increase foreign currency debt sustainability, and reduce vulnerability to financial crises (Elberry et al., 2023).

The type of creditors for an ideal debt composition focuses on the choice between domestic vs foreign creditors, bond-holders vs banks, and private vs official creditors. Due to the increasing globalization, it is necessary to distinguish between debt held by non-residents (foreign creditors), regardless of the currency denomination of the debt, and debt denominated in a foreign currency, regardless of the residence of the creditor. Foreign creditors are debtholders receiving interest payments and have the ability to impose sanctions in case of default. Domestic creditors on the other hand, are taxpayers in addition to their role as creditors. In that regard, it is an advantage to choose domestic creditors, as interest payments on sovereign debt are considered redistribution or transfer of money from

domestic taxpayers to domestic debtholder. Whereas in case of foreign creditors it is considered a transfer abroad and thus causes welfare loss. On the other hand, domestic debt could have negative crowding-out effects. The effect on private domestic investment following the shift of recourses to public debt, lowers investment, growth rate, and welfare. Contrary to this, borrowing from foreign creditors can increase private investment, growth, and welfare. Another positive effect of borrowing from foreign creditors, is the confidence in its economic conditions the borrowing country signals, this could attract more foreign capital into the country leading to improvements in growth and welfare (Elberry et al., 2023).

The analysis of the optimal choice between bank loans or bond issuance establishes that long term bond issuance is cheaper than borrowing from a bank. However, short term bank loans could still have an advantage over short term securities due to the ease to roll-over bank loans compared to the struggle of coordinating a large number of bondholders. There are several theoretical advantages of using bank loans as opposed to bond financing for mitigating the negative impact of a debt crisis. One reason for this, is that the non-tradability of bank loans protects a country facing a crisis from speculative attacks that exacerbate the debt crisis. In the case of tradable securities, the collective action of speculators to sell securities immediately will induce others to do the same, thereby increasing the debt servicing costs and rendering government debt more unsustainable. A second reason is that banks' credit rating will not be affected by the deteriorating government credit rating - unlike tradable securities. This could make bank loans cheaper. A third argument is that bank loans are available domestically, and therefore provide greater financial stability and lower vulnerability to crises compared to securities owned by foreign investors. Theoretical trade-offs can help guide the evaluation of the pros and cons of different public debt compositions. However, there are many factors that affect the optimal debt management, such as monetary policy, the sovereign's reputation, level of international reserves in the choice of debt maturity and currency denomination, and the urgency of financing needs when to seek resources in the IMF's lending programmes (Elberry et al., 2023).

Policy implications

Debt levels and economic conditions have made major shifts in the past decades. What was deemed unstainable 10 or 20 years ago might be actuality today. To reflect the dynamic nature of fiscal challenges it is important to include recent research and updated data. The COVID-19 crisis had a considerable impact on fiscal policies, economic conditions, and debt levels worldwide. Sebastian Hauptmeier and Christophe Kamps studied debt policies in the aftermath of the COVID-19 crisis. They link two ongoing discussions on fiscal policies:

1. The implications of low interest-rate growth for debt sustainability and the optimal coordination between fiscal and monetary policy.
2. The transformation of the European Union fiscal governance framework.

It is crucial to consider political-economic constraints when considering debt policies in practice. Concurrently, research on the political economy of budgetary institutions indicates that more rigorous fiscal rules contribute to fiscal discipline, and restrain sovereign debt (Hauptmeier & Kamps, 2022). Recent research suggests that low interest rates can alleviate concerns about the

sustainability of public debt by reducing the burden of interest payments on government budgets. However, it is necessary to acknowledge the risks associated with low interest rates, such as the possibility of financial instability or limitations of monetary policy effectiveness (Blanchard, 2019). Interest rates have remained very low in the last decade, but after the pandemic they increased significantly.

A major shortcoming in the existing debt limit calculations is the failure to consider persistent deviations of inflation from the central bank's price stability objective. The inflation overshooting observed in several EMU Member States ahead of the financial crisis gave a misleading sense of security, while the subsequent undershooting of inflation in various EMU Member Sates post-crisis significantly firmed the requirements under the existing debt rule. In both scenarios the existing debt rule was not consistent with an effective backing of fiscal policy for monetary policy in the pursuit of stabilizing prices. The EU enforces a 60% debt-to-GDP rate rule. This states that member states who are above this 60% debt-to-GDP ratio, are required to decrease the excess debt by one twentieth per year. This measure was introduced in response to the debt crisis in 2011. In practice, this rule has barely played a role in the implementation of the fiscal framework in the EU, this is because a strict implementation of this rule would be self-defeating, meaning it would do more damage than good (Hauptmeier & Kamps, 2022). Hauptmeier and Kamps propose parametric changes to this debt rule to remove some of its economic weakness, while only requiring limited change to EU legislation. The first proposal is a "nominal" cyclical adjustment, aimed to treat fluctuations of nominal GDP around the real GPD growth potential and deviations of inflation from a 2% norm as cyclical factors. This would ensure fiscal adjustments better reflect economic cycles. Additionally, it would improve the alignment of fiscal and monetary policy when inflation rates are below the price stability objective. The second proposal is a reduction in the debt adjustment parameter from 5% of the distance to the reference debt target value of 60%, to 3%. Consequently, the primary balance targets for high-debt Member States would be lower, this way it would become more feasible for countries to comply with the rule, both from an economic and political point of view. The third proposal is a symmetric treatment of the debt target level, meaning a convergence towards the debt level from below. This would reduce the current heterogeneity in euro area debt levels. This would allow fiscal policy to support monetary policy better in times of crisis.

To study how the optimal conduct of monetary and fiscal policy depends on the level of accumulated government debt and how debt evolves under such optimal policies, Adam (Adam, 2011) considers three government instruments that are generally considered relevant for the conduct of stabilization policy. Namely:

1. Monetary policy defined as controlling of the short-term nominal interest rate.
2. Fiscal policy through decisions regarding spending on public goods
3. Fiscal financing decision whether to use government debt or labour income taxes as a mean to finance current expenditure.

Higher levels of government debt often require higher income tax rates to service the debt. These rates distort labour supply downward, impacting private consumption. To prevent further tax rate increases, public consumption and investment also decrease. Debt has an impact on welfare through

the increase in tax rates it causes. The paper considers an economic environment with three key distortions: monopoly power in product markets, the need for distortionary labour income taxes to finance public goods and debt interest payments, and nominal rigidities in price adjustment. Due to these distortions, optimal policy suggests reducing government spending below the first-best allocation for public and private consumption, particularly when government debt is high. Nominal rigidities prevent effective use of price level changes for taxation when nominal government debt exists. As a result, public debt tends to follow a near-random walk, with standard deviations dependent on the level of outstanding debt. The paper finds that larger public debt leads to greater fiscal budget risks and tax rate implications, incentivizing debt reduction over time. The degree of this debt reduction depends on the predictability of technology shocks. In a scenario where initial government debt is zero, optimal policy dictates maintaining a balanced budget exclusively through reductions in government spending in response to adverse shocks. This suggests that public debt optimally reverts to zero over time (Adam, 2011). This is a different conclusion than most other studies mentioned in this literature study, where optimal debt levels are not close to zero.

2.2 Economic consequences of government debt

The way countries have accumulated debt over the past decennia almost makes it seem like debt accumulation is inconsequential. While a lot of countries try to implement fiscal policies to decrease their debt levels, they have continued to rise. This is a result of economic and political factors. The economic consequences of rising debt levels can be severe when the debt isn't properly managed, debt management has played and important during economic and financial shocks (International Monetary Fund, 2003). Following the financial crisis of 2008, many governments in OECD economies implemented expansionary fiscal policy measures and offered rescue packages of unprecedented size to the financial sector. These actions lead to a significant increase in the debt levels, triggering fear for some countries about the sustainability and consequences of public finances (Adam, 2011). The recent COVID-19 crisis caused another significant increase in debt levels, while the economy contracted, governments had to spend substantial amounts of money trying to respond to the pandemic. These developments prompt the importance of the question: what are the normative implications of this significant accumulation of public debt on the economy? The vast literature on this topic will provide divergent answers to this question. There are many studies that show a negative impact of high debt levels on economic growth. While the two can be linked, that does not mean causality can be established, or that the causality runs from debt level to economic growth, causality could be reverse, or they could be caused by other factors influencing the two simultaneously. It is possible that it is not high debt levels that have a negative impact on economic growth, but rather the contractionary policies that are implemented as reaction to, or prevention of high debt levels (Panizza & Presbitero, 2014). In this section, diverse literature on the consequences of public debt will be discussed. With the broadness of this subject, literature will not provide an unambiguous answer to what the consequences of public debt are, the goal is to provide a range of possible consequences, and the channels through which debt can be linked to these consequences.

Negative impact on economic growth

The importance of government debt for economic growth has become vital, especially in a context where policy makers are facing increasing fiscal imbalances. In terms of economic theory, fiscal policy may induce growth at moderate levels of debt, under typical Keynesian behaviour. However, at higher debt levels, a future rise in tax will be expected, reducing the possible positive effect of government debt, lowering investment and consumption. This will result in less employment and lower output growth. The empirical evidence on the importance of government debt and its effect on economic growth is not entirely conclusive. There are two main schools of literature on the negative effect of debt on economic growth: a linear relationship vs a non-linear relationship with a turning point.

Linear relationship

Afonso and Jalles attempt to fill in some gaps and provide some additional empirical evidence on the effect of government debt (and its maturity structure) on output growth and productivity (Afonso & Jalles, 2013). The substantial deterioration of public finances in many advanced economies because of the 2008 financial crisis caused a revival of the theme, as a response, governments around the

world implemented important fiscal stimulus. It became more important than ever to understand the effects of public debt on economic growth, capital accumulation and productivity. Studies vary on which countries they include for their analysis, with the heterogeneity between countries this can have a significant impact on the results. Afonso and Jalles use cross-sectional-time series data for a group of 155 developed and developing countries for the period 1970 to 2008. The empirical results confirm the negative effect of the public debt ratio for the full sample in the dataset. The result is robust across econometric methodologies, with the inclusion of various sets of regressors. There was no evidence found to support a Laffer-type relationship, as a quadric debt term was found to be statistically insignificant. For an OECD-sub group of the dataset, results show that the longer the average maturity of public debt the higher the growth will be. Results also show that high dept-to-GDP ratios worsen the detrimental effect a financial crisis has on economic growth (Afonso & Jalles, 2013).

Non-linear impact: turning point

There are many different ways to analyse data on government debt. Almost every paper uses a different combination of countries. With the strong heterogeneity between countries this may result in vastly different outcomes. Checherita-Westphal and Rother investigated the average impact of government debt on per-capita GDP growth in twelve euro-area countries over a period of approximately 40 years starting in 1970. The paper finds evidence of a non-linear impact of public debt on per-capita GDP growth rate, i.e., a concave relationship, with the turning point around 90-100% of GDP. Statistical confidence around this turning point indicates that the threshold might go as low as 70% of GDP. This long-term perspective is reinforced by the evidence of a similar impact of public debt on the potential/trend GDP growth rate. The potential endogeneity problem, in particular the issue of simultaneity or reverse causation is addressed in the following ways: one, they use 1-year and 5-year forward growth rates, as well as potential and trend GDP growth rates. Two, they use a quadric relationship in the debt, while a linear one is found to be insignificant. Third, they use instrumental variable estimation models. The main channels through which government debt is likely to have a concave relationship with economic growth rate are found to be private saving, public investment, and total factor productivity. While they estimate these relationships individually, government debt might influence economic growth rate through multiple channels simultaneously (Checherita-Westphal & Rother, 2012).

Reinhart and Rogoff exploit a new multi-country historical dataset on government debt to establish a systematic relationship between high public debt levels, economic growth, and inflation. The main result is that whereas the link between growth and debt seems relatively weak at low debt levels, mean growth rates for countries with debt levels over 90 percent of GDP are several percent lower. They find no systematic relationship between inflation and high debt levels for advanced economies as a group, but there are individual exceptions including the United States. Their results incorporate data on 44 countries over a period of about 200 years. The nonlinear effect of debt on growth is reminiscent of "debt intolerance" and is presumably related to a nonlinear response of market interest rates as countries reach limits of their debt sustainability. When countries experience sharp rise in interest rates, they are forced to make painful fiscal adjustments in the form of tax raises and spending cuts, or in extreme cases default. The way debt accumulates is also crucial. For example,

war-related debt may have less detrimental effects on future growth and inflation compared to peacetime debts. Postwar periods often witness robust economic growth as resources are redirected from military to civilian purposes. Moreover, the conclusion of high wartime spending, which caused these high debt levels, naturally occurs with the return of peace. Conversely, peacetime debt surges may signify underlying political and economic instabilities, which can persist over extended periods (Reinhart & Rogoff, 2010). There is an ongoing debate on the effects of high debt levels on economic growth, which continues to draw attention from academic researchers, policymakers, media, and politics. (Bitar et al., 2018) revisit the hypothesis by Reinhart and Rogoff to examine whether it is robust to systematic alterations in the conditioning information set. They systematically evaluate the robustness of the partial correlations between public debt and economic growth. Their independent observations conclude with reasonable confidence that the non-linear effect of public debt on economic growth is in fact correct.

Modelling the effects of debt on growth

This part will show a model containing equations that determine debt dynamics (Fall & Fournier, 2015). The model consists of dynamic equations of real GDP growth, short and long-term interest rates, the primary balance, and inflation. These equations are estimated with annual panel data from the period 1985 to 2003. The real growth rate g_{it} of country i at year t, the inflation rate measured by the GDP deflator π_{it}, the overnight nominal interest rate r^s_{it} , the long-term nominal interest rate r^l_{it} and the primary balance PB_{it} as a per cent of GDP.

$$g_{it} = \beta_{1,1} GAP_{it-1} + \beta_{1,2}(r^l_{it-1} - \pi_{it-1}) + \beta_{1,3} \Delta\, PB^{st}_{it} + \beta_{1,4} \Delta\, PB^{st}_{it} 1_{t\geq 2009} + \beta_{1,5} \Delta\, PB^{st}_{it} 1_{t\geq 2009}$$

$$+ \beta_{1,6} emu_{it} 1_{t\geq 2009} + \beta_{1,7} \Delta\, PB^{st}_{it} GAP_{it-1} + \beta_{1,8} GAP_{it} 1_{t\geq 2009} + u_{1,i} + \alpha_{1,t} + \varepsilon_{1,it}$$

Where PB^{st}_{it} is the structural primary balance, GAP_{it} the output gap and emu_{it} a dummy equal to one for euro area countries. The paper continues with showing a table with the results and show the statistical significance of the coefficients of this equation.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Annual growth rate	Annual growth rate	Annual growth rate	Annual growth rate	Annual growth rate	Annual growth rate
Lag (Gap)	-0.31***	-0.28***	-0.34***	-0.35***	-0.35***	-0.31***
	[0.037]	[0.037]	[0.044]	[0.042]	[0.042]	[0.037]
Lag (Real LT interest rate)	-0.10***	-0.13***	-0.11***	-0.11***	-0.11***	-0.10***
	[0.027]	[0.049]	[0.027]	[0.028]	[0.028]	[0.027]
Structural primary balance	-0.13***	-0.13***	-0.10	-0.08*	0.06	-0.49***
change	[0.046]	[0.046]	[0.088]	[0.047]	[0.088]	[0.293]
Structural primary balance	-0.41***	-0.43***	-0.19	-0.46***	-0.37***	-0.42***
change after 2009	[0.095]	[0.093]	[0.165]	[0.095]	[0.098]	[0.095]
EMU after 2009	-0.92***	-1.00***	-0.91***	-0.94***	-0.89***	-0.91***
	[0.298]	[0.29]	[0.299]	[0.294]	[0.292]	[0.298]
Lag (Gap) after 2009	-0.16**	-0.19**	-0.19**	-0.12	-0.13*	-0.16***
	[0.076]	[0.076]	[0.076]	[0.08]	[0.079]	[0.076]
Structural primary balance	0.031**	0.032***	0.008	0.029**	0.026**	0.032
change * lag (Gap)	[0.012]	[0.012]	[0.021]	[0.013]	[0.013]	[0.012]
Lag (Real ST interest rate)		-0.11***				
		[0.042]				
Lag (Inflation)		-0.16***				
		[0.043]				
Fiscal consolidation			-0.023			
			[0.137]			
Fiscal consolidation * Lag (Gap)			0.050			
			[0.035]			
Fiscal consolidation			-0.31			
after 2009			[0.245]			
Lag (Public debt)				-0.008*	-0.008	
				[0.005]	[0.005]	
Structural primary balance					-0.003**	
change * lag (Public debt)					[0.001]	
Structural primary balance						0.008
change * Struct. public spending						[0.007]
Sample	1985-2013	1985-2013	1985-2013	1985-2013	1985-2013	1985-2013
Year fixed effects	Yes	yes	yes	yes	yes	yes
Country fixed effects	Yes	yes	yes	yes	yes	yes
N	693	688	693	658	658	693
Rho	0.320	0.300	0.321	0.311	0.308	0.320
R2	0.644	0.659	0.647	0.662	0.664	0.644

Note: Panel regression with AR(1) Prais-Winsten correction and panel heteroskedasticity-robust standard errors. Standard errors are in parenthesis. Fiscal consolidation is captured by the change in the structural primary balance if positive, zero otherwise.

Table 2 Real Growth determinants (Fall & Fournier, 2015)

The negative coefficient associated with the output gap reflects the deviation from the potential growth (Table 1), it is consistent with the way potential output is defined and calculated. Real growth is also negatively affected by the real interest rate and by fiscal consolidation. The fiscal multiplier is stronger when the output gap is negative, in line with the recent literature that found higher multipliers in times of crisis. Growth can also be influenced by the short-term interest rate, and by inflation (Table 1, Column 2). The fiscal multiplier found in the baseline equation is not significantly different during consolidation and stimulus episodes (Table 1, Column 3). Government debt could have a negative adverse impact on growth beyond its impact on long-term interest rates (Table 1, Column 4). The effect that the fiscal multiplier is getting smaller when the debt level increases could not be confirmed here (Table 1, Column 5). Last, there is no link between the size of the government, as measured by the ratio of structural spending to GDP, and the size of the automatic stabilisers (Table 1, Column 6) (Fall & Fournier, 2015). This model provides insight into the dynamics of key

macroeconomic variables and their interplay with fiscal policy, interest rates, and output gaps. This offers valuable information on implications of public debt for policymakers aiming to understand and manage economic performance and stability.

Robustness of negative impact on economic growth

There are many papers trying to prove a relationship between debt levels and economic growth, since growth is one of the main economic variables indicating the prosperity of a country. Panizza and Presbitero, "Public Debt and Economic Growth in Advanced Economies" surveys the literature on the link between public debt and economic growth in advanced economies. According to the theoretical "conventional view of public debt", output is primarily determined by demand in the short run. Increase in public debt has a positive effect on disposable income, aggregate demand, and overall output. This positive short-term effect of higher debt is expected to be greater when output is far from capacity. These effects are different in the long run. The decrease in public savings caused by a higher budget deficit will not be fully offset by an increase in private savings. Consequently, national savings will decrease, which results in lower total investment, either home or abroad. Decrease in investment at home will have a negative effect on GDP, because it will lead to a smaller capital stock, increased interest rates, lower labour productivity and wages. Decrease in foreign investment, will have a downbeat effect on foreign capital income and will thus decrease the country's future GNP. This negative effect of an increase in government debt on future GDP can be augmented by distortionary taxes. Assuming annual real GDP growth is 3 percent, and the convergence speed is 2 percent, it is found that the change in steady-state output has a rather small effect on growth. Calculations indicate that increasing public debt by 100 percent of GDP would decrease annual GDP growth by approximately twenty basis points in the first 20 years, which is not a very significant decrease. The adverse effect of government debt could be much more severe if high public debt increases uncertainty or leads to anticipation of future confiscation, which could be through inflation and financial repression. In that case, higher debt level could have an unfavourable effect even in the short run (Panizza & Presbitero, 2013).

The conventional split between the short and long-run effects of debt don't take into account the fact that prolonged recessions may reduce future potential output (because they increase the amount of discouraged workers, with an associated loss of skill, and have an adverse effect on organizational capital and investment in new activities). In this case, increasing debt and running a fiscal deficit might have a positive effect on output, both in the short and long-run (Panizza & Presbitero, 2013). It has been argued that, in a low interest situation, expansionary fiscal policy is likely to be self-financing (Delong & Summers, 2012). There is in fact evidence that recessions affect the level of future GDP permanently.

A large number of empirical studies find a non-linear relationship between debt and growth that is characterized by the existence of a threshold above which public debt starts having negative effects on economic growth. It is possible that high levels of debt pose constraints on a country's ability to carry out counter cyclical policies, and therefore increase output volatility and reduce economic growth. However, it is more plausible that the relationship between public debt and the ability of executing countercyclical policies depends on the composition of government debt than on the level

of government debt. This would mean that countries with different debt structures and monetary arrangements are likely to begin facing problems at very different levels of debt (Panizza & Presbitero, 2013).

One empirical study on the link between debt and economic growth finds that elevated levels of public debt are negatively correlated with economic growth, but at lower levels of public debt (below 90%) there is no link between growth and public debt. This threshold effect is illustrated by collecting annual data on growth output and debt for 20 advanced economies for the period of 1946 to 2009. The countries were split into four groups based on the country's debt-to-GDP ratio. Only in the highest group (90% and above) there was a significant difference in growth rate (Reinhart & Rogoff, 2010).

One of the problems when interpreting the correlation between public debt and growth is the presence of variables that are correlated with both debt and growth, and thus suffer from omitted variable bias. The evidence that public debt is negatively correlated with economic growth doesn't necessarily imply that debt reduces growth. The relationship between public debt and economic growth could also be driven by the fact that low economic growth leads to high levels of debt (Reinhart et al., 2012). Alternatively, the observed correlation between economic growth and government debt could be owed to a third factor that has a joint effect on these two variables. Using lagged values of debt mitigates, but not resolves the endogeneity problem. Assessing the existence of a causal relationship between debt and growth requires an instrumental variable that has a direct effect on debt but no direct (or indirect) effect on growth. Panizza and Presbitero show in their paper that the negative correlation between debt and GDP growth vanishes in the instrumental variable regressions. Their findings are consistent with theoretical considerations suggesting that OLS estimates are negatively biased. They ran a large number of robustness tests and address potential problems with their identification strategy. Their paper serves as a cautionary tale and emphasizes on the importance of more research aimed at identifying the causal effect of public debt on growth (Panizza & Presbitero, 2013).

A non-linear relationship between public debt and economic growth was found by (Checherita-Westphal & Rother, 2012). Studying data on growth and public debt in 12-euro area countries, they find that the relationship between public debt and growth can be described as an inverted U, and that the marginal effect of debt becomes negative when debt-to-GDP ratio is between 90 and 105 percent. This approach is sensitive to extreme values and a hump-shaped relationship might be driven by few observations (Panizza & Presbitero, 2013).

The adverse relationship between government debt and economic growth and the classis 90 percent threshold are not robust across samples, specifications, and estimation techniques. There is evidence that the effect of public debt depends on the quality of institutions and that its adverse effect is confined to non-democratic developing countries. This evidence is consistent with the lack of evidence of a causal effect of public debt on growth in OECD countries. It is important to take heterogeneity into account, and the aggregate non-linear relationship between debt and subsequent growth might be the result of very diverse country-specific attributes. Figure 1 plots data of the aggregate and country-specific quadratic fits obtained by regressing growth over debt for 16 OECD

countries over the period 1982-2008. The aggregate data shows an inverted-U curve (the bold line) and a 90 percent threshold. However, the country specific regressions yield very different results. Many countries have a U-shaped relationship between public debt ad growth, in some cases, we see a positive relationship between debt and growth. Therefore, figure 1 suggests that the sample might not be groupable, and that it is no use to try to identify common threshold effects across countries (Panizza & Presbitero, 2013).

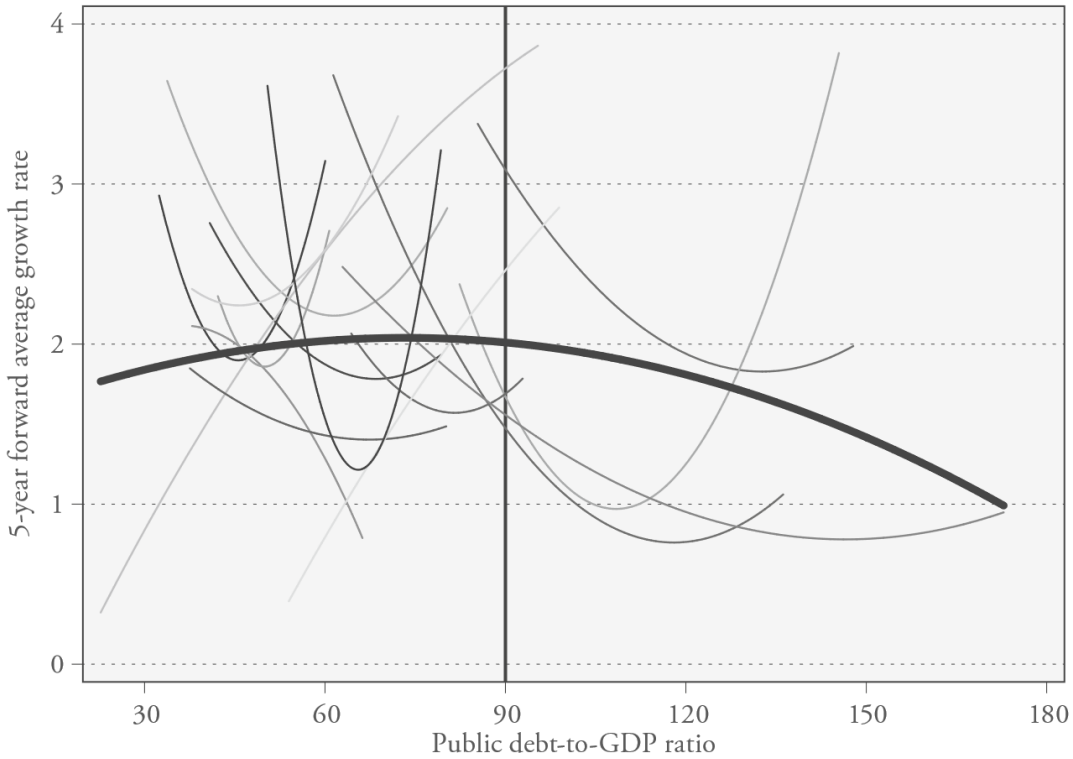

Figure 1 aggregate and country-specific quadratic fits (Panizza & Presbitero, 2013)

High level of debt might cause government to put restrictive fiscal policies into place to reduce the probability to get into trouble when any type of crisis was to happen. These restrictive policies, in turn, could reduce growth, particularly when implemented in a time of recession. Therefore, it would be true that debt reduces growth, but only because contractionary policies were implemented as a response to high debt levels. While this interpretation justifies long-term policies aimed at reducing debt levels, it also implies that governments should not implement restrictive policies in the middle of a crisis (Panizza & Presbitero, 2013).

Interest rates

It would be irresponsible to continue accumulating debt without considering what potential long-term macro-economic consequences could be. Especially considering the expectation that debt levels will continue to rise. The World Economic Outlook, established by the IMF, developed two models that illustrate these possible implications. The first model is the Global Integrated Monetary and Fiscal Model (GIMF). The second one is a small stochastic macro-economic model that emphasizes uncertainty in fiscal dynamic (FiscalMod). The former is used illustrate the implications for the

baseline of an accumulation of large stocks of debt by advanced economies, the latter is used to illustrate the distribution of outcomes around possible baselines in an uncertain world with macro-economic surprises (Dept, 2012).

The fiscal position of G3 countries (euro area, Japan, USA) has deteriorated in recent years, this resulted in a sharp increase in public debt levels. This was largely driven by the financial crisis: government spending was increased to address financial institution problems and maintain output in the face of diminished private demand. On top of that, low private demand led to lower public revenue. The GIMF simulation replicates this development and shows a rise in G3 debt-to-GDP ratios over a 10-year period by the amounts forecast in the WEO baseline between 2007 and 2017. The weakness in private demand initially results in low real interest rates. However, once private demand returns to normal and public debt converges to a new higher level, the demand increase for savings from G3 economies raises the global real interest rate, which rises almost 40 basis points above the baseline in the long term. The following discussions focus mostly on the macro-economic implications of these higher real interest rates, the simulation analysis necessarily abstracts from the potential long-term benefits of the stimulus. The stimulus was probably instrumental in averting a potential deflationary spiral and protracted period of exceedingly high unemployment, the GIMF model is not well suited to capture these macro-economic conditions (Dept, 2012).

There are two important implications higher real interest rates have for the subsequent level of economic activity. First, higher interest rates raise the servicing costs of outstanding government debt. To cope with those increased debt-service costs, fiscal policy adjustments must occur. It is assumed that higher labour income taxes and consumption taxes each account for 30 percent of the required funding. Another 30 percent comes from reduction in transfers to households. The last 10 percent comes from higher taxes on capital income. Jointly, these effects lead to a lower level of sustainable output. Second, higher interest rates increase the cost of capital, further reducing the level of capital stock, firm's labour demand, and ultimately: sustainable output. Together these two effects lead to GDP converging to a new long-term level approximately one percent below the previous baseline. The long-term level of output would be even lower if a simultaneous rise in sovereign risk premium would occur for the economies with higher public debt levels. When focusing on relative impacts, Japan is worse off than the USA and the euro area, because it had the highest debt level and the largest increase in the initial scenario. The rising real interest rate adds to debt-service costs in Japan, resulting in larger fiscal adjustments to pay those costs, leading to a bigger impact on the incentive to work, invest, and consume. Furthermore, higher public debt in advanced economies does not only reduce their potential baseline GDP outcomes, but all countries also suffer because higher global interest rates affect everyone. The impact on real interest rates and thus on real GDP of higher public debt and lower private saving is highly dependent on the rate at which households are willing to substitute consumption at some point in the future for consumption today, in other words: the intemporal elasticity of substitution (Dept, 2012).

Bohn and Henning have conducted a lot of research on government debt. Their paper published in 2011 on the economic consequences of rising US government debt states that debt is issued to finance budget deficits, this causes an increase in supply of government bonds, which thereby raises interest rates, unless private savings were to rise by an offsetting amount. These higher interest

rates require higher return on private borrowing and therefor crowd out capital investment. This lower capital stock reduces the productive capacity of the economy, thereby reducing future GDP. This damage is amplified if debt service requires distortionary taxes. A vast amount of empirical literature has studied the strength of these effects, significant effects are remarkably difficult to find. Therefore, the argument can be made that the effects of debt can be harmful, but are modest in size, take effect gradually, and could be reversed straightforwardly (Bohn, 2011).

Public investment

Most research on the consequences of public debt focuses on economic growth. An overlooked topic is government investment. Public investment is essential for potential output, societal welfare, and for long-term economic prosperity. These effects are hard to quantify, but when governments lower investment in health care, housing, education, defence, justice, etc., it is only natural that society as a whole will decline in the long term. Public investment dropped in most OECD countries in the aftermath of the global financial crisis (Fournier, 2016).

The OECD published research shedding new light on the long-term effects of public investment. One key condition is for public spending to have positive long-term effects is that this spending is productive, meaning it increases output and therefore future GDP. Another condition for public investment to be effective is that it does not crowds out private investment. They employ an empirical approach to estimate the effects public investment has on potential GDP and potential growth. They find that public investment has a positive effect on output, this can be partially explained by its positive effect on labour productivity. The effect of public investment is large, increasing the share of public investment in primary spending by one percentage point could increase the long-term GDP level by about 5% (Fournier, 2016).

Certain forms of public investment are more beneficial than others. When splitting public investment by function reveals a broad-based positive growth effect of public investment in education, health, housing, defence, community amenities and recreation, culture, and religion. The strongest effect is found for health, this possibly reflects that investment in health improves workers health and well-being and, in turn, productivity. The positive effect of investment in defence could reflect research spillovers from the high-tech technology defence industry into the business sector. Public investment on research and development is found to have a large positive effect on both GPD level and potential growth, especially spending on research. Higher spending on research can drive fundamental advances in knowledge and create new opportunities for future research (Fournier, 2016).

The growth benefits of public investment can be larger in countries that initially have a low stock of public capital, because the need for public investment is larger. For countries with high public capital stock the risk for investing in cost-inefficient projects is increased. Additionally, some public investment projects are complementary to business investment, but at high level of capital stocks public investment could substitute and crowd out business investment, and therefore having little additional effect on growth. This means that long-term growth effect of public investment may decrease with the level of public capital stock. There is a financing cost for public capital, either through raising distortionary taxes or increasing public debt, so at some level of capital, the net marginal return of public investment might turn negative. Research finds that the optimal stock of

public capital is about 75% to 110% of GDP. Current level of capital stock is below this level for all OECD countries except Japan, this suggests that all other countries have room for additional public investment (Fournier, 2016).

The paper of Vanlaer (Vanlaer, 2019) studied the debt overhang hypothesis, which states that high public debt results in low public investment. To perform this exercise, they addressed the potential issue of reverse causality between debt and investment by using a GMM model, exploiting the instrumental variable approach based on the linear GMM estimator of Arellano & Bond (1991). The results of the empirical analysis show a significant negative link between general government consolidated gross debt and gross fixed capital formation in the EU. The results of the dynamic GMM estimation, indicate that a 1 standard deviation increase in public debt results in a decrease in public investment of 0.92 percentage points. Equivalently, if public debt increases by one percentage point, public investment is reduced by €1.85 billion, given the level of public investment prevalent in 2015 (Vanlaer, 2019).

As the results show that high debt can adversely affect public investments, fiscal consolidation measures might be justified from a policy perspective. In this research, the main focus is on the average relation between debt and growth. According to part of the related literature (e.g. Eberhardt & Presbitero, 2015; Reinhart et al., 2012), this could potentially be misleading. The impact of a high level of debt on growth might in fact be influenced by country-specific characteristics such as past crisis episodes, the institutional framework (Manasse & Roubini, 2009) and debt composition (i.e. short-term versus long-term debt), domestic versus external debt, the currency denomination, (Dell'Erba, Hausmann & Panizza, 2013), etc. However, since they focus on countries that are members of the European Union that are characterized by a common EU policy - leaving little room for large differences between countries - studying the average relation between public investments and public debt is an appropriate approach. In conclusion, this paper offers an interesting contribution to the literature in several ways. They analyse debt overhang effect through a broad variety of estimations, incorporating a wide set of explanatory variables. Moreover, they studied the link between public debt and public investment using different econometric approaches and comparing high vs. low debt countries, pre vs. post crisis period, EU countries vs. EZ countries and stock vs. flow measures. The main findings of the paper are the following: that the debt overhang effect (i) is observed only in high debt countries, (ii) is not significantly stronger during and after the crisis (2009-2015), (iii) is slightly less strong inside the EZ than in the entire EU, (iv) there is no threshold effect; and (v) both the flow and stock of debt have a negative effect on investment (Vanlaer, 2019).

Channels through which debt affects financial stability

Both private and public debt are integral to the functioning of a market economy. Debt is essential to facilitate productive investment and growth over time in the private sector. Debt can be helpful to smoothen consumption and finance lumpy investment. For most advanced economies, as well as in most macroeconomic models, at least before the 2008 crisis, government debt is deemed to be safe. Government debt plays a vital role in the functioning of the financial system and the transmission of monetary policy. Yet, when debt becomes too high, it could become risky for the

economy. One needs to recognize that debt is not risk free, especially in a monetary union like the euro area, high public debt becomes problematic. This is because they lack monetary policy autonomy. With this institutional set-up, national fiscal policies carry the burden to adjust to asymmetric shocks. Euro area countries with high levels of debt are not well equipped to carry out this task of stabilisation. Risk of debt sustainability in a member state can pose a risk to the stabilisation of the whole euro area. The European Central bank conducted a study to contribute to the stabilisation vs sustainability debate in the euro area (European Central Bank., 2020). They use large scale DSGE models to review the macroeconomic implications of high public debt. The main results of their simulations are the following:

- An elevated level of government debt makes the economy more vulnerable to crises.
- High government debt prolongs the time spent at the zero lower bound (when interest rates are near zero)
- International spill overs increase the time spent at the zero lower bound for the economy in high debt.
- A high debt level crowds-out private debt in the short and long run
- High government debt restricts the scope for counter-cyclical fiscal policy.
- High government debt affects adversely potential output, especially if there is a significant increase in sovereign debt premia, and if governments resort to distortionary types of taxation to finance the debt burden.

These findings underscore the challenges faced by national fiscal policies within the euro area when being confronted by idiosyncratic shocks in the presence of high public debt. The primary explanation lies in the constraints on monetary policy within the institutional design, with the main channel being that of heightened sovereign spreads and uncertainty. These results align with the broader literature on sovereign vulnerability, which suggests that elevated risk premia and borrowing costs can transmit to other sectors or jurisdictions, particularly within integrated economic and monetary unions. Investors may thus question both the sustainability of fiscal policies more easily when a country has high debt levels, as well as its capacity to effectively implement counter-cyclical fiscal policies and stabilise the economy (European Central Bank., 2020).

Factors affecting the negative implications of government debt

The lack of consensus regarding conclusions drawn from the wide array of empirical studies, can be attributed, in part, to the diverse perspectives, methodologies, sample selections, and analytical tools employed. This heterogeneity in approaches has contributed to a literature characterized by a lack of theoretical grounding, which has been described as “measurement without theory”. Many empirical studies in economy, including those examining the relationship between public debt and economic growth, fall into this category. Typically, researchers have focused on a limited number of explanatory variables in attempts to establish statistically significant relationships between public debt and economic growth, resulting in divergent literature. This underscores the presence of both statistical and conceptual weakness in the empirical literature. There is need for a more rigorous and theoretically grounded approach to empirical research in this area, one that considers a broader range of factors and employs robust analytical frameworks. This would enhance the credibility and

reliability of findings, providing policymakers and researchers with greater confidence in the conclusion drawn from empirical studies (Bitar et al., 2018).

One of the defining features of sluggish recovery from the global financial crisis is uncertainty. After the financial crisis, high uncertainty coincided with weakness in the global recovery. Many commentators argue that uncertainty is a major cause of escalating financial stress and recession in the euro area and stalling labour markets in the United States. High debt levels can amplify uncertainty and thereby amplifying these negative effects. Uncertainty is shown to have damaging impact on economic activity. Its adverse effects are transmitted through multiple channels, with institutional constraints and financial market imperfections often magnifying them. As experienced severely since the financial crisis, uncertainty is highly countercyclical. Cross-country evidence indicates that elevated uncertainty is frequently associated with deeper recessions and weaker recoveries. Economic uncertainty is often referring to an environment where little or nothing is known about the future of the state of the economy. The economic uncertainty that follows from shocks can stem from a variety of sources, such as changes in economic and financial policies, dispersion in future growth prospects, wars, acts of terrorism, productivity movements, and natural disasters. All of which a government is less able to respond to effectively when debt levels are high (Dept, 2012).

Economic theory suggests that macro-economic uncertainty can have a negative effect on output through a variety of channels. On the demand side, firms will reduce investment and delay their projects when faced with high uncertainty. The reaction of households to high uncertainty exhibits similar behaviour: they reduce their consumption of durable goods as they wait for more certain times. On the supply side, businesses' hiring plans are also negatively affected by increased uncertainty, reflecting costly adjustment of personnel. Financial market imperfections can amplify the adverse effect of uncertainty on growth. In theory, uncertainty makes it more challenging to assess the value of collateral and causes a decline in expected returns on projects financed with debt (Dept, 2012). Consequently, creditors charge higher interest rates and limit lending. The decrease in borrowing causes investment to contract, especially for credit-constrained firms, this results in slower productivity growth because of reduced spending on R&D. The impact of uncertainty differs across countries and sectors. Empirical studies suggest that uncertainty tends to be detrimental to economic growth. This uncertainty can be magnified by high debt overhang (Dept, 2012).

While budget deficits could reflect short-term attempts to kick-start the economy in times of crisis by means of fiscal stimulus, the long-term consequences might be detrimental to growth and investment. It is therefore particularly important to study the factors that are associated with these negative consequences. Contrary to previous studies, (Berggren & Bjørnskov, 2019) relate the consequences related to government debt to the degree to which the economy is regulated. They perform an empirical analysis covering 67 countries during the period 1975-2010, using a measure of regulatory freedom from the Economic Freedom of the World index. Their main finding is that regulatory freedom, particularly with respect to credit availability, is negatively related to the debt-to-GDP ratio. This means that stricter regulation of credit tends to go hand in hand with larger public indebtedness. This is important because debt accumulation affects resource allocation in an economy and ultimately economic growth. Their empirical research suggest that a less regulated economy is

related to smaller government debt, and that this relationship does not depend on whether a recession is underway. Another of their findings is that a country's credit rating is positively and significantly associated with the overall regulatory freedom. Furthermore, freedom from credit regulation is associated with confidence in major companies. These results indicate that the link between financial regulation and debt development may be explained by reflection effects and reputation, although they find no empirical evidence to this. It is still plausible that increasing public debt would give rise to regulatory restrictions. Therefore, these results cannot rule out endogeneity bias, even though they offer some solutions to it (Berggren & Bjørnskov, 2019).

2.3 Macro-economic evolutions

The goal of this thesis is to study the implications of government debt levels. What are the contributing factors that make a certain amount of debt unsustainable and what are the economic consequences of accumulating debt. The last decades have shown significant changes in both government debt levels, and economic variables. To study the effect, one has on the other is no easy task. It is easy to wrongly interpret a correlation for causation. While there is no doubt economic variables like inflation, interest rates, and growth rates are linked to government debt, the presence or direction of causality are hard to prove. The economy is volatile and highly affected by the population's trust in it. The recent COVID-19 was an excellent example of how extreme economic behaviour can change. We are only two years past the pandemic, but most developed countries seem to have recovered nicely from the sharp economic decline the pandemic caused.

This section is dedicated to study the development of the economic variables relevant for this paper's research on government debt. Namely, debt levels, public investment, real growth rate, private investment, long-term and short-term interest rates, and inflation. It will link the literature study to the empirical part and give a better understanding of the variables that empirical part of this paper will analyse. A group of 23 OECD countries was chosen for this analysis. Other studies have big variations in the countries they analysed, this will naturally give different results in estimating certain effects, due the to the large heterogeneity between countries. The countries included are Australia, Austria, Belgium, Canada, Czechia, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Japan, Luxembourg, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, United Kingdom, and United States.

This part will have a lot of graphs to give a clear view of the evolution of the variables. Not all countries will be shown this is to keep an organized overview. Another reason to show data on a few selected countries is to address the heterogeneity between countries. The empirical part of this paper will analyse the entire data set. The data of Belgium, Germany, Greece, Japan, Luxembourg, and the United States will be shown in this section. The choice to display Japan was made because it has the highest debt level of all countries and exhibits some very interesting dynamics between all the variables that were studied. Luxembourg was chosen because it has the lowest debt level out of all the countries from the sample. Since this thesis is written in Belgium, by a Belgian, for a Belgian university, including Belgium was an obvious choice. Inclusion of the United States was based on its global economic importance, which transcends all other countries'. Germany was chosen because it is the biggest economy in the EU and has a medium level of debt, exhibiting signs of a healthy economy, finally, Greece was included because it defaulted on its sovereign debt in 2012 and has faced many extreme economic conditions ever since. The collected data is for the period 2000 to 2022. The choice for more recent data was made to make the research relevant to the current global economic landscape. One of the major changes of the economic landscape was the introduction of the euro in 2000.

General Debt-to-GDP ratio

The first data relevant to this research are the government debt levels. Governments accumulate debt when expenditures exceed their revenue. In figure 2 the evolution of the debt-to-GPD ratios over the last 23 years for 6 countries is shown. The spike every country experienced in 2020 due to the COVID-19 crisis is an interesting topic for research. The global financial crisis of 2008 showcased a similar spike in the debt-to-GDP ratio. While governments made large expenses getting the economy back on track, the increase in the debt-to-GDP ratio is partly caused by the sharp decline both crises had on the economic activity. Both crises caused a decline in GDP, when the economy recovered the debt ratio moved partly back towards the levels from before the crises. Another factor that contributes to the debt level ratio is inflation. As will be shown further in this section, inflation increased significantly in recent years. This causes the GDP to rise, while outstanding debt remains the same amount, and thus a smaller percentage. There is big a difference between the evolution of debt levels between countries. Japan has a debt level of 253% of GDP, by far the highest out of all countries, and it has been increasing rapidly over the last 20 years. Countries like Italy, Portugal, Spain, UK, and USA have also experienced a significant increase in their debt level.

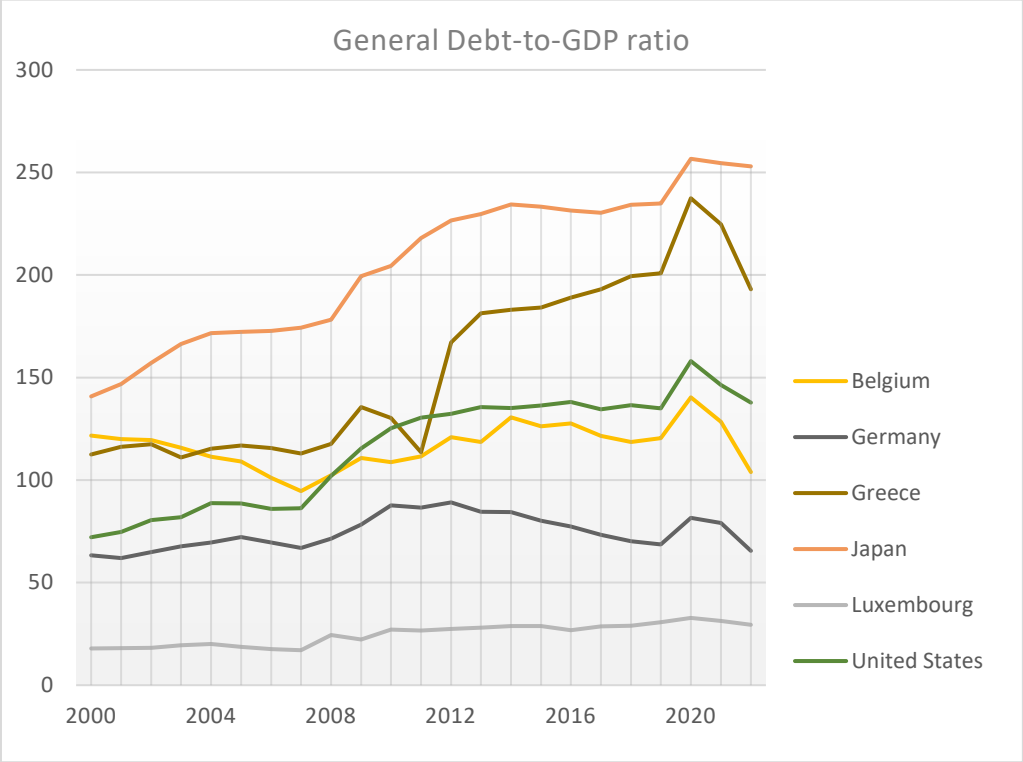

*Figure 2 General Debt-to-GDP ratio (*OECD Data Explorer*, n.d.)*

National accounts

Revenue and expenditure

The next data set relevant to this research are the expenses, revenues. Figure 3 shows the revenue and expenditures of the six countries as percentages of their GDP. Government revenue mainly comes from different forms of taxes, while there is a large variety of expenditures like, infrastructure, education, social services, public administration, defence, and many more.

Belgium has the highest ratio of both revenue and expenditure. In the past fifteen years expenditures have exceeded revenue, with revenue fluctuating around 51 percent of GDP and expenditures around 55 percent. Germany had large expenses after the financial crisis and the COVID-19 crisis but have expenditure and revenue close together outside of that. Greece's expenses were very high after the financial crisis until they defaulted on their debt in 2012, afterwards they had to comply with strict surplus rules, they were able to run a primary surplus until the COVID-19 crisis. Luxembourg, having the lowest debt ratio of the selected countries, had revenues exceeding expenditures most years, only in 2009 and 2020 expenditures exceeded revenue, following the financial crisis of 2008 and the COVID-19 crisis of 2020. Japan's expenditures have far exceeded its revenue in the last fifteen years, with revenue ranging from 30 to 35 percent, and expenditures ranging from 35 to 45 percent. Then there is the USA, who follows a similar course as Japan, its revenue remains under 35 percent while the expenditures were as high as 45 percent in 2021. If Japan and the United States want to lower their debt levels, they will need additional revenue or significantly lower their expenses, neither are easy do to without altering the welfare of the population. Politicians do not like to raise taxes or reduce public spending, especially in election years. Both expenditure and revenue have experienced an upward trend in the last 23 years.

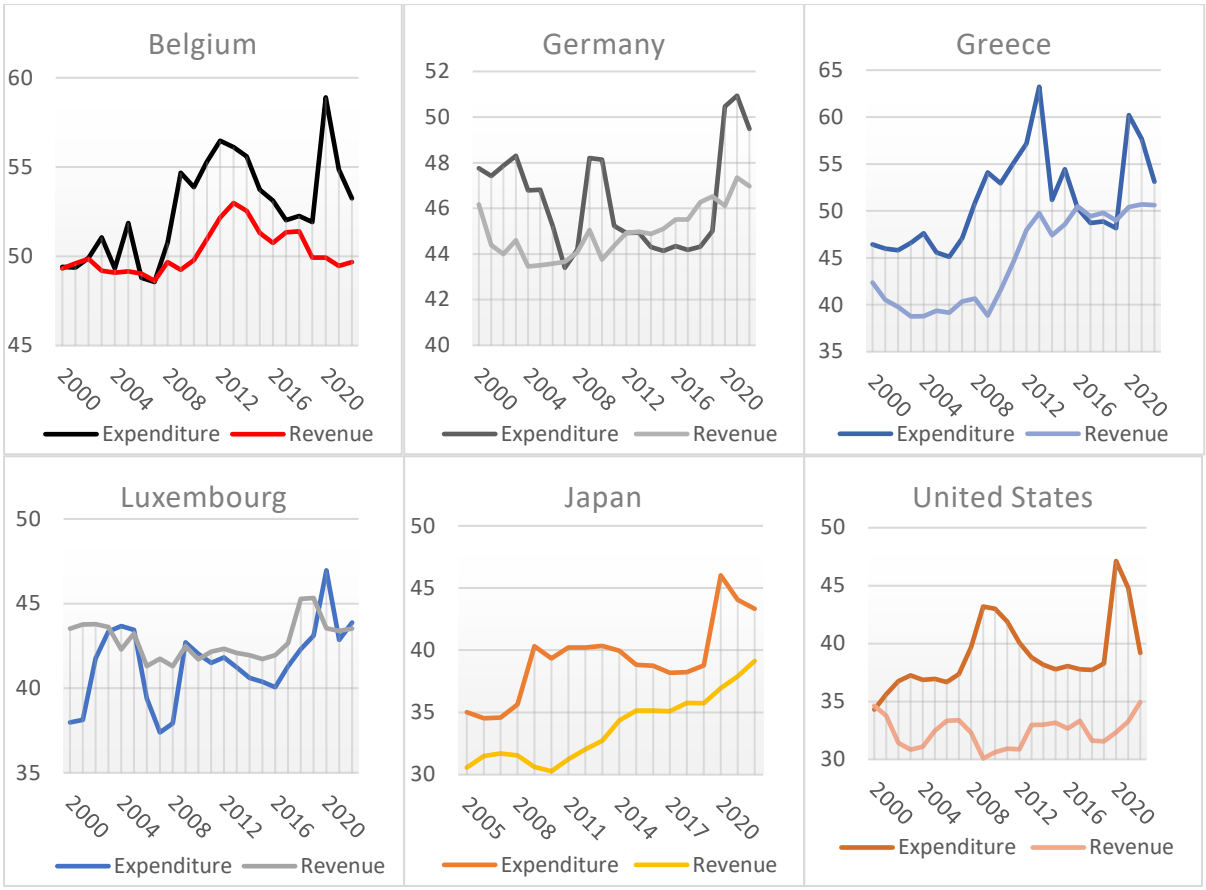

*Figure 3 Revenue and Expenditure as percentage of GDP (*OECD Data Explorer*, n.d.)*

Primary Balance and net interest payments

In figure 4, the primary balance (revenue minus expenditures excluding interest expenses in percentage of GDP) and net interest payments (interest expenses plus interest income as percentage of GDP) are shown. Belgium managed to have a positive primary balance before the COVID-19 crisis, which is a highly relevant political topic in Belgium, revived due to the upcoming elections. Net interest payments have gradually declined over the last 22 years from about 6 percent to approximately 2 percent. Germany had a positive primary balance for most years. Their interest expenses also saw a gradual decline from about 2 percent to below 1 percent. Greece had a rather large primary deficit leading up to defaulting on its sovereign debt, their interest expenses increased during this period as well. After their default they managed some primary surpluses, and their interest payments decreased. Japan ran a primary deficit consistently for the last 22 years, their interest payments on the other hand have remained very close to zero. Luxembourg ran a primary surplus in most years, on top of that their interest payments were negative most years, meaning that their interest income exceeds its interest expenses. Lastly, the United Sates ran a significant primary deficit almost the entire 22 years, their interest expenses remained very steady around 3 percent the whole period.

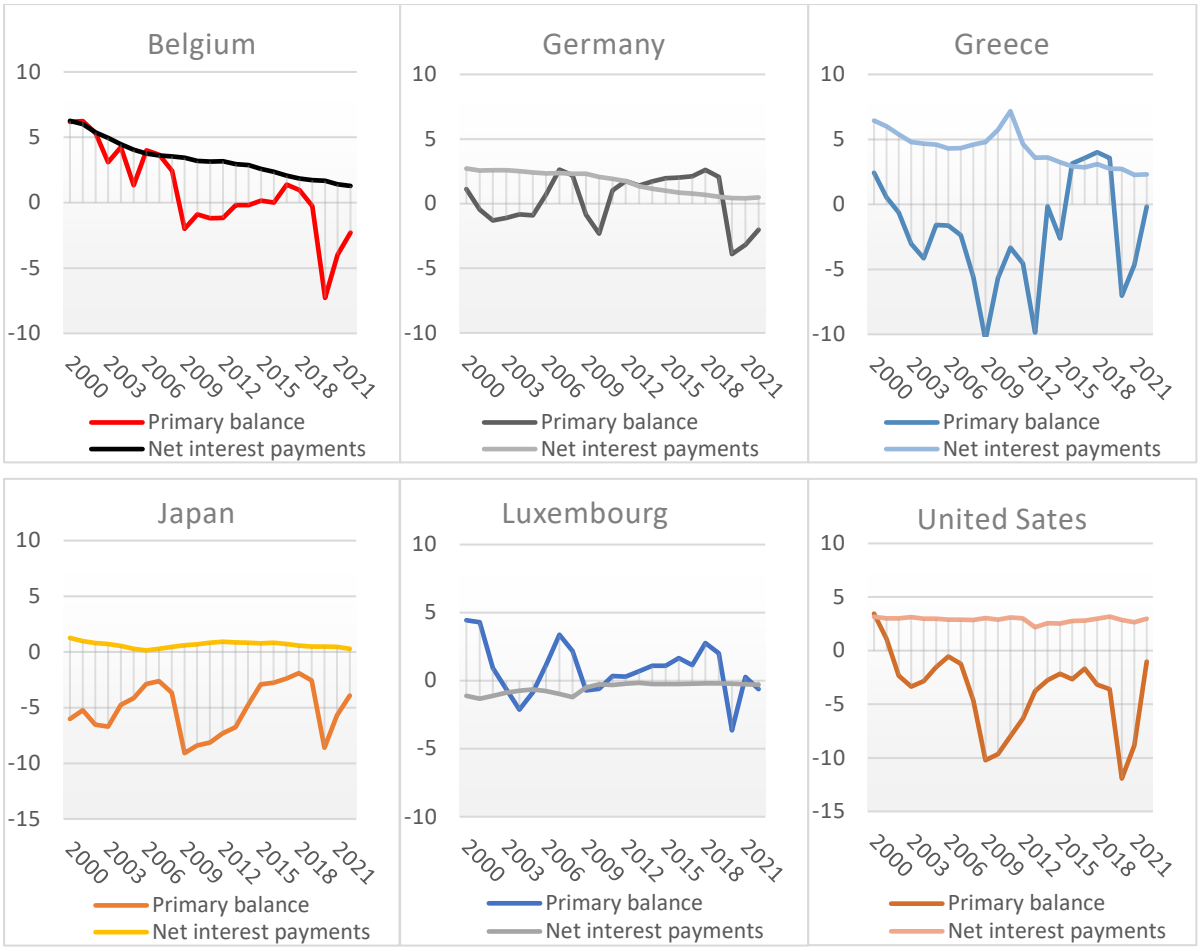

Figure 4 Primary balance, Net interest payments as percentage of GDP (OECD Data Explorer, *n.d.*)

Public investment

Public investment is an important part of the empirical part of this paper, it is essential for potential output, societal welfare, and for long-term economic prosperity. Government expenditures can be considered investments if they are directed towards durable assets like transport and energy infrastructure, healthcare and education facilities, IT systems, defence systems, and intangible assets such as research and development (OECD, 2023). This paper uses data on Gross Fixed Capital Formation as measurement for public investment. Figure 5 shows the evolution of public investment for the six selected countries.

Belgium had a gradual increase of public investment from a level of 2.4 percent in 2000 to a level of 2.7 percent in 2022. Germany followed almost an identical course. For Greece it is hard to daw conclusion from these numbers, since its GDP declined sharply after the financial crisis and continued to decrease until it defaulted on its deb tin 2012. Data on Japan only starts in 2005, they uphold a steady rate of public investment throughout the hole period, which is higher than most of the other countries. Luxembourg has the highest public investment rate of the selected countries; it has declined somewhat from the beginning of the period towards the end. Lastly, the United Sates shows a consistent public investment rate. The increase during the financial crisis and COVID-19 crisis can be explained by the reduction of economic activity in those years and not by an actual increase in investment.

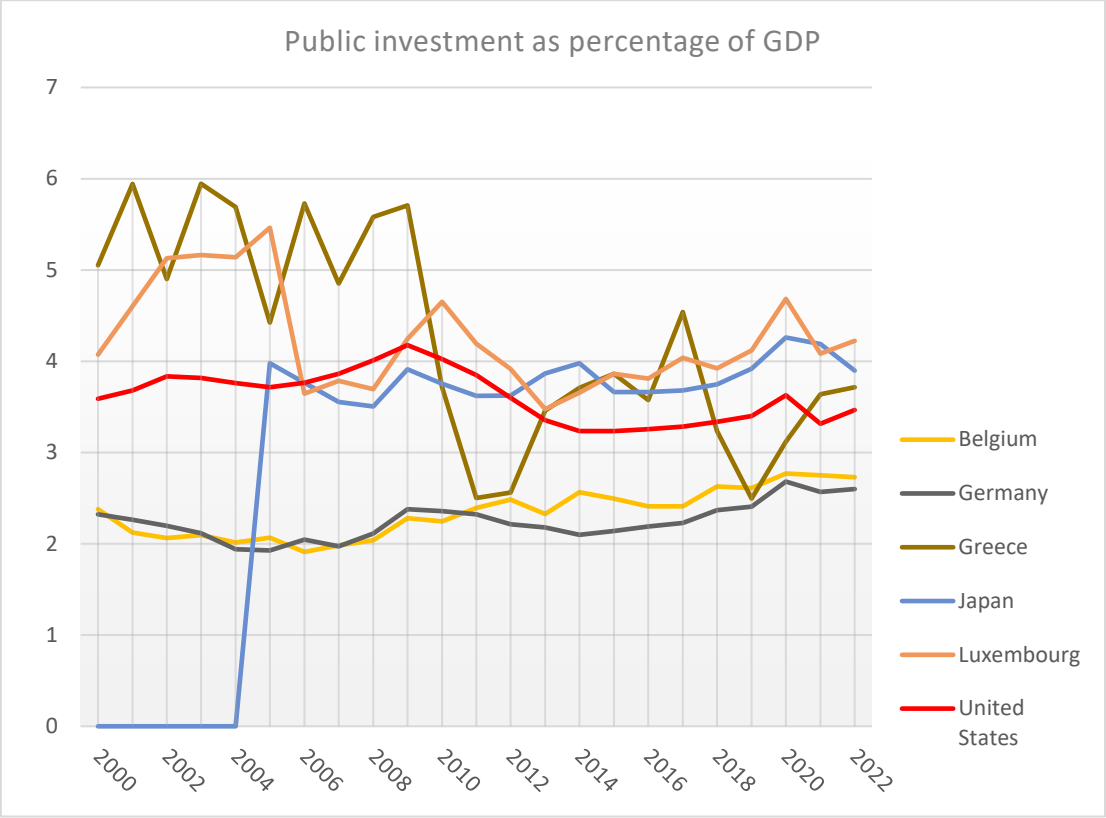

*Figure 5 Public investment as percentage of GDP (*OECD Data Explorer*, n.d.)*

Real GDP growth rate

The next relevant data for this thesis is the real GDP growth rate. This is the most researched topic in literature discussing the effects of public debt. While research on the matter is ambiguous, economic growth is a very important factor to take into account when implementing a fiscal policy. The growth rates for Belgium, Germany, Greece, Luxembourg, Japan, and the USA are shown in figure 6. These countries present an interesting variety of country specific attributes making them a good object for observation. Apart from the financial and COVID-19 crises, Belgium has had a steady growth fluctuating around 2 percent. Greece has struggled the most maintaining a steady economic growth rate. Both countries were severely affected by the financial and COVID-19 crisis. As the literature shows, countries in the EU are more sensitive to high debt levels, especially during economic shocks (Fall et al., 2015). Japan has had a rather low growth rate, this could be linked to its very high debt levels, but a causal relationship between debt and growth remains hard to prove (Panizza & Presbitero, 2013). Luxembourg has a slightly higher growth rate than the other six countries. The USA's growth rate was similar to that of Belgium.

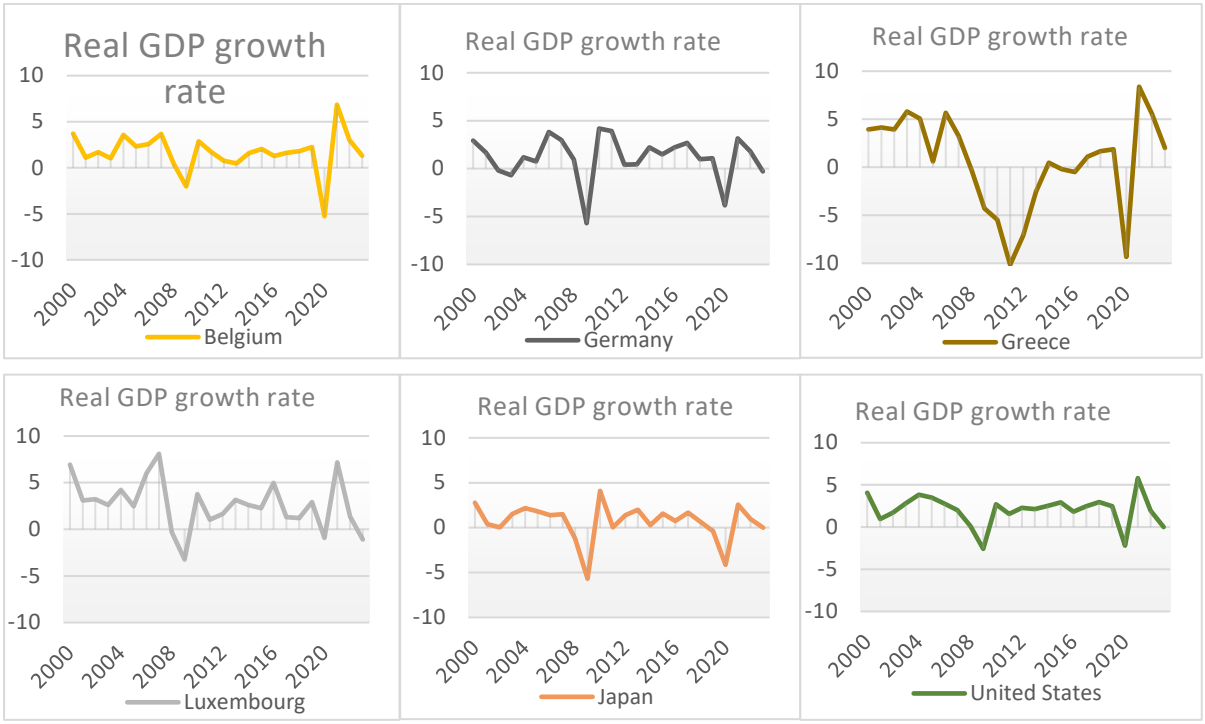

Figure 6 Real GDP Growth Rate (OECD Data Explorer, *n.d.)*

Long-term and short-term interest rates

Another interesting dataset is the long-term and short-term interest rates. Figures 7 and 8 show the evolution of the short-term and long-term interest rates respectively. The same six countries were selected for observation. Central banks use changes in interest rate to influence borrowing, spending, and investment in the economy. Lowering interest rates stimulates economic economy, while raising interest rates can help cool down inflationary pressures. One thing that stands out is that Japan has kept its interest rates very low, this is an example of a monetary policy measure that could be used to cope with its high debt levels. Both its long-term and short-term interest rate are near zero. Belgium, Germany, and Luxembourg have the same short-term interest rate set by the European Central Bank, so only one of the three is visible in the graph. This short-term interest rate was increased significantly after the COVID-19 crisis as a reaction to high inflation. The long-term rates on the other hand vary strongly. We can see that the long-term interest rate for Greece was extremely high after the default on its sovereign debt in 2012, it has since normalized. The USA's interest rates have followed a similar trajectory as that of the European countries. Interest rates are one of the main tools for governments to influence the economy, in times of crisis it is very important to be able to correctly use interest rates to stabilize the economy.

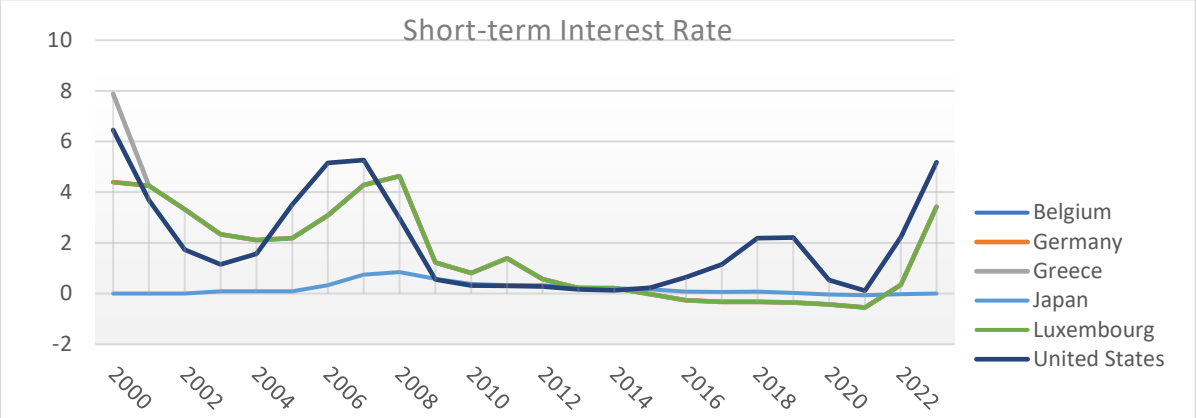

Figure 7 Short-term Interest Rates (OECD Data Explorer, n.d.)

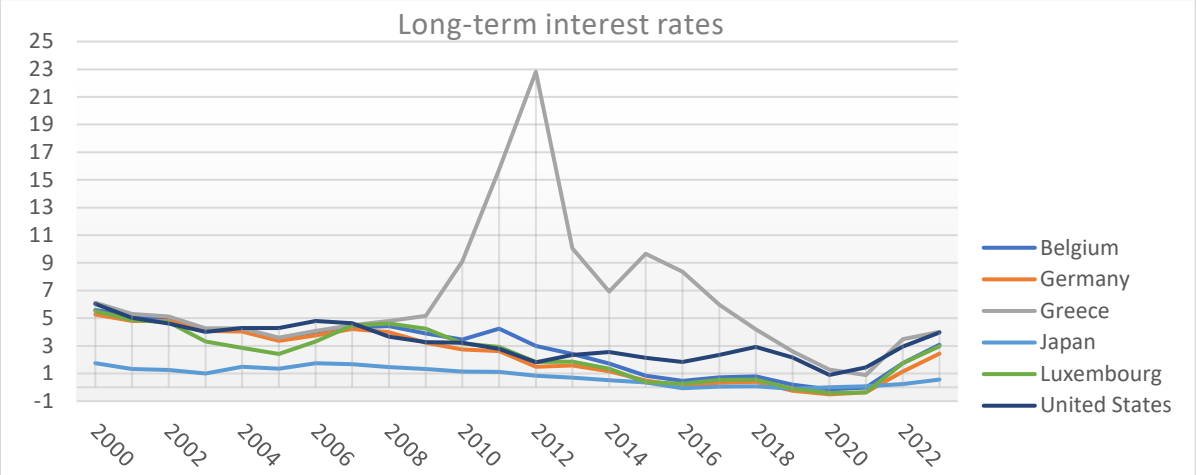

Figure 8 Long-term Interest Rates (OECD Data Explorer, n.d.)

Consumer Price Index

The last dataset relevant to this paper is the inflation rate, in the form of the Consumer Price Index (CPI). The same six countries are observed, showed in figure 9. The inflation rate has increased drastically in the aftermath of the pandemic. Countries attempted to stimulate the economy, furthering inflationary pressure. The inflation for 5 of the countries follows a very similar trend. Showing that these countries are deeply integrated into the global economy, that financials markets are highly interconnected, and that these countries often face similar economic shocks. Japan is the only country with significantly different inflation levels, data for 2021 and 2022 were not available on the OECD website, the numbers for 2021 and 2022 are from the databank of the World (*World Development Indicators | Databanks*, n.d.). Japan's inflation rates were a lot lower than most other countries' most years, except for a spike in 2014. For Belgium, Germany, Greece, Luxembourg, and the USA the rise in inflation rates after the recent pandemic were much more severe than the one following the financial crisis of 2008.

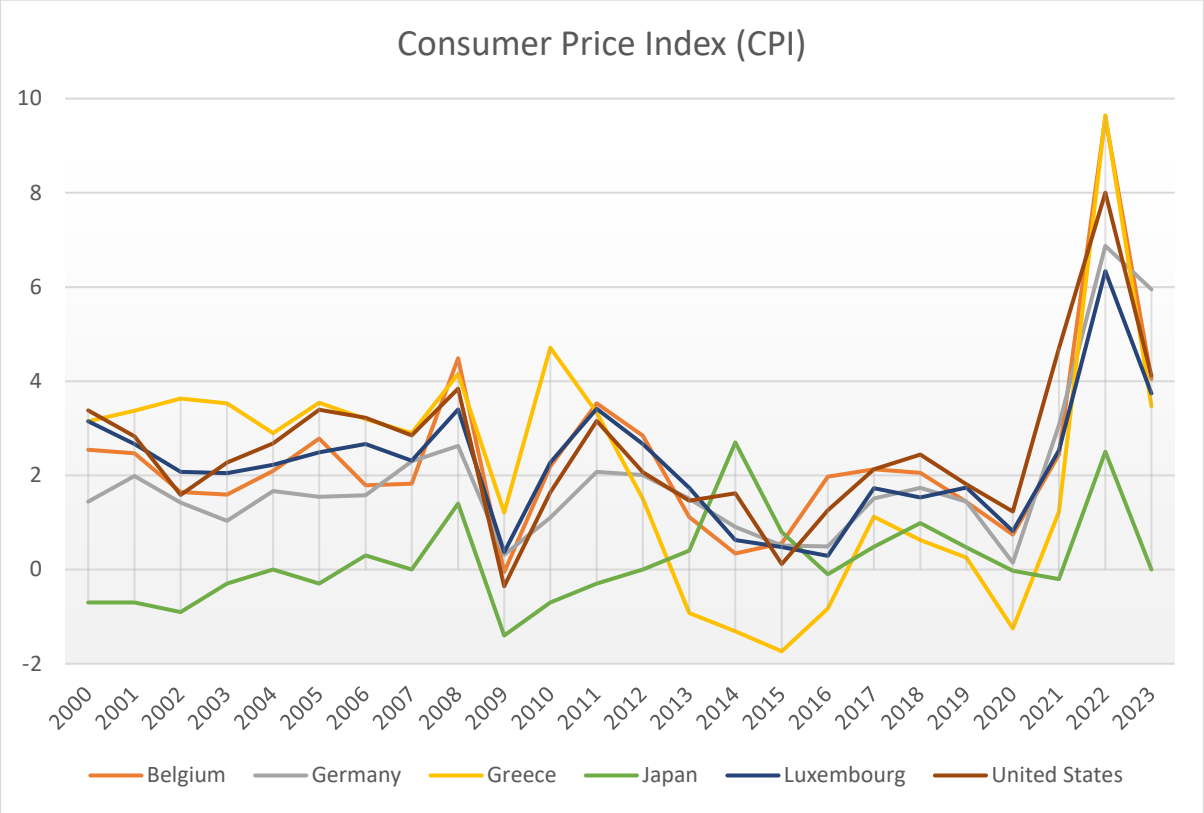

Figure 9 Consumer Price Index (OECD Data Explorer, *n.d.)*

3 Methodology

The literature study covered a broad range of consequences of public debt. To contribute to the existing literature, this paper will examine a subject that has not received the attention it deserves in the public debt debate: public investment as well as add new analyses on some of the topics that have been studied more extensively: economic growth, private investment and inflation (CPI). Public investment can enhance productivity, promote economic growth, improve societal wellbeing, and support long-term policies, making it a very interesting topic for additional research. The relationship between public debt and public investment is critical for policymakers who need to balance fiscal responsibility with the needs for growth-enhancing investments. One of the main concerns of keeping interest rates low is that inflation would increase, thereby affecting the population's purchase power which leads to higher uncertainty and lower investment, therefore inflation (CPI) was included in the analysis.

The setup of the research is based on the groundbreaking paper of Reinhart and Rogoff (Reinhart & Rogoff, 2010) who used descriptive statistics to illustrate that the average growth rate for countries with debt-to-GDP ratios above 90 percent drops down drastically. Politicians widely used this paper to justify fiscal austerity policies in debt-burdened economies. In this paper this setup will be used to test whether public investment, private investment, economic growth, and inflation exhibit significant differences between debt levels. Furthermore, according to the literature, whenever growth levels are above the long-term interest rates, debt is "self-sustaining" (Delong & Summers, 2012), meaning that high debt levels are sustainable as long as economic growth is above the long-term interest rate (Blanchard, 2019; Bohn, 1995). This paper will empirically test this theory in the context of public investment, private growth, economic growth, and inflation. This research will examine how growth, investment, and inflation react to periods where economic growth is below long-term interest rates. This will be tested for the whole data set as well as when debt levels are above 100 percent to examine whether these results are different.

Data

Data for the study was sourced from the OECD (Organisation for Economic Co-operation and Development) database. The analysis encompasses a diverse set of OECD member countries, including Australia, Austria, Belgium, Canada, Czechia, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Japan, Luxembourg, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States. These countries were deliberately chosen to ensure a heterogeneous research sample while maintaining a similarity in their level of economic development. Some nations were excluded due to the presence of extreme outliers or unavailable data, resulting in a final analysis of 23 countries. Most of the countries are European, however some interesting economies from outside Europe were included to observe the difference outside Europe. The observation period spans from 2000 to 2022, this was chosen to provide recent and relevant insights into the current global economic landscape. The study contains data on 23 countries over 23 years, resulting in 529 observations.

Variables

The study investigated the following variables:

Debt-to-GDP ratio: Refers to the gross general government debt in percentage of GDP. Figure 10 shows how the average level of debt of the entire sample has evolved in the 23 years of observation. The average debt level was below 70 percent in 2000, while it is near 100 percent in 2022.

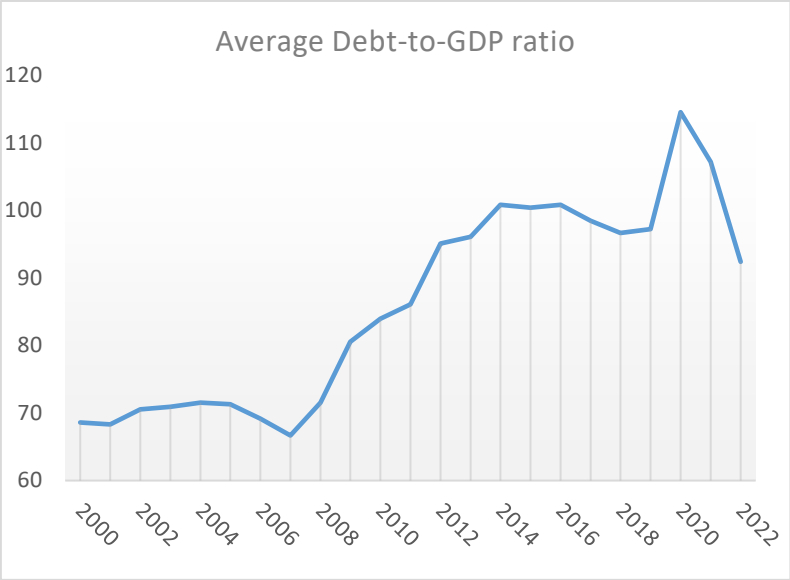

Figure 10 Average debt level of entire sample

Real GDP growth rate

A key indicator of economic performance, measuring the annual percentage change in a country's inflation-adjusted gross domestic product. There will be 3 measures of growth used in the analyses: growth in the same year, 1-year growth (growth in the year after the base year), and the 5-year average year which is the average growth year of the 5 years after the base year (referred to as long-term growth).

Public investment: Government Gross Fixed Capital Formation (GFCF) (%GDP)

Gross fixed capital formation (GFCF), also called "investment", is defined as the acquisition of produced assets (including purchases of second-hand assets), including the production of such assets by producers for their own use, minus disposals. (*GDP and Spending - Investment (GFCF) - OECD Data*, n.d.). Government GFCF represents the investment by the government in long-term physical assets that contribute to economic growth and public welfare.

Long-term interest rate

Long-term interest rates refer to government bonds maturing in ten years. Rates are mainly determined by the price charged by the lender, the risk from the borrower and the fall in the capital

value. Long-term interest rates are generally averages of daily rates, measured as a percentage. Long-term interest rates refer to government bonds maturing in ten years (*Interest Rates - Long-Term Interest Rates - OECD Data*, n.d.).

r-g: long-term interest rate minus real economic growth: According to the theoretical literature, high debt does not have as severe negative implications when interest rates are below growth rates (Bohn, 1995; Delong & Summers, 2012).

Private investment: private Gross Fixed Capital Formation (GFCF) (%GDP)

Private GFCF represents the investment by private sector businesses and households in long-term physical assets that enhance the productive capacity of the economy and contribute to economic growth and development.

Inflation (consumer price index)

The consumer Price Index (CPI) is a vital gauge of inflationary pressure within an economy, offering insights into the purchasing power of consumers and the broader implications for monetary policy. As a composite measure of price changes across a basket of goods and services typically consumed by households. The CPI provides a nuanced understanding of inflation dynamics, influencing both economic actors and policymakers. By tracking fluctuations in the CPI, economists can discern underlying trends in price levels, identifying potential imbalances and informing decisions related to interest rates, wages, and fiscal policy. The CPI serves as a barometer of economic stability, guiding stakeholders in navigating the delicate balance between price stability and sustainable growth (*What Drives Inflation in the Major OECD Economies?*, n.d.).

All these variables affect economic performance and public welfare. The link between debt-to-GDP and all the other variables will be investigated. Information on the evolution of these variables in the period 2000 to 2022 was provided in the previous section "macroeconomic evolutions". Many of variables are expressed in percentage of GDP. While this offers a number of benefits, like comparability and accounting for inflation, the disadvantage is that in years of crisis, when economic output (GDP levels) drop, data can be misleading. For example, when economic activity plummeted during the pandemic, the effect of the increase in outstanding debt was magnified when expressed in percentage of GDP.

Descriptive statistics

The descriptive statistics in table 3 give insight into the range of the dataset. Many of the variables exhibit pretty large outliers, this is often in response to a global crisis. This variability underscores the importance of conducting a robust analysis that accounts for diverse economic contexts and potential outliers.

Descriptive Statistics					
	N	**Minimum**	**Maximum**	**Mean**	**St.dev**
Public GFCF	529	1,54	7,69	3,62	0,95
private GFCF	528	0,00	26,93	18,43	3,34
Debt_GG	529	17,05	256,65	86,04	45,75
LT- interest rates	527	-0,52	22,81	3,18	2,34
growth +1	506	-11,17	8,67	1,69	2,79
growth	529	-11,17	8,67	1,79	2,78
LT-growth	414	-5,91	5,47	1,57	1,46
g-r	527	-29,90	7,89	-1,39	3,72
CPI	527	-1,74	15,10	2,14	2,05

Table 3 descriptive statistics variables

Correlation between variables

The correlation matrix in table 4 shows the correlation of the economic variables with each other as well as with the debt-to-GDP ratio. There are many significant correlations within the dataset. Debt has a negative correlation with real growth rate, 1-year growth, LT-growth, public GFCF, long-term interest, private GFCF, and the CPI, all these correlations are significant at the one percent level. This indicates that increase in debt levels is associated with a decline in all these variables. This negative correlation seems counterintuitive and contradictory to the literature for long-term interest rate, some explanation to this could be that countries can strategically alter interest as a monetary policy measure. Another explanation could be that most of the countries are EU members, where the interest rates are very similar for all countries

Public investment is positively correlated with private investment, showing that when public investment increases private investment also slightly increases. Private investment is negatively correlated with interest rates, which conforms with the theoretical reasoning on this subject, stating

that high interest rates lead to lower private investment. The most important correlations for this study are the ones between public debt and public investment (GFCF) and between public debt and economic growth.

Correlations

	Public investment	private GFCF	Debt_GG	Long-term interest rates	growth +1	growth	LT-growth	g-r	CPI
Public investment	1	.093*	-.177**	0,012	.105*	0,076	0,042	0,049	.101*
private GFCF	.093*	1	-.240**	-.186**	0,027	.152**	0,047	.228**	0,072
Debt_GG	-.177**	-.240**	1	-.134**	-.117**	-.238**	-.323**	-.092*	-.202**
Long-term interest rates	0,012	-.186**	-.134**	1	-.124**	-0,047	0,005	-.664**	.299**
growth +1	.105*	0,027	-.117**	-.124**	1	.112*	.573**	.161**	-.117**
growth	0,076	.152**	-.238**	-0,047	.112*	1	.267**	.778**	.266**
LT-growth	0,042	0,047	-.323**	0,005	.573**	.267**	1	.172**	0,046
g-r	0,049	.228**	-.092*	-.664**	.161**	.778**	.172**	1	0,009
CPI	.101*	0,072	-.202**	.299**	-.117**	.266**	0,046	0,009	1

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4 correlation matrix research variables

4 Results

4.1 Public debt and Economic growth

Short-term growth

Economic growth is one of the most important indicators of the economy's well-being. Many papers find that public debt levels have a negative effect on economic growth. To investigate this link the setup of R&R was reproduced with different categories for the debt-to-GDP ratios, the results are shown in figure 11, the number of observations for each category are 55, 128, 109, 60, 74, 103 respectively. The short-term growth analysis reveals a clear inverse relationship between debt levels and economic growth. Countries with debt levels below 40% of GDP exhibit the highest average short-term growth at 3.20%. As debt levels increase, short-term growth rates decline. Those with 40-60% debt experience an average growth of 2.22%, while countries with 60-80% debt have an average growth of 2.00%. Further increases in debt levels lead to even lower growth rates, with countries in the 80-100% debt range showing an average growth of 1.61%, and those with 100-120% debt exhibiting a slightly higher growth of 1.74%. The most significant decline is observed in countries with debt levels exceeding 120%, where the average short-term growth drops dramatically to just 0.22%. R&R find that economic growth drops at debt levels of 90 percent (Reinhart & Rogoff, 2010), the analysis performed in this study finds this "threshold" is at debt levels of 120 percent. R&R's data goes back further, uses a different selection of countries, and uses central debt instead of general debt, these reasons could be the explanation for these differences.

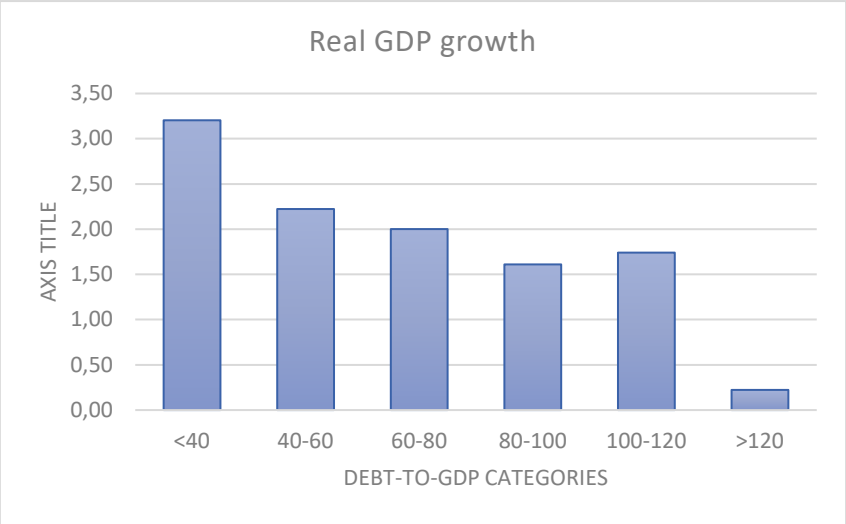

*Figure 11 growth categorized by debt-to-GDP ratio (*OECD Data Explorer*, n.d.)*

There are many studies that find that high debt has a negative effect on growth at higher debt levels in accordance with R&R, others find a more linear link between the two. However, there is also a branch of literature that argues that the negative effect of debt on growth cannot be proven to be causal, causality could be reverse, the effect is small if it does exist, it could be caused by omitted

factors (Panizza & Presbitero, 2013). These are all valid arguments, the effect of public debt on economic growth has yet to be proven, however, it is an issue that needs to be addressed by policymakers. The findings in this paper would indicate that there is a level of public debt where economic growth is significantly lower. However, these results do not prove that debt itself is the cause of this negative effect. It is entirely possible that the negative effect is caused by the fiscal austerity measures that are implemented whenever public debt becomes too high. Another cause could be an exaggerated reaction by the countries that the highly indebted country relies on for funding, even if a country is perfectly capable of meeting all its debt obligations, but the lenders do not believe so, they could lose access to funding which could have detrimental effects. Another cause of declining economic growth could be the reduction in public investment. If a highly indebted country reduces investment spending for long periods of time, it might not be able to keep up with modern technology and/or have sufficient developed infrastructure to remain competitive in a fast-developing global economy.

1-year growth

To test the robustness of these findings the same analysis was repeated for 1year future growth. The results are shown in figure 12. When using 1-year future growth the effect of higher debt levels is more gradual than when using growth in the same year. Countries with debt levels below 40% of GDP exhibit the highest average short-term growth at 2.72%. As debt levels increase, 1-year growth rates decline: those with 40-60% debt experience an average growth of 2.07%, while countries with 60-80% debt have an average growth of 1.62%. Further increases in debt levels lead to slightly lower growth rates, with countries in the 80-100% debt range showing an average growth of 1.52%, and those with 100-120% debt exhibiting a slightly higher growth of 1.38%. The most significant decline is observed in countries with debt levels exceeding 120%, where the average short-term growth drops to 0.68%. These findings indicate a more gradual decline of growth while debt levels increase.

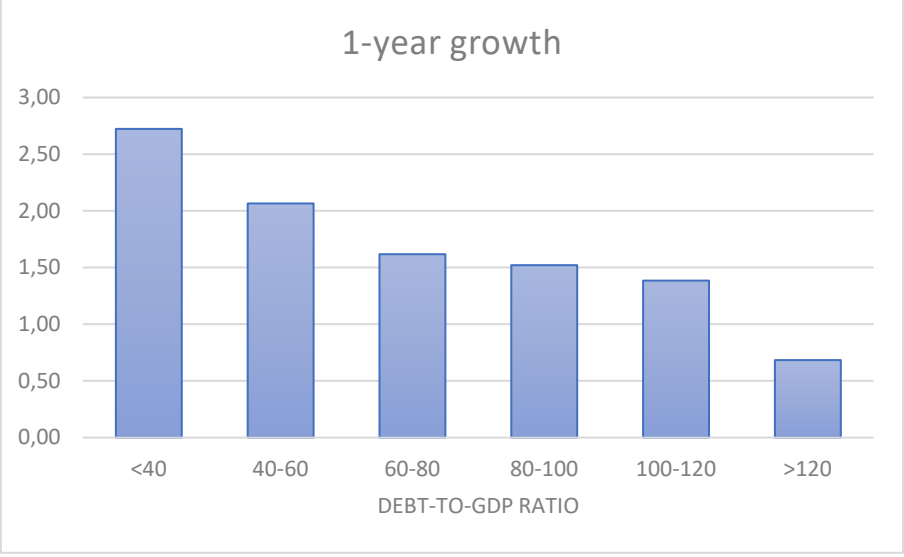

Figure 12 1-year growth categorized by debt-to-GDP ratio (OECD Data Explorer, *n.d.)*

Long-term growth

It is important to distinguish between long-term and short-term growth, this section will analyse whether effects are comparable for long term growth. The paper of R&R did not include long-term growth. For every year the average growth over the next five years was calculated and divided into categories according to debt-to-GDP ratio, the results are shown in figure 13. The analysis reveals a clear negative relationship between debt levels and long-term economic growth. Specifically, countries with debt levels below 40% of GDP experience the highest average long-term growth at approximately 2.58%. As debt levels increase, growth rates decline. Countries with debt levels between 40-60% see an average long-term growth of about 1.87%, those with 60-80% debt experience around 1.68% growth, and those with 80-100% debt have a growth rate of approximately 1.20%. The decline continues with countries having 100-120% debt averaging 1.05% growth, while those with debt exceeding 120% show the lowest average long-term growth at just 0.75%. These findings highlight the cumulative adverse effects of high debt over time. These results are a lot more gradual than those of short-term growth. Long-term growth can be affected by many different factors and therefore provide ambiguous results.

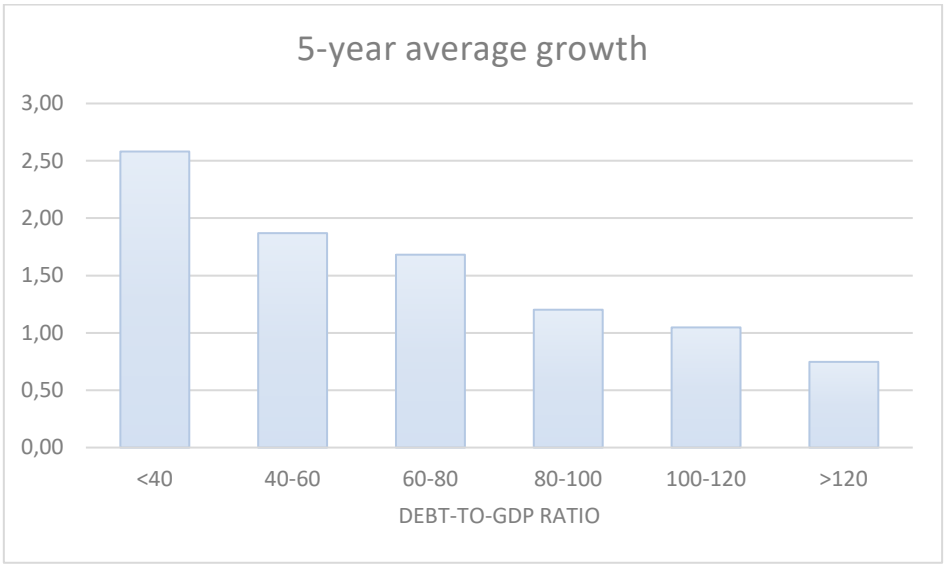

*Figure 13 5-year average growth categorized by debt-to-GDP ratio (*OECD Data Explorer*, n.d.)*

4.2 Public debt and investment

Public investment

Public investment can enhance productivity and promote economic growth, improve societal wellbeing, and support long-term policies. Government expenditures can be considered investments if they are directed towards durable assets like transport and energy infrastructure, healthcare and education facilities, IT systems, defence systems, and intangible assets such as research and development (OECD, 2023).

The setup from Reinhart and Reinhoff 2010 (R&R) (Reinhart & Rogoff, 2010) was applied to public investment. The data for public investment was divided into categories of debt-to-GDP ratio, the results are shown in figure 14, the number of observations for each category are 55, 128, 109, 60, 74, 103 respectively. Countries with debt levels below 40% of GDP exhibit the highest average public investment at 4.04%. As debt levels increase, public investment levels decrease: those with 40-60% debt experience an average public investment of 3.68%, while countries with 60-80% debt have an average public investment of 3.71%. Further increases in debt levels show stable public investment levels for countries in the 80-100% debt range at 3.71%. Those with 100-120% debt exhibit an average public investment rate of 3.46%. Countries with debt levels exceeding 120%, have an average public investment of 3.26%. There is no sign of a threshold beyond which public investment drops drastically. However, we do see a gradual decline in public investment when debt levels increase. While the difference in percentage might not look that big, it does account for a significant difference in total spending on investment.

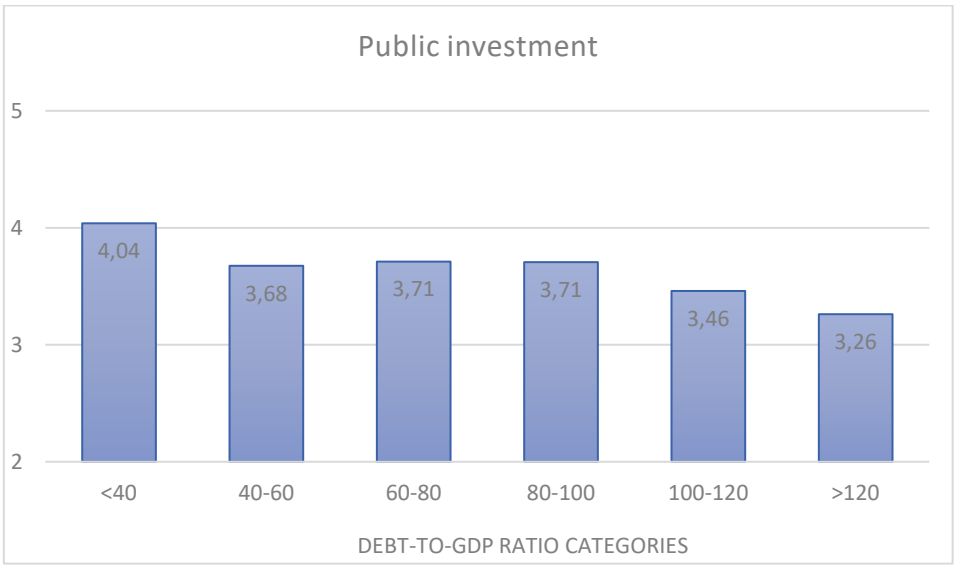

*Figure 14 public investment (as percentage of GDP) categorized by debt-to-GDP ratio (*OECD Data Explorer, *n.d.)*

To put this figure into perspective, a 0.2 percent decline in public investment in Belgium expressed in euro would mean a decline of approximately 1 billion euro (GDP 2022 = 552.4 billion x 0.002). Such a cut in public investment can have far-reaching and profound consequences for the country's economy and society. This amount could have been allocated to building state-of-the-art hospitals,

ensuring better healthcare. It could have funded the construction of new schools and the renovation of existing ones, shaping the future workforce of the nation.

Moreover, 1 billion euros could be invested in upgrading critical infrastructure, such as roads, bridges, and public transportation systems, which are vital for economic growth and connectivity. This level of investment can significantly reduce traffic congestion, lower transportation costs, and increase overall productivity. The ripple effects of such investments are enormous, creating jobs, stimulating local economies, and improving the quality of life for citizens.

This could also have considerable impact on innovation and technology, such as renewable energy, biotechnology, and digital technologies. Investments are crucial for maintaining competitive advantage in the global market and driving sustainable economic growth. Investment cuts could stall or reverse progress in these critical areas.

In summary, while the percentage decline in public investment due to rising debt may seem minor, the actual monetary impact on public investment is not just a statistic; it represents lost opportunities, delayed progress, and a potential setback in various sectors that are pivotal to the nation's well-being and future prosperity. The true cost of such a reduction extends far beyond immediate fiscal concerns, resonating through the economy.

In the European union, members are required to lower their debt levels when they are above 60 percent. Investment is not a necessary expense, so countries with high debt levels could decrease public investment to run the required primary surplus. This choice will likely have negative consequences in the long run. Effects from investments can be noticeable almost immediate or take effect gradually over a very long term, this makes it very difficult to quantify its impact. Fournier estimated that the effect of public investment is large: increasing the share of public investment in primary spending by one percentage point could increase the long-term GDP level by about 5% (Fournier, 2016). When this reduction in investment persists over a long period of time, countries will suffer economic setback and welfare loss. With that being said, two critical considerations must be made: first, it is very important for public investment to be efficient, not merely high. Second, public invest needs to complement and enhance private investment.

Private investment

Private GFCF represents the investment by private sector businesses and households in long-term physical assets that enhance the productive capacity of the economy and contribute to economic growth and development.

Applying the setup from Reinhart and Rogoff (2010) to private investment, the data was categorized based on debt-to-GDP ratios in the same way as for public investment, the results are presented in figure 15. Countries with debt levels below 40% of GDP exhibit the highest average private investment at 19.74%. As debt levels increase, private investment levels decrease: those with 40-60% debt experience an average private investment of 18.87%, countries with 60-80% debt have an average private investment of 18.35%. Further increases in debt levels lead to lower private investment levels, with countries in the 80-100% debt range showing an average private investment of 18.24%, and those with 100-120% debt exhibiting a slightly lower average private investment of

18.16%. The most significant decline is observed in countries with debt levels exceeding 120%, where the average private investment is 16.89%.There is no sign of a threshold beyond which public investment drops drastically. However, we do see a gradual decline in public investment when debt levels increase. While the difference in percentage might not look that big, it does account for a significant difference in total spending on investment.

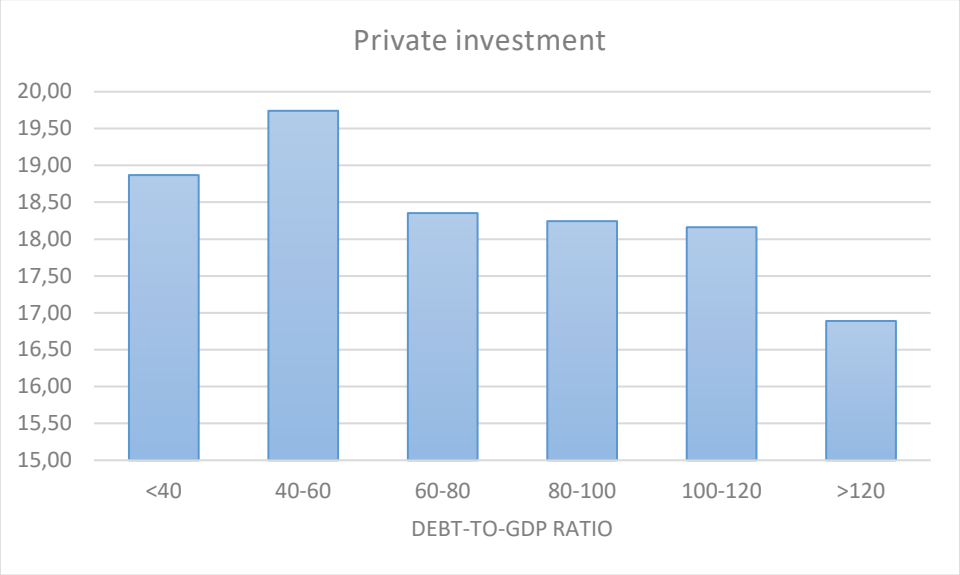

*Figure 15 private investment (as percentage of GDP) categorized by debt-to-GDP ratio (*OECD Data Explorer, *n.d.)*

The data shows that private investment levels tend to decrease as the debt-to-GDP ratio increases. This pattern suggests that higher public debt levels may discourage private investment, potentially due to concerns about economic stability and the sustainability of fiscal policies. Lower private investment in high-debt environments could be attributed to several factors, including increased borrowing costs, reduced investor confidence, and potential crowding out effects where government borrowing limits the availability of capital for private sector investments.

These findings underscore the importance of maintaining balanced debt levels to foster a conducive environment for private investment. Policymakers should focus on strategies that manage public debt effectively while promoting private sector growth.

4.3 The effect of public investment on economic growth

Effects of public investment on economic growth are likely more noticeable in the long run, these effects are hard to analyse because they take effect gradually and investment needs to be persistent for effects to hold. To estimate the influence of investment on growth (both long-term and short-term) economic growth was compared for low to high levels of investment, results are shown in figure 16. The analysis demonstrates a positive relationship, indicating that higher levels of public investment are associated with greater economic growth over the long term. Specifically, countries investing 2-3% experienced an average long-term growth rate of 1.55%. For countries with investment rates of 3-4%, the average growth rate is 1.48%, the countries that invest more than 4% of GDP saw the highest average long-term growth rate at 1.70%. For the 1-year growth these effects are slightly bigger. Public investment spending of 2-3 percent results in an average 1-year growth of 1.39 percent, average 1-year growth for 3-4 percent investment equals 1.68 percent, and for public investment above 4 percent the average 1-year growth equals 1.99. These differences might not seem very large, but small percentage changes may have large outcomes, especially if they persist over long periods of time. As mentioned earlier Fournier's thorough analysis of the effect of public investment estimated that the effect of public investment can be very large (Fournier, 2016). This type of analysis is not well-suited for capturing long term effects of investment. But we can see that countries with higher public investment have higher growth rates on average.

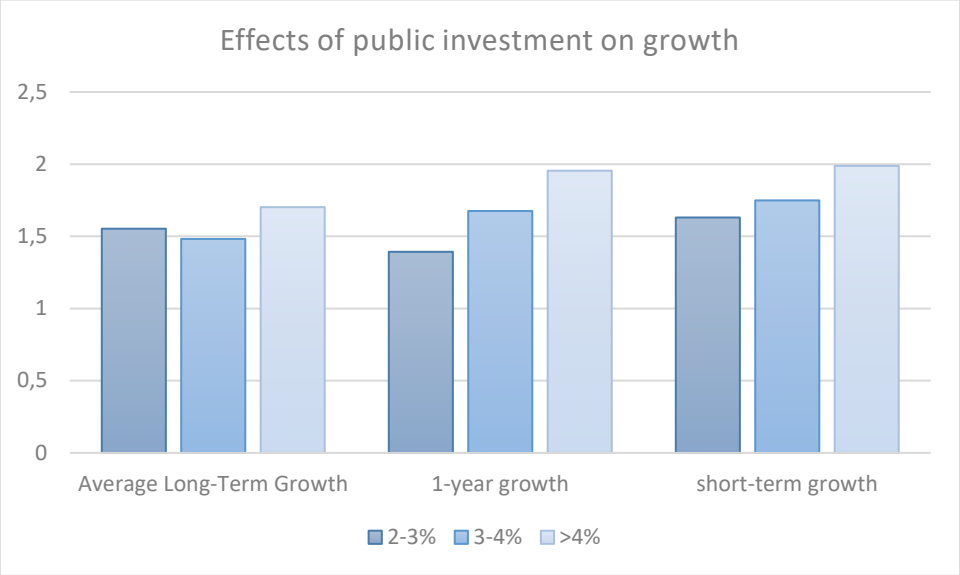

*Figure 16 the effects of public investment on economic growth (*OECD Data Explorer*, n.d.)*

4.4 Public debt and inflation (CPI)

The Consumer Price Index (CPI) serves as a critical indicator of inflation by measuring the average change over time in the prices paid by urban consumers for a market basket of consumer goods and services. Analysing the CPI helps understand the purchasing power of consumers and the economic stability of a nation. Whenever interest rates are low inflation is expected to occur, however countries can keep inflation low through monetary policy, as shown by Japan. The Consumer Price Index (CPI) analysis reveals varying inflation rates across different debt-to-GDP ratio categories, results are shown in figure 17. Countries with a debt level of less than 40% of GDP have the highest average CPI at 2.60. As debt levels increase, CPI values show a mixed trend. For countries with debt levels between 40-60%, the average CPI is 2.21. This is followed by a slight increase to 2.43 for the 60-80% debt category and a nearly stable CPI of 2.44 for the 80-100% debt category. Countries with debt levels between 100-120% exhibit a CPI of 2.61, the highest among the observed categories. However, the CPI drops significantly to 1.06 for countries with debt levels exceeding 120%, suggesting that extreme high debt levels may be associated with lower inflationary pressures.

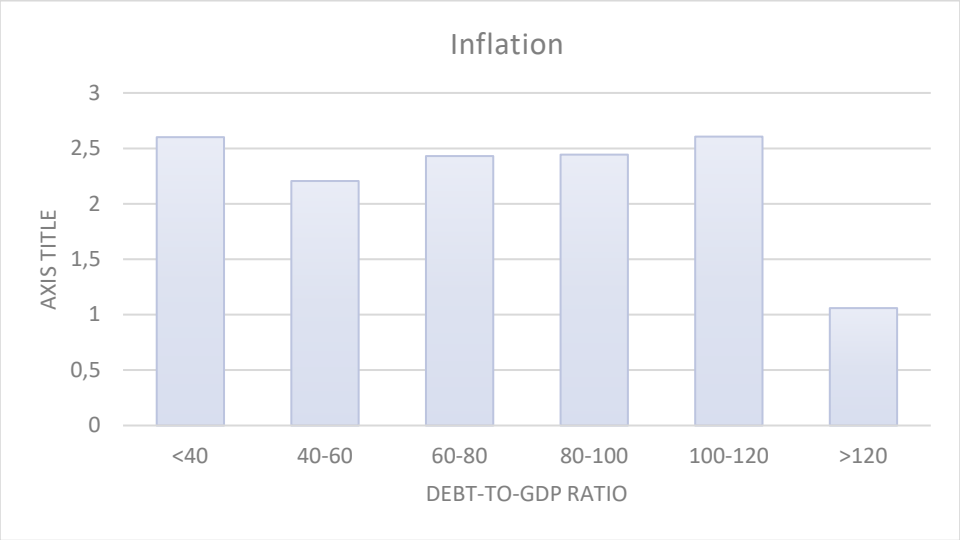

*Figure 17 CPI categorized by debt-to-GDP ratio (*OECD Data Explorer*, n.d.)*

This data indicates a complex relationship between debt levels and inflation, with the highest CPI values found at both lower and moderate debt levels, while extremely high debt levels show reduced CPI, showing that the practical implementation of countermeasures by highly indebted countries can mitigate inflation effectively. Some explanations why this trend might occur could be: central bank policies, economic contraction, or austerity measures. From observing the data in the previous section "2.3 macro-economic evolutions" we saw that Japan has extremely high debt, with low interest rate and low inflation compared to the rest of the observed countries. Therefore, the analysis was repeated with the exclusion of Japan, which did not result in significant differences in these findings. More research is needed to understand the dynamics and specific conditions under which high debt does not translate into high inflation. This includes studying the role of austerity measures, debt composition, international support mechanisms, and the specific monetary policies employed by these countries.

4.5 Public debt and interest rates

One of the main concerns of high debt levels is increasing interest rates. These higher interest rates increase the cost of outstanding debt and reduce economic output (Dept, 2012). This part will explore whether these concerns show up in an empirical context. The results in figure 18 show that countries with the highest debt levels have the lowest average interest rates. Studies like (European Central Bank., 2020) have similarly found that countries with high debt levels spend more time at the zero lower bound (interest rates near zero). The category of countries with debt levels above 120 percent contains several extreme values, Japan falls under this category and keeps it interest rates near zero. Contrary, Greece experienced interest rates as high as 20 percent and also falls in this category. From these results we can conclude that countries do not necessarily experience increases in interest rates when debt levels are high. Countries with high debt levels need to keep their interest rates low to keep their interest expenses under control. European countries are more susceptible to adverse effects of high debt levels because they are not in control of their monetary policy. While keeping interest rates low is not without risk, it does lift the burden of high debt levels (Blanchard, 2019).

*Figure 18 Long-term interest rate categorized by debt-to-GDP ratio (*OECD Data Explorer*, n.d.)*

4.6 What happens when interest exceeds growth?

This part studies whether economic growth, public investment, private investment, and the consumer price index are different in periods where interest rate is below the growth rate. According to the theoretical literature high debt does not have the same extend of negative implications whenever interest rates are below growth rates (Blanchard, 2019; Bohn, 1995; Delong & Summers, 2012). To start, we look at the evolution of growth and interest rate for the period 2000 to 2022, results are shown in figure 19. Interest rates have decreased substantially over the last 23 years, where the average long-term interest rate was nearly 6 percent in 2000, it went below 1 percent in 2020, after it increased slightly to 2 percent. Economic growth dropped twice in the last 23 years, first in reaction to the financial crisis of 2008, then in reaction to the COVID-19 crisis of 2020.

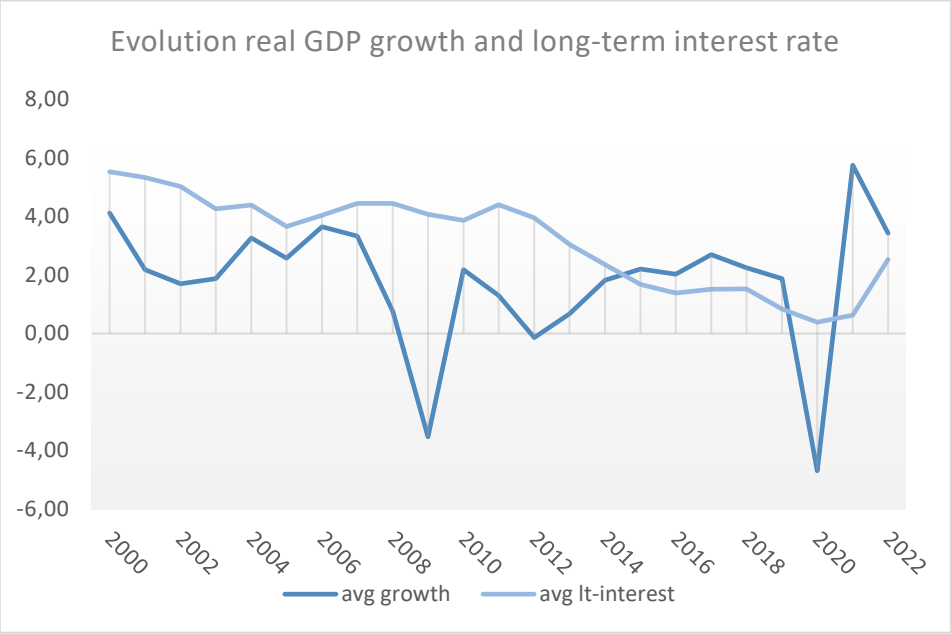

Figure 19 average long-term interest rate and economic growth of all observations

*(*OECD Data Explorer*, n.d.)*

Short-term growth

For the first analysis the whole data set was split into two groups: group 1 where growth>LT-interest, group 2 where growth<LT-interest. Of the 527 observations 185 fall under group 1, while 342 fall under group 2. The average interest rate for group 1 equals 1.56 percent and the average interest rate for group 2 equals 4.05 percent. Next the average growth rate was calculated for each group. This first analysis shows an average growth rate of 3.39 percent for group 1, and an average growth rate of 0.91 percent for group 2. This difference is very substantial, indicating periods where interest rates are above growth rates exhibit significant lower economic growth. The results are shown in figure 20.

These results can be misleading because during the observed period two global crises occurred. Therefore, the analysis was repeated excluding data for 2009, 2010, 2020, and 2021, because these years could manipulate results by having really low growth rates followed by high ones. The result of this analysis shows an average growth rate of 3.02 percent for group 1, and an average growth rate of 1.71 percent for group 2. These results are quite different then when all years are included, but the difference between economic growth between the two groups is still substantial.

High public debt levels (Debt-to GDP > 100)

Next, these analyses were repeated for high public debt levels. To do this, the same analysis was performed with the condition that debt-to-GDP level>100. When analysing the difference between group 1 and 2, group 1 has an average growth rate of 3.24 percent, while group 2 has an average growth rate of -0.21 percent. This difference very high, indicating that low growth for high debt levels is highly affected by periods where interest is below growth.

These results can again be misleading due to the data during the global crises. Therefore, the analyses were repeated excluding data for the years 2009, 2010, 2020, and 2021. This provides the following results: group 1 has an average growth rate of 2.65 percent, and group 2 has an average growth rate of 0.86 percent. While these results are significantly different then when all years are included, the difference between the groups remains substantial, confirming that low growth for high debt levels is highly affected by periods where interest is below growth.

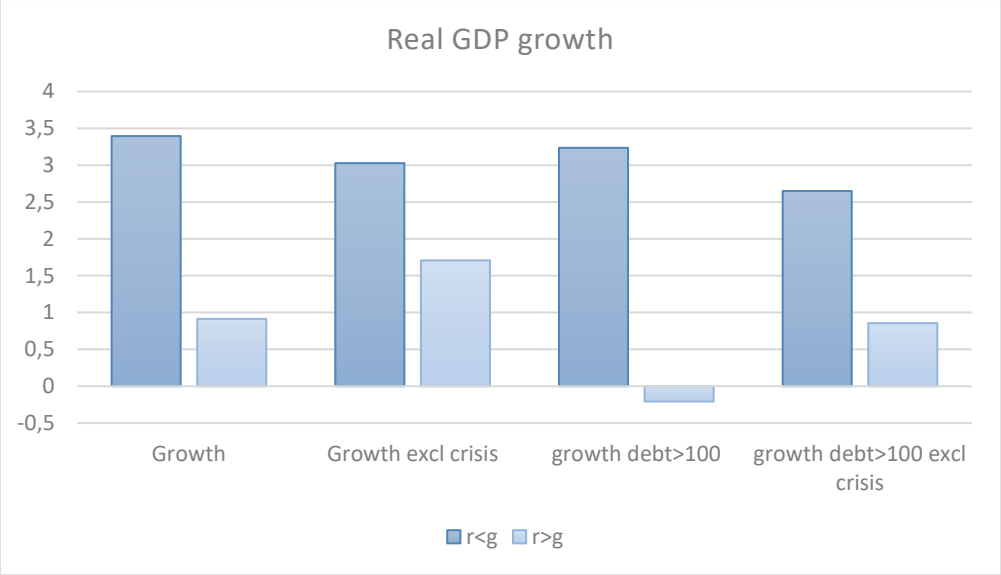

*Figure 20 economic growth in periods where interest rates are above or below economic growth (*OECD Data Explorer*, n.d.)*

All these analyses indicate that the negative impact of public debt on economic growth is highly affected by whether interest rates are below growth rates or not. This confirms the theoretical literature that states that high public debt is sustainable when growth is above interest rates (Bohn, 1995; Delong & Summers, 2012). However, when this analysis is repeated for 1-year growth and long-term growth these effects are non-existent. This could indicate that other factors may play a more determinant role on growth over longer periods. Generally speaking, economic growth fluctuates around a 2 percent trend for developed countries, however there are many chocks resulting causing extreme values any many factors affecting growth. These analyses do not account for these factors, other types of analysis like regression analysis could better capture the complex nature of economic growth.

Public Investment

This analysis was performed the similarly for public investment. So, all the observations were split up into the same two groups based on whether interest rates were below growth rates, and the average public investment rate was calculated. For group 1 (g>r) the average investment rate is 3.63 percent, for group 2 (g<r) the average investment rate is 3.61 percent. This is only a very small difference, so public investment rates do not seem affected when interest rates are below growth rates. The results are shown in figure 21.

To address potential distortions caused by the global crises, the analysis was repeated excluding data from 2009, 2010, 2020, and 2021. For group 1 the average investment rate is 3.61 percent, for group 2 the average investment rate is 3.52 percent. This difference is still pretty small.

High public debt levels (Debt-to GDP > 100)

To examine the impact of high public debt, the analysis was conducted with the condition that the debt-to-GDP level is greater than 100 percent. For group 1 the average investment rate is 3.36 percent, for group 2 the average investment rate is 3.31 percent. In this scenario, the investment rate is still not affected by the condition that the interest rate is below the growth rate.

Repeating the high debt analysis while excluding the crisis years provides an average investment rate of 3.36 percent for group 1, and an average of 3.21 percent for group 2.

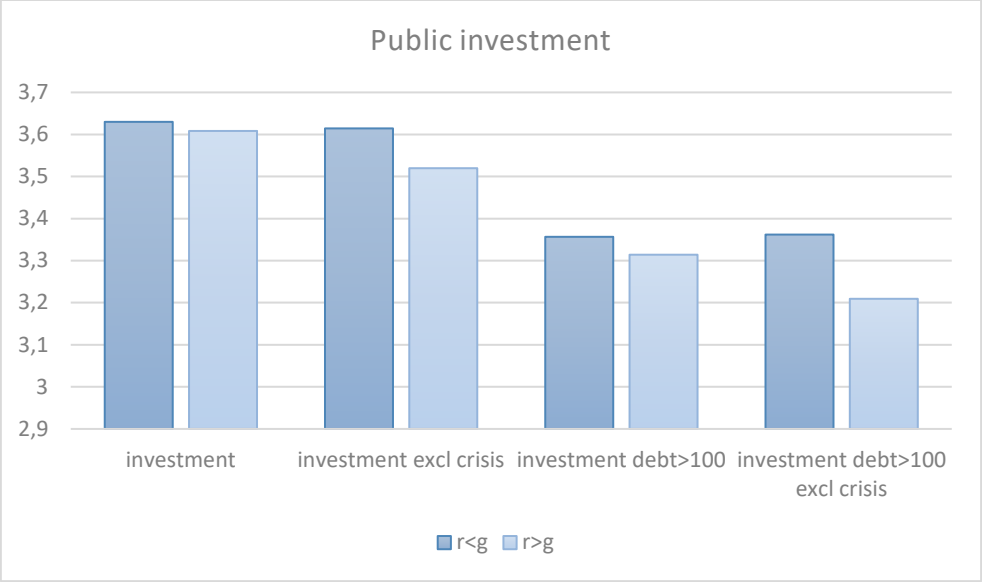

Figure 21 public investment (as percentage of GDP) in periods where interest rates are above or below economic growth

*(*OECD Data Explorer*, n.d.)*

These analyses do not indicate that public investment is lower in periods where the interest rate is above economic growth, we can only conclude that public investment is lower when debt levels are above 100 percent. Public investment is a very different measure as economic growth. Investment is a choice made by policymakers; effects thereof are often gradual over long periods of time.

Economic growth is a result of many different factors and has a much higher volatility than investment. However, public investment is a great way to aide future economic growth. Countries that struggle economically like Spain, Portugal, and Italy have shown strong declines in spending on investment in the last 10 years. But it is no surprise that there are no significant short-term effects of interest rates and growth rates.

Private investment

This analysis was performed similarly for private investment. All the observations were split up into the same two groups based on whether interest rates were below growth rates, and the average private investment was calculated for each group (results are shown in figure 22). For group 1 (g>r) the average investment rate is 18.92 percent, for group 2 (g<r) the average investment rate is 18.13 percent. This is a 1 percent difference, so investment rates are higher when interest rates are below growth rates.

To address potential distortions caused by the global crises, the analysis was repeated excluding data from 2009, 2010, 2020, and 2021. For group 1 the average investment rate is 19.02 percent, for group 2 the average CPI 18.23 percent. This difference is similar and exhibits the same relationship. This is consistent with theory stating that low interest rates stimulate private investment (*Interest Rates - Long-Term Interest Rates - OECD Data*, n.d.)

High public debt levels (Debt-to GDP > 100)

To examine the impact of high public debt, the analysis was conducted with the condition that the debt-to-GDP level is greater than 100 percent. For group 1 the average investment rate is 18.59 percent, for group 2 the average investment rate is 16.66 percent. In this scenario, the effect on the investment rate is twice that of the previous analysis, we now see a difference of two percent between the two groups. This shows that private investment rates are significantly lower in periods that the interest rate is below the growth rate, and that this effect is amplified by high debt levels. This aligns with the theory that implies that high debt levels reduce investment spending, especially when interest rates are high (Linnemann & Schabert, 2010).

Repeating the high debt analysis while excluding the crisis years provides an average investment rate of 18.64 percent for group 1, and an average of 16.48 percent for group 2. These results are almost identical to those of the previous section. This confirms the relationship of higher private investment in periods where the interest rate is below the growth rate. This relationship shows the reaction of the population to changing economic conditions.

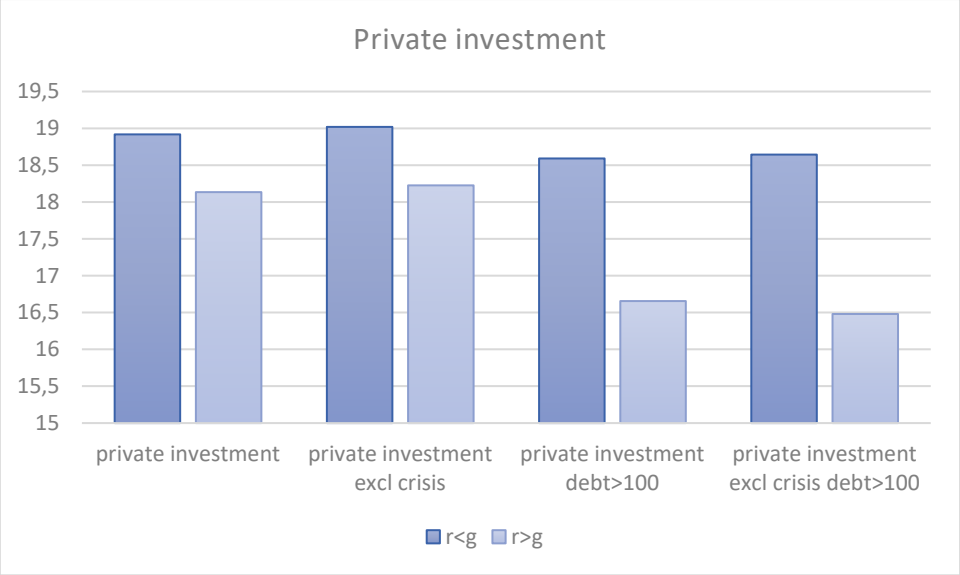

Figure 22 private investment (as percentage of GDP) in periods where interest rates are above or below economic growth (OECD Data Explorer, *n.d.)*

Inflation (CPI)

The same analysis was performed for inflation (CPI). The observations were split up into the same two groups based on whether interest rates were below growth rates, results are shown in figure 23. For group 1 (g>r) the average CPI is 1.98 percent, for group 2 (g<r) the average CPI is 3.70 percent. There is a substantial difference between the two groups. Because inflation and debt levels are measured in the same year these numbers could indicate that high interest rates are implemented when inflation is high, this is a typical monetary measure to control high inflation. The differences when crisis years are excluded are a lot more modest.

High public debt levels (Debt-to GDP > 100)

When only observations for debt-to-GDP ratios above 100 percent are analysed, the averages look very different. Here the average inflation for group 1 (g>r) was 2.15 percent, while the average inflation for group 2 was 1.51 percent. These differences are much closer together, and the relationship between the two groups is opposite. These results could indicate that higher levels of debt influence the reaction of policymakers to inflation. When a country has high outstanding debt raising interest rates would cause very high interest costs for the country. Additionally, high inflation rates can reduce the real cost of servicing debt.

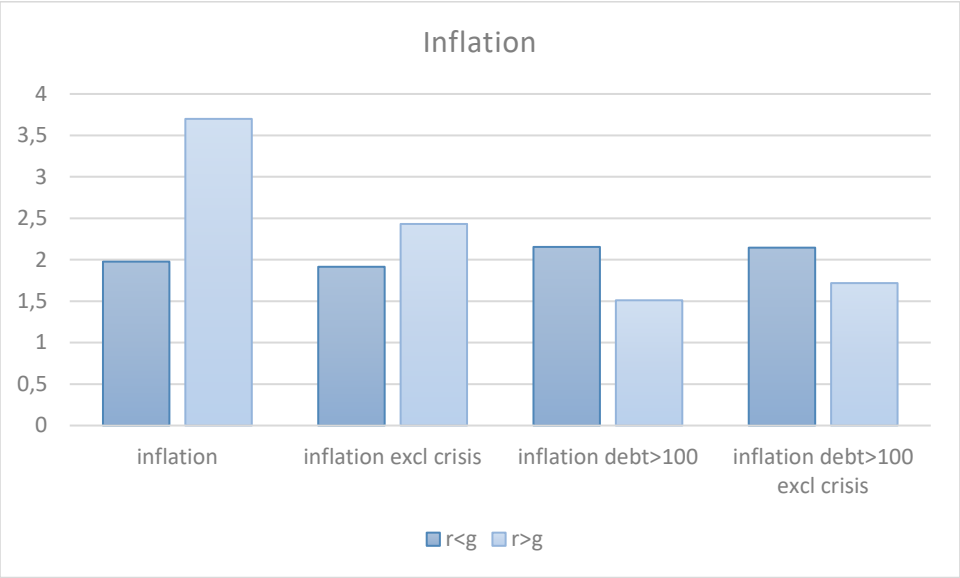

Figure 23 inflation (CPI) categorized in periods where interest rates are above and below growth rates

4.7 Limitations

This thesis, while shedding light on the complex dynamics between government debt, economic growth, public and private investment, and inflation, acknowledges several inherent limitations that suggest the need for further nuanced inquiry.

Firstly, the study's focus on the quantitative impacts of public debt on economic variables does not encompass other significant influencers that could alter these relationships. Factors such as political stability, regulatory frameworks, and global economic trends also play crucial roles in shaping economic outcomes but were beyond the scope of this analysis. Incorporating these factors could provide a more comprehensive understanding of the debt-economic growth nexus.

Moreover, the analysis of the interest rate-growth differential, a cornerstone of this research, captures a critical aspect of the debt discussion but does not address the full spectrum of macroeconomic interactions. The observed absence of effects in both 1-year and long-term growth analyses underlines the need for a more multifaceted approach. This could involve integrating more complex macroeconomic models that capture a broader range of variables and interactions, thereby providing a deeper insight into the underlying mechanisms.

Additionally, the empirical methodology employed, while robust in its current form, is limited in its ability to establish causality. This constraint leaves room for alternative interpretations of the data and underscores the importance of adopting methods that can more definitively determine causal relationships in future studies.

The temporal scope of the data used, although extensive, limits the observation of longer-term trends and dynamics. Studies employing longer historical periods could reveal more about the persistence and long-term effects of debt on economic variables, offering valuable insights into how economies adapt over time.

Finally, comparative studies across different economic systems could provide deeper insights into how diverse fiscal and monetary policies impact debt sustainability and economic outcomes.

5 Conclusion

This thesis has explored the multifaceted nature of government debt, examining its sustainability, economic consequences, and the interplay between debt levels and public investment. By synthesizing existing literature and conducting empirical analysis, the study provides a comprehensive understanding of the implications of rising public debt in developed countries. This thesis highlights the importance of understanding the complex dynamics between debt levels and economic outcomes. Policymakers need to consider a range of factors, including debt composition, regulatory environment, institutional quality, and monetary policy, when formulating strategies to manage public debt, promote economic growth, and maintain public welfare.

The literature study covered a broad range of consequences of public debt. To contribute to the existing literature this examined some subjects that has not received the attention it deserves in the public debt debate: public investment, as well as add supplementary analyses on some of the topics that have been studied more extensively: economic growth, private investment, and inflation (CPI). According to the literature, whenever growth levels are above the long-term interest rates, debt is "self-sustaining", meaning that high debt levels are sustainable as long as economic growth is above the long-term interest rate. This paper put this theory in an empirical context. To study these variables 23 OECD countries over the period 2000-2022 were analysed.

Firstly, the analysis confirms a negative correlation between high public debt levels and economic growth. Specifically, economies with public debt exceeding 120% of GDP experience significantly reduced short-term growth rates, aligning with the threshold theory proposed by Reinhart and Rogoff. However, this study advances the discussion by demonstrating that such thresholds may vary depending on the economic context and historical data used. The long-term growth data indicates that higher debt levels correlate with reduced growth over extended periods, but the impact appears more gradual than in short-term scenarios.

In terms of investment, both public and private investments tend to decline as debt levels increase. While the reduction in public investment may result from deliberate policy choices aiming to manage high debt levels, the decrease in private investment is likely driven by reduced confidence and potential crowding out effects. This thesis shows that such reductions have substantial real-world implications, potentially stifling essential economic infrastructure and innovation, which in turn could impair long-term economic competitiveness and growth.

The examination of the Consumer Price Index reveals an intricate interaction between debt levels and inflation, challenging the conventional wisdom that higher debt could lead to increased inflation. This study found that very high debt levels can be associated with lower inflation rates, possibly due to stringent monetary policies and austerity measures implemented to maintain economic stability.

In periods where growth rates exceed interest rates, economies exhibit much higher growth, confirming theories that suggest high public debt may not severely impact growth under such conditions. However, these effects are not present in 1-year or long-term growth. This could indicate that other factors may play a more determinant role on growth over longer periods. Public

investment rates appear relatively unaffected by these dynamics, displaying only minimal fluctuations between the two scenarios, even when high debt levels are considered. This suggests that public investment decisions are less influenced by short-term interest rate fluctuations. The resilience of public investment despite varying economic conditions underscores its role as a critical and stable component of fiscal policy aimed at supporting long-term economic stability and growth. Private investment responds more strongly to these interest rate dynamics, generally performing better when growth exceeds interest rates, especially at high debt levels. The analysis shows that inflation is substantially higher in periods when r>g. Because inflation and debt levels are measured in the same year these numbers could indicate that high interest rates are implemented when inflation is high. When only high debt-to-GDP ratios are analysed, the averages look very different. These differences are much closer together, and the group where r<g has the lowest inflation. These results could indicate that higher levels of debt influence the reaction of policymakers to inflation. When a country has high outstanding debt, raising interest rates would cause very high interest expenses for the country. Additionally, high inflation rates can reduce the real cost of servicing debt.

To avoid the long-term negative consequences of high debt, governments should prioritize efficient public investment that complements private sector activities and enhances economic growth. This cannot account for other factors adversely affecting economic growth, but it does give a country the best opportunity to improve economic prospects. The relationship between interest rates and growth underscores the need for coordinated monetary and fiscal policies, particularly in high-debt environments, to maintain economic stability and foster sustainable growth. While high levels of public debt present significant challenges, careful management and strategic investment can mitigate negative impacts and support long-term economic health. This thesis contributes to the ongoing debate on public debt by providing nuanced insights into its effects and highlighting the importance of tailored, context-specific policy solutions.

6 Bibliography

Adam, K. (2011). Government debt and optimal monetary and fiscal policy. *European Economic Review*, *55*(1), 57–74. https://doi.org/10.1016/j.euroecorev.2010.11.003

Afonso, A., & Jalles, J. T. (2013). Growth and productivity: The role of government debt. *International Review of Economics & Finance*, *25*, 384–407. https://doi.org/10.1016/j.iref.2012.07.004

Beqiraj, E., Fedeli, S., & Forte, F. (2018). Public debt sustainability: An empirical study on OECD countries. *Journal of Macroeconomics*, *58*, 238–248. https://doi.org/10.1016/j.jmacro.2018.10.002

Berggren, N., & Bjørnskov, C. (2019). Regulation and government debt. *Public Choice*, *178*(1/2), 153–178.

Bitar, N., Chakrabarti, A., & Zeaiter, H. (2018). Were Reinhart and Rogoff right? *International Review of Economics & Finance*, *58*, 614–620. https://doi.org/10.1016/j.iref.2018.07.003

Blanchard, O. (2019). Public Debt and Low Interest Rates. *American Economic Review*, *109*(4), 1197–1229. https://doi.org/10.1257/aer.109.4.1197

Bohn, H. (1995). The Sustainability of Budget Deficits in a Stochastic Economy. *Journal of Money, Credit and Banking*, *27*(1), 257–271. https://doi.org/10.2307/2077862

Bohn, H. (2007). Are stationarity and cointegration restrictions really necessary for the intertemporal budget constraint? *Journal of Monetary Economics*, *54*(7), 1837–1847. https://doi.org/10.1016/j.jmoneco.2006.12.012

Bohn, H. (2011). The Economic Consequences of Rising U.S. Government Debt: Privileges at Risk. *FinanzArchiv / Public Finance Analysis*, *67*(3), 282–302.

Cadenillas, A., & Huamán-aguilar, R. (2016). Explicit formula for the optimal government debt ceiling. *Annals of Operations Research*, *247*(2), 415–449. https://doi.org/10.1007/s10479-015-2052-9

Cadenillas, A., & Huamán-Aguilar, R. (2018). On the Failure to Reach the Optimal Government Debt Ceiling. *Risks*, *6*(4), 138. https://doi.org/10.3390/risks6040138

Checherita-Westphal, C., & Rother, P. (2012). The impact of high government debt on economic growth and its channels: An empirical investigation for the euro area. *European Economic Review*, *56*(7), 1392–1405. https://doi.org/10.1016/j.euroecorev.2012.06.007

Collard, F., Habib, M., & Rochet, J.-C. (2015). Sovereign Debt Sustainability in Advanced Economies. *Journal of the European Economic Association*, *13*(3), 381–420.

Delong, J. B., & Summers, L. H. (2012). Fiscal Policy in a Depressed Economy. *Brookings Papers on Economic Activity*, *2012*(1), 233–297. https://doi.org/10.1353/eca.2012.0000

Dept, I. M. F. R. (2012). World Economic Outlook, October 2012: Coping with High Debt and Sluggish Growth. In *World Economic Outlook, October 2012*. International Monetary Fund. https://www.elibrary.imf.org/display/book/9781616353896/9781616353896.xml

Elberry, N. A., Naert, F., & Goeminne, S. (2023). Optimal public debt composition during debt crises: A review of theoretical literature. *Journal of Economic Surveys*, *37*(2), 351–376. https://doi.org/10.1111/joes.12491

European Central Bank. (2020). *Economic consequences of high public debt: Evidence from three large scale DSGE models.* Publications Office. https://data.europa.eu/doi/10.2866/509669

Fall, F., Bloch, D., Fournier, J.-M., & Hoeller, P. (2015). *Prudent Debt Targets and Fiscal Frameworks* (SSRN Scholarly Paper 2649081). https://doi.org/10.2139/ssrn.2649081

Fall, F., & Fournier, J.-M. (2015). Macroeconomic uncertainties, prudent debt targets and fiscal rules. *OECD Economic Department Working Papers*, *1230*, 0_1,3,7-46. https://doi.org/10.1787/5jrxv0bf2vmx-en

Fournier, J.-M. (2016). *The Positive Effect of Public Investment on Potential Growth*. OECD. https://doi.org/10.1787/15e400d4-en

Fournier, J.-M., & Fall, F. (2017). Limits to government debt sustainability in OECD countries. *Economic Modelling*, *66*, 30–41. https://doi.org/10.1016/j.econmod.2017.05.013

GDP and spending—Investment (GFCF)—OECD Data. (n.d.). theOECD. Retrieved 17 May 2024, from http://data.oecd.org/gdp/investment-gfcf.htm

Ghosh, A. R., Kim, J. I., Mendoza, E. G., Ostry, J. D., & Qureshi, M. S. (2013). Fiscal Fatigue, Fiscal Space and Debt Sustainability in Advanced Economies. *The Economic Journal*, *123*(566), F4–F30. https://doi.org/10.1111/ecoj.12010

Hauptmeier, S., & Kamps, C. (2022). Debt policies in the aftermath of COVID-19—The SGP's debt benchmark revisited. *European Journal of Political Economy*, *75*, 102187. https://doi.org/10.1016/j.ejpoleco.2022.102187

Interest rates—Long-term interest rates—OECD Data. (n.d.). theOECD. Retrieved 12 May 2024, from http://data.oecd.org/interest/long-term-interest-rates.htm

International Monetary Fund, I. (2003). Guidelines for Public Debt Management: Accompanying Document and Selected Case Studies. In *Guidelines for Public Debt Management*. International Monetary Fund. https://www.elibrary.imf.org/display/book/9781589061941/9781589061941.xml

Linnemann, L., & Schabert, A. (2010). Debt Nonneutrality, Policy Interactions, and Macroeconomic Stability. *International Economic Review*, *51*(2), 461–474.

McBride, J., Chatzky, A., & Siripurapu, A. (2020). *The National Debt Dilemma*. Council on Foreign Relations. https://www.jstor.org/stable/resrep29855

OECD. (2023). *Government at a Glance 2023*. OECD. https://doi.org/10.1787/3d5c5d31-en

OECD Data Explorer. (n.d.). Retrieved 11 April 2024, from https://data-explorer.oecd.org/

OECD Data Explorer • Financial indicators dashboard: Government. (n.d.). Retrieved 3 April 2024, from https://data-explorer.oecd.org/vis?fs[0]=Topic%2C1%7CEconomy%23ECO%23%7CNational%20accounts%23ECO_NAD%23&fs[1]=Measure%2C0%7CGross%20debt%20of%20central%20government%23LES1311_FD4%23&pg=0&fc=Measure&snb=1&vw=tb&df[ds]=dsDisseminateFinalDMZ&df[id]=DSD_FIN_DASH%40DF_FIN_DASH_S13&df[ag]=OECD.SDD.NAD&df[vs]=1.0&pd=2000%2C2022&dq=A.AUS%2BBEL%2BAUT%2BCZE%2BDNK%2BFIN%2BFRA%2BDEU%2BGRC%2BHUN%2BISL%2BIRL%2BISR%2BITA%2BJPN%2BKOR%2BLUX%2BMEX%2BNLD%2BNZL%2BNOR%2BPOL%2BPRT%2BESP%2BSWE%2BCHE%2BTUR%2BGBR%2BUSA.LES13_FD4.&ly[rw]=REF_AREA&ly[cl]=TIME_PERIOD&to[TIME_PERIOD]=false

Panizza, U., & Presbitero, A. F. (2013). Public debt and economic growth in advanced economies: A survey. *Swiss Journal of Economics and Statistics*, *149*(2), 175–204. https://doi.org/10.1007/BF03399388

Panizza, U., & Presbitero, A. F. (2014). Public debt and economic growth: Is there a causal effect? *Journal of Macroeconomics*, *41*, 21–41. https://doi.org/10.1016/j.jmacro.2014.03.009

Reinhart, C. M., Reinhart, V. R., & Rogoff, K. S. (2012). Public Debt Overhangs: Advanced-Economy Episodes since 1800. *Journal of Economic Perspectives*, *26*(3), 69–86. https://doi.org/10.1257/jep.26.3.69

Reinhart, C. M., & Rogoff, K. S. (2010). Growth in a Time of Debt. *American Economic Review*, *100*(2), 573–578. https://doi.org/10.1257/aer.100.2.573

Vanlaer, W. (2019). *Essays on the impact of debt and saving on economic performance in the EU doctoral dissertation*. http://hdl.handle.net/1942/27731

What Drives Inflation in the Major OECD Economies? | READ online. (n.d.). Oecd-Ilibrary.Org. Retrieved 8 May 2024, from https://read.oecd-ilibrary.org/economics/what-drives-inflation-in-the-major-oecd-economies_5kgdx1jgvtf8-en

World Development Indicators | DataBank. (n.d.). Retrieved 25 April 2024, from https://databank.worldbank.org/reports.aspx?source=2&series=FP.CPI.TOTL.ZG&country=JPN