Inaugural-Dissertation

Essays on the Political Economy of Public Investment and Debt

vorgelegt von

Ekaterina Jürgens

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Coauthors

This dissertation is composed of three chapters. Chapters 1 and 2 are based on single-authored papers. Chapter 3, *"Passing the partisan filter: Political narratives, partisan bias and opinions on public finances"*, is based on joint work with Prof. Dr. Sebastian Gechert (Professor for Macroeconomics, University of Technology, Chemnitz). The research idea and the experiment design were originated by me. The survey was designed by Sebastian Gechert, while I was participating and learning from the process. I carried out the quantitative analysis of the data obtained from the experiment. We collectively interpreted and discussed the results and wrote the text of the paper.

Contents

List of Abbreviations

2SLS	Two Stage Least Squares
ADF	Augmented Dickey–Fuller
AIC	Akaike Information Criterion
BCI	Bayesian Corruption Index
COFOG	Classification of the Functions of Government
ECB	European Central Bank
EMU	Economic and Monetary Union
EU	European Union
FRSI	Fiscal Rules Strength Index
FR	Fiscal Rule
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
GLS	Generalized Least Squares
GMM	Generalized Method of Moments
HP	Hodrick-Prescott
IMF	International Monetary Fund
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
PF	Production Function
SFC	Stock-Flow Consistent
SGP	Stability and Growth Pact
WEO	World Economic Outlook

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Summary

> The next step forward must come,
> not from political agitation or premature experiments,
> but from thought.
>
> *John Maynard Keynes*
> *"The End of Laissez-Faire", 1926*

John Maynard Keynes proclaimed the end to the orthodoxy of his time - *the laissez-faire* - a hundred years ago (Keynes, 2010). But the doctrine, which calls against any substantial state intervention into economic systems, has not only survived to our time, but has also maintained significant influence on public policy.

The confluence of recent crises, including the climate catastrophe, the COVID-19 pandemic, as well as the war in Ukraine and the accompanying energy crisis, has yet again exposed the necessity of state interventions in economic activity, including comprehensive innovation alongside the renewal of physical and human capital. However, such measures require increased public expenditure and might potentially lead to elevated levels of sovereign debt. Indeed, the sustainability of public finances has long been a focal point of economic research and policymaking, as governments are pressured to balance fiscal discipline with the imperative to promote economic prosperity. Moreover, in an era marked by economic, financial, and geopolitical volatility, the tension between fiscal constraints and the need for public investment has become increasingly acute.

Against this background, this doctoral thesis explores the political economy of public investment and debt by studying the interconnection of fiscal policy institutions and macroeconomic outcomes, as well as societal perceptions thereof. My research seeks answers to three main questions: *Do European fiscal frameworks facilitate or hinder sufficient public investment? How sustainable is the public debt ratio in a scarce public investment scenario? What factors affect attitudes of voters towards public investment and debt?* The timely relevance of this inquiry is remarkable, given the increasingly unstable political landscape, characterized by growing polarization and deepening ideological divides.

The three articles contained in this thesis, which are intertwined by the same topic of public investment and debt, are methodologically diverse. The first paper employs macroeconomic panel data to examine how fiscal rules affect public investment and its procyclical dynamics across the European Union (EU). The second paper develops a stock-flow consistent (SFC) macroeconomic model to analyze the path of public debt and investment under different fiscal rule scenarios. In the third paper, a survey experiment is conducted to investigate how political self-identification and narratives affect laypersons' attitudes towards public finances. In what follows, I summarize the findings of my research.

The first chapter of this thesis, titled *"Fiscal rules and procyclicality of public investment in Europe"*, investigates the effect of fiscal rules on public investment across EU countries. The contribution of this chapter is threefold. I test the procyclicality of public investment in the EU. Then I validate the hypothesis that fiscal rules have a significant impact on the levels and the procyclicality of public investment. Finally, I examine which categories of public investment are affected. Since fiscal policy is subject to asymmetric dynamics over the business cycle, I disentangle the cyclical behavior of public investment and the effects of fiscal rules in downturns and upswings. In addition, I consider the design of fiscal rules since more flexibly designed rules preserve public investment during consolidation episodes.

The findings in this chapter reveal that government investment in the EU is procyclical, and this effect is driven by the procyclical reaction in downturns. Not only public investment levels decrease during economic contractions, but also public investment in percent of GDP declines, indicating over-procyclicality, i.e. public investment falls more than the GDP. Thus, EU members on average exhibit dynamics of public investment that is more characteristic of developing countries (Frankel, Vegh, & Vuletin, 2013; Ardanaz & Izquierdo, 2022). Also, the design of the fiscal framework proves to be of major importance. I find that rigid fiscal rules tend to reduce government investment and amplify the procyclicality of public investment during economic downturns. Fiscal rules with flexibility features, on the other hand, do not show any statistically significant impact on public investment. This aligns with Ardanaz, Cavallo, Izquierdo, and Puig (2021) who show that flexible rules prevent cuts in public investment during consolidation episodes.

Furthermore, I identify that public investment in crucial areas, such as environment protection, healthcare, education, and social protection, tends to shrink significantly when fiscal rules are implemented, especially during recessions. These findings suggest that fiscal rules may have worsened the erosion of healthcare systems in EU countries before the COVID-19 outbreak. Also, a drop in social protection investment during recessions is concerning since expenses for social aid are meant to move against the cycle. Consequently, the objective of ensuring stable public finances can be jeopardized if fiscal rules hinder growth by aggravating the negative effect of recessions.

The second chapter of this thesis, *"Deficit aversion as a path to higher debt: Sovereign debt dynamics in a stock-flow consistent model with public capital"*, examines the long-term dynamics of public investment and sovereign debt under different fiscal policy scenarios. Following Dafermos and Nikolaidi (2019), I build a simple SFC model with private households, firms, and government sector. My central innovation to SFC modeling is introducing a production function that includes public capital, along the lines of Tavani and Zamparelli (2016). The production function allows me to explicitly model demand-side and supply-side effects of public investment, since both government consumption and investment enter the aggregate income, however, only the latter adds up to the public capital stock and thus increases the productivity of the private capital stock.

Having developed this unique SFC model, I derive the debt sustainability condition which shows that the debt-to-output ratio can be stable under fiscal deficit or surplus, depending on the difference between the interest rate on government bonds and the growth rate. Further, I simulate two numerical scenarios: a balanced budget fiscal rule and a golden rule of public investment. I show that, since the growth rate is endogenous to public investment in the model, the two scenarios illustrate two distinct economic outcomes of the debt sustainability condition. On the one hand, increased public investment induces a growth rate above the interest rate on government bonds and allows for a negative budget balance in the long run. On the other hand, balanced budget scenario results in a growth rate below the interest rate on bonds so that fiscal surplus is needed for a stable debt ratio.

These results challenge the conservative notion regarding debt sustainability. While deficit aversion is often justified on the grounds of reducing debt burdens, the findings in this chapter show that restrictive fiscal policies can be counterproductive. By suppressing public investment, austerity policies can hinder economic growth and exacerbate fiscal vulnerabilities. On the contrary, maintaining adequate levels of the public capital stock, particularly in the sectors that are critical for the productivity of the economy as a whole, is essential for ensuring sustainable public finances.

The third chapter under the title *"Passing the partisan filter: Political narratives, partisan bias and opinions on public finances"*, written in co-authorship with Sebastian Gechert, shifts the focus to the societal dimension of the political economy of public investment and debt. Synthesizing narratives economics theory (Shiller, 2017) and the partisan bias literature, we explore how political partisanship and political narratives affect voters' opinions about public finances. In a novel survey experiment, we test the causal effect of pro-consolidation and pro-public investment narratives on participants' opinions about public debt and how to deal with budget deficits. More precisely, we confront randomly selected subsamples of our respondents with one of the election program statements, taken from the 2021 election campaigns of a major fiscally conservative party (CDU) and from a major fiscally liberal party (B90/Greens). The conservative statement stresses that fiscal consolidation promotes intergenerational fairness, while the liberal statement emphasizes the need for additional deficit-financed public investment in Germany.

Our findings align with the partisan bias literature, as we observe substantial differences in preferences in line with partisanship, remaining largely unaltered by narrative treatments. Predictably, voters on the left (die Linke and Greens) prefer a tax increase or borrowing to cutting expenditure. Supporters of the far-right party AfD favor spending cuts, but not tax increases. A preference for parties on the left of the political spectrum comes with less agreement that the level of public debt in Germany is a major problem in comparison to centrist voters, while the opposite is true for right-wing voters, who are more likely to consider the level of public debt in Germany to be a severe problem.

However, we identify an asymmetry in the treatment effects interacted with respondents' party preferences. The pro-consolidation narrative affects left-leaning voters and increases the likelihood that they would consider public debt to be a severe problem. This interaction brings the assessment of public debt of left-leaning voters in the same range as centrist or non-partisan voters, while the conservative position of right-wing voters is even reinforced. The pro-investment narrative does not have a statistically significant interaction effect with party preferences. We interpret our findings in the way that only emotionally charged narratives pass the "partisan filter". Thus, self-identification with a particular political party could serve as a filter to accepted narratives; the pro-consolidation narrative may have passed the partisan filter because it taps into deep ethical values when framed as "intergenerational justice".

Altogether, the three chapters of this thesis highlight the need for a holistic approach to fiscal policy that integrates economic theory and empirical evidence and seeks to balance fiscal responsibility with providing solutions to inevitable structural changes. The policy implications of this research underscore that fiscal frameworks should be designed with sufficient flexibility to reduce their procyclical effect and prevent them from impeding public investment in critical infrastructure. Rather than adhering to rigid fiscal targets, it is reasonable to prioritize investments that enhance productivity and long-term economic resilience. By framing government programs in terms of their higher purpose to society, policymakers can build broader consensus on effective fiscal policy. As the world grapples with the struggles of the 21st century, from economic slowdown and climate emergency to demographic and geopolitical shifts, the findings of this thesis provide a robust foundation for rethinking fiscal policy, in favor of better macroeconomic and social outcomes, than *the laissez-faire* doctrine has been able to deliver.

Chapter 1

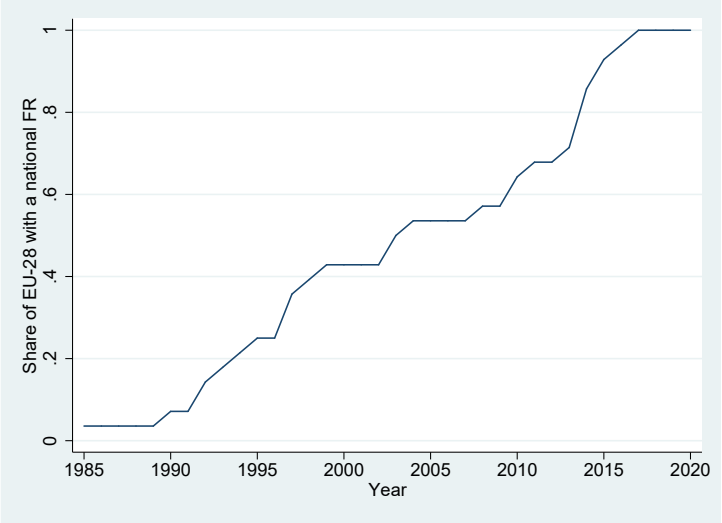
Fiscal rules and procyclicality of public investment in Europe[1]

[1]This article is currently under review in the Review of Keynesian Economics.
I am grateful to Prof. Dr. Sebastian Gechert and Dr. Christoph Paetz for their valuable suggestions. Also, I appreciate comments of several anonymous referees on earlier versions of this paper.

1.1 Introduction

Numerical fiscal rules have been implemented in over ninety countries in the recent decades, either on the supranational, or on the national level (IMF, 2022; Schaechter, Kinda, Budina, & Weber, 2012). Fiscal rules include deficit rules restricting the budget balance to a specific value, debt rules limiting the accumulation of government debt at a target level, or rules regarding government expenditure and revenue. Figure 1.1 depicts the share of the EU-28 members that incorporated at least one numerical fiscal rule in their national legislation over the past decades. Whereas only one member state (Germany) had a national fiscal rule in place in 1985, by 2017 all EU-28 countries adopted rules-based fiscal constraints as part of their national regulation.

Figure 1.1: Share of the EU-28 members with at least one national fiscal rule, 1985-2020.



Source: Author's elaboration based on the IMF Fiscal Rules Dataset (Schaechter et al., 2012).

Rules-based constraints on government budgets, its components, and debt are intended to ensure prudent public finances. A meta-regression analysis of the empirical literature on the budgetary implications of fiscal rules suggests that they can be effective in restricting public deficit levels, while the effect on debt levels is less clear (Heinemann, Moessinger, & Yeter, 2018). Importantly, if fiscal rules reduce government deficits, it is crucial to understand which budgetary components are affected. For instance, if they hinder government investment, this could potentially be harmful to macroeconomic performance, given that the public capital stock is a central factor of production in developed economies and government investment has significant short- and long-run multiplier effects (Bom & Ligthart, 2014; Gechert, 2015).

Government transfers and consumption underlie legal obligations that cannot be changed at short notice, so cutbacks in entitlement programs are associated with high political costs; whereas a retrenchment of investment expenditure categories may be politically more feasible (Breunig

& Busemeyer, 2012). Lower government deficits at the expense of public investment can lead to disadvantageous outcomes in the long run. When public investment is reduced, it may be only decades later that the consequences of capital stock deterioration materialize. Empirical investigations of fiscal consolidation episodes provide evidence that investment spending shrinks when fiscal rules exert pressure on the budget (Bamba, Combes, & Minea, 2020; Castro, 2017). Moreover, it may be difficult to predict how investment reduction for different categories will unfold in the future, as was the case with cuts in public investment in healthcare expenditures in Italy after the financial crisis, which increased the vulnerability of the Italian healthcare sector during the COVID-19 crisis (Prante, Bramucci, & Truger, 2020). Another risk of fiscal rules is that they reinforce the procyclical reaction of fiscal policy if numerical targets cannot adapt sufficiently to economic fluctuations. This aspect is of particular importance as fiscal multipliers tend to be higher and more persistent during recessionary periods (Auerbach & Gorodnichenko, 2012; Blanchard & Leigh, 2013; Fatás & Summers, 2018; Gechert, Horn, & Paetz, 2019) and fiscal consolidation episodes (Barnichon, Debortoli, & Matthes, 2022).

For these reasons, fiscal rules, if designed poorly, can lead to weaker growth and ultimately, instead of stabilizing public finances in the long run, fail to achieve their primary objective and undermine fiscal sustainability. While there is an extensive empirical literature on fiscal reaction functions that analyze the cyclical behavior of fiscal policy (Frankel et al., 2013; Ardanaz & Izquierdo, 2022, among others) and the impact of fiscal rules on fiscal indicators as well as fiscal policy reactions (Bergman & Hutchison, 2015; Guerguil, Mandon, & Tapsoba, 2017; Jalles, 2018), public investment behavior and how it is affected by fiscal rules has received less attention in the empirical literature so far.

The contribution of this paper is threefold. I first test the procyclicality of public investment in the EU. I then validate the hypothesis that fiscal rules have a significant impact on the levels and procyclicality of public investment. Finally, I examine which categories of public investment are particularly affected. Since fiscal policy is subject to asymmetric dynamics over the business cycle (Perotti, 1999), I disentangle the cyclical behavior of public investment and the effects of fiscal rules in downturns and upswings. In addition, I consider the design of fiscal rules since more flexibly designed rules could preserve public investment during consolidation episodes (Ardanaz et al., 2021).

To address my research questions, I collect annual panel data for 23 EU countries over the period from 1985 to 2019. I focus on the EU since the member states are subject to the same set of supranational rules and share similar economic and political conditions. This enables me to exploit the variation in national fiscal rules across countries and time. Crucially, national fiscal rules in Europe provide sufficient heterogeneity in design features in both the cross-sectional and the longitudinal dimensions.

My results show that government investment in the EU is procyclical, and this effect is driven by the procyclical reaction in downturns. Not only public investment levels decrease during economic contractions, but also public investment in percent of GDP declines, indicating over-procyclicality (public investment falls more than the GDP). Also, the design of the fiscal framework proves to be of major importance. I find that rigid fiscal rules tend to reduce government investment and amplify the procyclicality of public investment during economic downturns. Fiscal rules with flexibility features, on the other hand, do not show any statistically significant impact on public investment.

Furthermore, to the best of my knowledge, this paper is the first to analyze in a systematic way the effects of fiscal rules on specific public investment categories. I identify that public investment in crucial areas, such as public order, environment protection, healthcare, education, and social protection, tends to shrink significantly when fiscal rules are implemented, especially during recessions. These findings suggest that fiscal rules may have worsened the erosion of healthcare systems in EU countries before the COVID-19 outbreak. Also, a drop in social protection investment during recessions is concerning, since expenses for social aid are meant to move against the cycle. My findings thus draw attention of policymakers towards the aspect of sufficient flexibility of fiscal rules in order to safeguard a higher level of public investment.

The remainder of the paper is organized as follows. Section 1.2 provides an overview of the related literature. Section 1.3 presents the data and describes the empirical model. Section 1.4 reports the main results and provides robustness checks regarding my variables of interest and the estimation methods. Section 1.5 presents the analysis concerning the categories of government investment affected by fiscal rules. Section 1.6 concludes and discusses policy implications.

1.2 Related literature

As already mentioned, fiscal rules seem to be useful in restricting public deficits (Heinemann et al., 2018). However, budget consolidation is mainly achieved by reducing expenditures (Asatryan, Castellón, & Stratmann, 2018; Nerlich & Reuter, 2013). This raises concern of procyclical effects of fiscal rules, especially because fiscal multipliers are higher in recessions (Auerbach & Gorodnichenko, 2012; Blanchard & Leigh, 2013; Fatás & Summers, 2018; Gechert et al., 2019) and for contractionary as compared to expansionary measures (Barnichon et al., 2022).

Empirical evidence on procyclicality of fiscal policy and the influence of fiscal rules is abundant, but it does not speak with one voice. In general, the procyclicality of public spending in developed countries was shown to decline over time (Frankel et al., 2013). Ardanaz and Izquierdo (2022) support this finding; they also show that the procyclicality of public investment in developing countries can be observed in recessions. Aghion and Marinescu (2008) compute time-varying cyclicality coefficients and establish that the procyclicality diminished over time in their sample

of 19 OECD countries, but not in the EMU. On the contrary, Huart (2013) finds that euro area fiscal policy has become more countercyclical after Maastricht, in particular during recessions. Galí and Perotti (2003) show that the Stability and Growth Pact (SGP) did not make fiscal policy more procyclical in the EMU during the first years after implementation. Bergman and Hutchison (2015) find that fiscal rules, if they are combined with high government efficiency, are capable of reducing the procyclicality of fiscal policy. Larch, Orseau, and van der Wielen (2021) conclude that compliance with EU fiscal rules allows to conduct fiscal policy in a more countercyclical manner. However, Guerguil et al. (2017) argue that not all fiscal rules are equally effective: Investment-friendly rules seem to be more suited in decreasing the procyclical effect, especially in recessions and when the rule is implemented in domestic legislation. Reuter, Tkačevs, and Vilerts (2022) found that fiscal rules, if they were stringent, but formulated in cyclically adjusted terms, reduced volatility of budgetary components.

Nevertheless, some contributions do find that fiscal rules work procyclically. For example, Fatás and Mihov (2006) show that numerical fiscal rules on the state level in the US reduce the capacity of fiscal response to economic shocks. Similarly, Jalles (2018) finds that, generally, fiscal policy is likely to be countercyclical, but some fiscal rules tend to dampen the degree to which public spending works against the cycle. Furthermore, Combes, Minea, and Sow (2017) demonstrate that various fiscal rules can have heterogeneous effects on the cyclical stance of public spending. Lastly, Paetz (2020) finds that cyclical performance of public finance in the EU is asymmetrical: Fiscal policy is procyclical in recessions, and, importantly, fiscal rules tend to reinforce this effect even further.

A number of theoretical studies model working mechanisms of fiscal rules and their possible impact on public investment. Peletier, Dur, and Swank (1999) illustrate how public investment can be insufficient under a balanced budget rule. Bassetto and Sargent (2006) show that a golden rule of public investment, assuming departure from Ricardian equivalence, improves efficiency of public expenditure. In a political economy model, Bouton, Lizzeri, and Persico (2020) show that fiscal rules can yield undesired outcomes: If government obligations are unconstrained and there are capital market frictions, imposing debt limits consistently results in a rise in overall public liabilities and worsens Pareto efficiency.

Empirical evidence on the effect of national fiscal rules on public investment and on the composition of public expenditure is scarce but growing. Potrafke (2023) provides a recent comprehensive literature overview of the effects of fiscal rules on a variety of macroeconomic variables, including public spending, its procyclicality and public budget composition. From the survey, he concludes that fiscal rules generally reduce government expenditure, however, not government investment. Indeed, the evidence is mixed to this day. Galí and Perotti (2003) present data to show that the decline of public investment in the EU started before the implementation of the Maastricht rules.

Yet, Nerlich and Reuter (2013) argue that national balanced budget rules rules reduced public investment in the EU. Dahan and Strawczynski (2013) estimate a panel of 22 OECD members during the period 1960 to 2010. They find that the relative growth rate of social transfers to government consumption declines under fiscal rules, however, not the relative growth rate of government investment vs. consumption. Bacchiocchi, Borghi, and Missale (2011) also employ OECD data for 29 developed countries. They analyze public gross fixed capital formation (GFCF) in developed economies by separating them into countries affected by the SGP and those not affected. The authors conclude that SGP rules do not constrain public investment.

Regarding fiscal rules on the sub-national level, Venturini (2020) looks into data on Italian municipalities from 1999 to 2015 and applies a difference-in-discontinuities design. She finds that communities with more than 5000 inhabitants, which became subject to a stricter fiscal rule in 2007, reduced the share of investment categories in their public expenditure. However, Burret and Feld (2018) find a positive effect of sub-national fiscal rules on public investment in Swiss cantons, due to investment accounts not being covered by the debt brake.

Delgado-Téllez, Gordo, Kataryniuk, and Pérez (2022) show that fiscal rules, alongside structural factors, help explain the decline in public investment in the OECD countries over recent decades. Schakel, Wu, and Jeurissen (2018) also analyze the OECD data on 22 countries; they deliver evidence that public expenditure in the health care sector shrinks significantly in the presence of national and supranational fiscal rules. However, Vinturis (2023) finds the negative effect of fiscal rules on public consumption, but not on public investment, so that the public investment-to-consumption ratio increases.

Further areas of research closely related to this study concern changes in public expenditure composition under consolidation pressure. Breunig and Busemeyer (2012) argue that fiscal consolidations disproportionately affect discretionary spending, such as public investment, compared to social entitlements, such as pensions. Empirical studies confirm that investment expenditure tends to shrink during fiscal consolidation episodes. For example, Bamba et al. (2020) find that fiscal consolidations reduce the government investment-to-consumption ratio, particularly in developing countries, when the debt level is high, and in the low phase of the business cycle. Also, Castro (2017) identifies a negative effect of fiscal consolidation episodes on public spending in 15 EU states in several categories, such as defense, public order, environment, housing, health, education and social protection. One recent and most relevant contribution to this branch of research can be highlighted: Ardanaz et al. (2021) find that flexible rules protect public investment from cuts during consolidation episodes, whereas rigid rules do not.

All in all, the effect of fiscal rules on public investment and its procyclicality in the EU has been studied only partially, and the research of their effects is not conclusive. My contribution closes the gap in a multitude of ways. First, I provide new evidence on the procyclicality of public investment

in the EU and disentangle its dynamics over the business cycle. Second, using the most detailed and comprehensive datasets on public investment and fiscal rules, I are able to examine the impact of fiscal rules on public investment, and importantly, the role of their design. Last but not least, I investigate which specific investment categories are affected. I do not focus on a time-varying or country-specific procyclicality measure à la Aghion and Marinescu (2008), but on the overall effect of fiscal rules on public investment in the EU. Thus, I follow Bergman and Hutchison (2015), Bamba et al. (2020), Ardanaz et al. (2021), among others, and estimate a dynamic panel with country-specific and time-fixed effects. This allows me to identify a general effect of fiscal rules on public investment and its categories.

My results nuance the finding that developed countries manage to avoid the procyclicality of public spending and, especially, public investment, whereas developing countries are still more susceptible to procyclicality (Frankel et al., 2013; Ardanaz & Izquierdo, 2022). My focus is on EU member states that do not coincide with the sample of developed countries in previous studies, as, for example, Ardanaz and Izquierdo (2022) categorize some Central and Eastern European countries as developing economies. I show that EU countries, on average, exhibit procyclical behavior of public investment that is more characteristic of developing countries. My observation that the procyclicality of public investment in the EU occurs in bad times resembles the findings in Paetz (2020). The result that rigid rules exacerbate the procyclicality of public investment, whereas flexible rules do not, aligns with Ardanaz et al. (2021) who show that flexible rules prevent cuts in public investment during consolidation episodes.

1.3 Model specification and data

1.3.1 Model specification

I start the empirical investigation with the following specification of a panel linear regression model with country-specific and year-fixed effects:

$$GOVINV_{it} = \alpha + \beta_1 Cycle_{it} + \lambda_i + \delta_t + \epsilon_{it}, \tag{1.1}$$

where $GOVINV_{it}$ is an indicator for public investment and the $Cycle$ variable is the cyclical component of real GDP in country i in period t.[2] The coefficient β_1 measures the reaction of government investment to the fluctuations of the economic cycle.

I employ three main specifications of the dependent variable: the cyclical component of public investment obtained by HP decomposition (analogous to the cycle component of GDP), public investment in percent of GDP, and public investment in log levels. In addition, I will show the

[2]The cyclical component is obtained by Hodrick-Prescott (HP) decomposition. The smoothing parameter λ for annual data is equal to 6.25 (Ravn & Uhlig, 2002). The robustness check section will also show alternative specifications for the $Cycle$ based on Hamilton filter.

results for specific categories of public investment (in percent of GDP). I include country-specific effects to account for persistent differences between the groups in my sample and time-fixed effects to eliminate common shocks in specific years. Lastly, I cluster standard errors on the group level to correct for heteroscedasticity and autocorrelation of the error terms.

Further I split the *Cycle* to investigate the cyclicality of public investment in good and bad times. The model will take the form:

$$GOVINV_{it} = \alpha + \beta_1 Cycle_{it}(bad) + \beta_2 Cycle_{it}(good) + \lambda_i + \delta_t + \epsilon_{it}. \tag{1.2}$$

The coefficient β_1 now captures the procyclicality of public investment in bad times, and the coefficient β_2 in good times. I use the common definition of bad times as negative values of the *Cycle* variable, and of good times as positive values.

In the next step, I add fiscal rules and other control variables to the model:

$$GOVINV_{it} = \alpha + \beta_1 Cycle_{it} + \beta_2 FR_{it} + \gamma^k X^k_{it-1} + \lambda_i + \delta_t + \epsilon_{it}, \tag{1.3}$$

where FR is the dummy for a fiscal rule. I test a dummy for any national fiscal rule and then separately flexible and rigid fiscal rules. Again, I will distinguish between recessions and upswings:

$$GOVINV_{it} = \alpha + \beta_1 Cycle_{it}(bad) + \beta_2 Cycle_{it}(good) + \beta_3 FR_{it} + \gamma^k X^k_{it-1} + \lambda_i + \delta_t + \epsilon_{it}. \tag{1.4}$$

Moreover, I also test how fiscal rules affect the procyclicality of public investment. For this, I follow the approach of Huart (2013) to condition the effects of the variable of interest on the fiscal rule dummy and separate the effect of both cycle variables into periods with and without fiscal rules. The model will take form:

$$GOVINV_{it} = \alpha + \beta_1 Cycle_{it}(bad) * FR_{it} + \beta_2 Cycle_{it}(good) * FR_{it} + \beta_3 FR_{it} + \gamma^k X^k_{it-1} + \lambda_i + \delta_t + \epsilon_{it}, \tag{1.5}$$

where β_1 as well as β_2 can take on different values conditional on whether $FR = 0$ or $FR = 1$, and β_3 captures the ceteris paribus effect of the fiscal rules on public investment.

Here, X^k_{it-1} is a vector of control variables that includes long-term interest rate, government debt in percent of GDP, government revenue in percent of GDP, a measure of institutional quality, and, in some specifications, the trend of GDP and the lagged dependent variable. The logic behind the control variables is as follows. Both higher interest rates and government debt incorporate financial barriers to investment. These two variables are anticipated to come with a negative coefficient. Government revenue measures the spending capacity and should exhibit a positive coefficient. The proxy for institutional quality is a corruption index and, since higher corruption should reduce government efficiency, I expect a negative coefficient. GDP trend is expected to have a positive effect on the level of public investment. All control variables are lagged one period

to reduce endogeneity problems. Moreover, the lagged dependent variable captures the inertia of public investment, when specified in log levels or as a share of GDP, and is expected to show a large and positive coefficient close to unity.

In a further set of control variables, I will also use a dummy for the European fiscal rules to check if they have any influence on the results. Although the countries in my sample are all subject to the SGP, a heterogeneity can arise because the member states have been covered by the Pact for different time periods. Furthermore, I will test a set of additional economic and political controls, widely used in the literature, and first and second lags of the variables of interest.

1.3.2 Data

I employ the IMF Fiscal Rules Dataset (IMF, 2022; Schaechter et al., 2012) which offers a comprehensive overview on the adoption of fiscal rules around the globe from 1985 to 2021. The dataset allows a differentiation between national and supranational fiscal rules. In my analysis, I will focus on national fiscal rules. Further details are also provided in the dataset, for example, whether the adopted fiscal rules are flexible. These flexibility features include: (*i*) escape clause which allows to switch the rule off in extraordinary circumstances, (*ii*) budget targets in cyclically adjusted terms, (*iii*) targets exclude public investment from the ceiling, or a combination thereof.

Data on public investment, i.e. public GFCF, and on GDP, both in constant international dollars, come from the IMF Investment and Capital Stock Dataset (IMF, 2021b; Xiao, Amaglobeli, & Matsumoto, 2021). I also employ the Organisation for Economic Co-operation and Development (OECD) dataset on public GFCF categorized according to the Classification of the Functions of Government - COFOG (OECD, 2022). Public debt data are retrieved from the IMF Historic Public Debt Database (IMF, 2021a; Abbas, Belhocine, El-Ganainy, & Horton, 2010). Long-term interest rates are the yields on government bonds with maturity of 10 years obtained from the International Financial Statistics (IMF, 2020). Data on government revenue are obtained from the World Economic Outlook (WEO) (IMF, 2021c). I use the Bayesian Corruption Index (BCI) as the measure of institutional quality (Standaert, 2015).

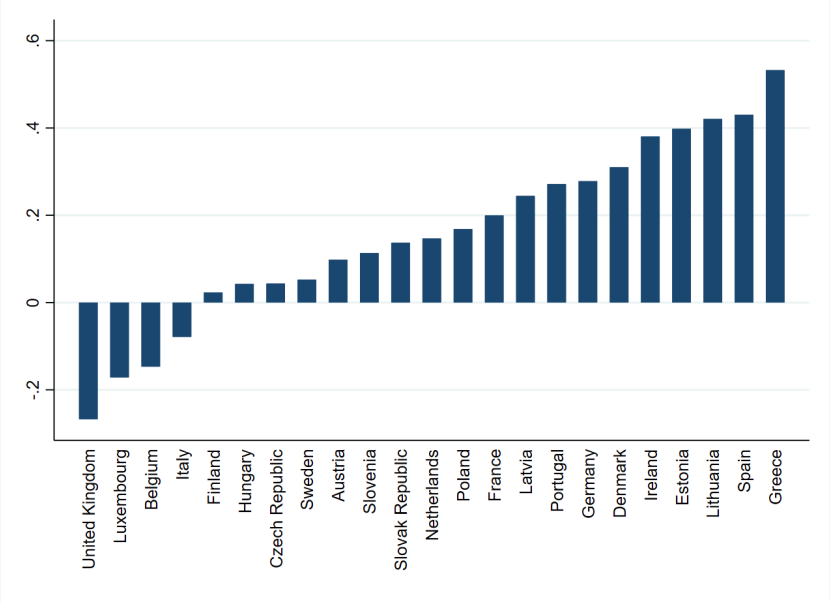
Additionally, I use an election dummy as well as a left-wing government dummy from the Database of Political Institutions (Cruz, Keefer, & Scartascini, 2020) as political controls and data on inflation, trade openness and the share of dependent population from the World Development Indicators (World Bank, 2023). Data on the Fiscal Rule Strength Index come from the European Commission (2022). This provides me with an unbalanced panel of 23 EU countries[3] for the period 1985 to 2019. Table 1.10 in the Appendix presents the descriptive statistics of the main variables.

To begin with, I investigate the geographical heterogeneity of the volume of investment expen-

[3]Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom. Bulgaria, Croatia, Cyprus, Malta, and Romania are not included due to insufficient historical data. United Kingdom was part of the EU during the observed period.

diture, cyclical volatility, and procyclicality across the sample. Figure 1.2 shows the correlation coefficients of the cyclical components of public investment and GDP for my 23 economies. A positive (negative) value indicates procyclical (countercyclical) government investment. There is a notable variability in the degree to which public investment correlates with the economic cycle across the countries. Some states (e.g. UK and Luxembourg) exhibit close to zero or even slightly negative correlation between the cyclical components of public investment and GDP, signifying that government investment mostly behaved acyclically or countercyclically. Others, especially Spain and Greece, show a rather high procyclicality of public investment.

Figure 1.2: Correlation coefficients of cyclical components of public investment and GDP



Notes: The cyclical components are obtained by HP decomposition. A positive (negative) value indicates procyclical (countercyclical) government investment. Source: Author's elaboration based on the IMF Investment and Capital Stock Dataset (IMF, 2021b).

In addition, Figure 1.3 (in the Appendix) shows the distributions of the cyclical component of government investment and of public investment as a share of GDP for individual countries. The differences between individual countries are large for both variables, indicating a high heterogeneity throughout the sample, where Eastern and Southern Europe exhibit larger spreads in values. Some countries have apparently experienced periods of very high and low public investment rates, while others kept much more consistent levels of public investment as a share of GDP, such as most of Western Europe. However, the dispersion of median values is substantial. All in all, there is no evident relationship between the size and the volatility of public investment across the sample. Instead, the economies seem to exhibit diverging patterns of public investment, confirming my choice of the econometric model with country fixed effects.

1.3.3 Stationarity of the main variables

Before I proceed with the econometric analysis, I will test the stationarity of the main variables to address the issue of a possible spurious relationship. Table 1.1 shows the p-values of the unit root tests for the main variables except the FR dummies which are by definition stationary. I choose the tests suitable for unbalanced panels where $T > N$ and allowing for group-specific autoregressive coefficients. I present the test statistics for series with (column 1) and without cross-sectional means (column 2). Demeaning the series is a technique proposed by Levin, Lin, and Chu (2002) to reduce the contemporaneous correlation across groups.

Table 1.1: Unit root tests of the main variables

Variables		Im–Pesaran–Shin*		Fisher (Dickey-Fuller)**		Fisher (Phillips–Perron)**	
		(1)	(2)	(1)	(2)	(1)	(2)
GovInv	log levels	0.967	0.616	0.999	0.991	0.992	0.620
GovInv	% of GDP	0.008	0.003	0.636	0.824	0.001	0.007
GovInv	cycl. comp.	0.000	0.000	0.000	0.000	0.000	0.000
Cycle	% of GDP	0.000	0.000	0.000	0.000	0.000	0.000
GDPtrend	log levels	0.761	0.000	0.925	0.000	0.225	0.000
Interest	%	0.989	0.000	1.000	0.000	0.988	0.000
Debt	% of GDP	0.996	0.496	1.000	0.891	1.000	0.985
Gov.Revenue	% of GDP	0.000	0.000	0.214	0.198	0.000	0.000
BCI	Index	0.011	0.002	0.047	0.000	0.102	0.968

Notes: p-values of Im-Pesaran-Shin (Im, Pesaran, & Shin, 2003) and Fisher-type (Choi, 2001) unit root tests for series with (1) and without cross-sectional means (2). *Number of lags for the ADF regressions is determined by AIC and limited by 4. **4 lags are used in the ADF regressions; p-value of the inverse-normal transformation is reported.

Indeed, all tests reject the null hypothesis of non-stationarity only for the cyclical component of GDP and of government investment. I cannot reject the null for the dependent variable in log levels and in percent of GDP (with the Dickey-Fuller test). Thus, I include the lagged value to the right hand side of the econometric model when I specify the dependent variable in log levels or as a share of GDP, since the variables tend to be autoregressive with a coefficient being close to unity. Furthermore, I cannot claim that the control variables are stationary since not all tests reject the null of unit roots in the data. Possible non-stationarity of regressors might be a problem if it produces a spurious correlation. Therefore, I specify control variables in first differences which are stationary.

Moreover, I perform the Born and Breitung bias-corrected test for serial correlation for the residuals of the OLS estimation of the main model with the dependent variable specified in log

levels. With a p-value of 0.385, I attest that the residuals exhibit no serial autocorrelation. Therefore, I proceed with the OLS estimation of the panel. However, I also show the results of the GLS estimation in Table 1.12 in the Appendix. They are remarkably similar to the OLS estimates in Table 1.3.

1.4 Baseline results

1.4.1 Procyclicality of public investment

This section will analyze how public investment reacts to economic cycle fluctuations. I will run the earlier specified regression models Equation 1.1 and 1.2 and use the three definitions of the dependent variable: First, I use the cyclical component of public investment obtained by HP decomposition (analogous to the cyclical component of GDP), as in Frankel et al. (2013); second, I express public investment in percent of GDP; in addition, I will use public investment in log levels.

Table 1.2 presents the results of the panel linear regressions. Columns 1 and 2 exhibit the coefficients for the first dependent variable, the cyclical component of public investment. Without distinguishing between the economic phases (column 1), the coefficient of the cycle variable is roughly 1 and is highly statistically significant. Thus, public investment in my sample is procyclical and diverges from the trend by 1 percentage point for every percentage point of the cyclical movement in GDP. In the next step, I disentangle the effects of the economic cycle in good and bad times (column 2). I separate the observations into *bad* and *good* phases, where *bad* is characterized by a negative value of the cycle variable (52% of all observations), and *good* is thus defined by a positive value (48% of all observations). This differentiation reveals that the cyclical component of public investment reacts over-proportionally (coefficient larger than 1) to the cyclical fluctuations in recessions, whereas in an upswing, the procyclicality seems to be less pronounced (coefficient smaller than 1).

Note that the positive coefficient of $Cycle(bad)$ in column 2 signifies procyclicality since the cyclical component of public investment also can take on negative values, so they move in the same (negative) direction. This is different for the other two specifications of the dependent variable since they can only take on positive values. For the clarity of the coefficient interpretation, I include the $Cycle(bad)$ in absolute values (non-negative) in the regressions with the dependent variables that can only be positive. The negative coefficient of the $Cycle(bad)$ in columns 4 and 6 thus means that public investment in percent of GDP and in log levels declines in response to output gap in bad times.

Columns 3 and 4 present the results of the regressions where the dependent variable is specified in percent of GDP. Importantly, the dependent variable in percent of GDP measures over-procyclicality of public investment, since in order for government investment in GDP to increase,

Table 1.2: Procyclicality of public investment

VARIABLES	(1) GovInv Cycl. comp.	(2) GovInv Cycl. comp.	(3) GovInv % GDP	(4) GovInv % GDP	(5) GovInv log levels	(6) GovInv log levels
Cycle	1.013***		0.009		0.007**	
	(0.002)		(0.008)		(0.002)	
Cycle (bad)		1.251***		-0.028*		-0.016***
		(0.329)		(0.015)		(0.005)
Cycle (good)		0.796***		-0.010		-0.002
		(0.213)		(0.011)		(0.005)
GovInv(t-1)			0.816***	0.809***	0.897***	0.888***
			(0.038)	(0.038)	(0.029)	(0.030)
Observations	774	774	752	752	758	758
R-squared	0.164	0.165	0.707	0.708	0.893	0.894
Number of groups	23	23	23	23	23	23
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Notes: Constant and fixed country and year effects are not reported for brevity.
Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

public investment must increase more than the GDP. The coefficient of the cycle variable is not statistically significant until I distinguish between bad and good times. The over-procyclicality of public investment as a share of GDP is evident only in the low phase of the cycle (column 4). Thus, public investment reacts over-proportionally to the economic downturn, but not to the upturn. The coefficient indicates that, if the economy is contracting, the dependent variable would go down by around 0.028 percentage points for every percentage point of the output gap.

Columns 5 and 6 show the findings for public investment in log levels. Public investment moves with the cycle and reacts with a 0.7% change to every percentage point of output gap (statistically significant at the 5% level). However, dividing the *Cycle* into good and bad times, I discover that the effect is large and highly statistically significant in recessions, whereas it is not statistically different from zero in upswings. So, the levels of public investment seem to be adversely affected by recessions in the EU.

1.4.2 The effect of fiscal rules on public investment and its procyclicality

This section presents the results of the panel regressions which include fiscal rules. In the first step, I specify public investment in log levels and show that (rigid) fiscal rules impact the levels of public investment and its procyclicality in the EU. In addition, I test the dependent variable in percent of GDP and show that the over-procyclicality of public investment is exacerbated by rigid fiscal rules. Also, the estimations with this dependent variable make the baseline results comparable to the later analysis in terms of the COFOG categories of public investment which are provided as a

share of GDP. As a robustness check, I also run regressions with the cyclical component of public investment.

Table 1.3 shows the results of the OLS estimations[4] of Equation 1.3, 1.4 and 1.5 with the dependent variable specified in log levels. First, I investigate the effect of fiscal rules on public investment by testing a dummy for a national fiscal rule, $NatFR$ (column 1). The dummy is equal to one if there is any fiscal rule operating which is adopted in domestic legislation. I confirm that fiscal rules seem to adversely influence investment expenditure: With a fiscal rule in place, public investment is 2.7% lower on average in my sample, all other factors held constant. However, the effect is statistically significant only at the 10% level. Notably, the coefficient of the cycle variable is larger, than in the model without controls, and statistically significant at the 5% level.

Control variables exhibit the expected sign and magnitude, except for interest rate and government revenue which are not statistically significant.[5] Importantly, the lagged dependent variable exhibits a plausibly large coefficient of almost 0.8. Thus, government investment demonstrates significant persistence. Since I constructed a dynamic panel (where the lagged dependent variable is one of the regressors) and apply a within-group estimator, the coefficient might be subject to Nickell's bias (Nickell, 1981). The coefficient of the lagged dependent variable is somewhat biased downwards, but the bias is minor due to the rather large number of periods in my sample. Since the data do not satisfy the large N, fixed T condition, the generalized method of moments (GMM) estimator developed to circumvent the Nickell's bias problem in dynamic panels (Bond, Hoeffler, & Temple, 2001) runs into an overidentification problem when using the full sample (Roodman, 2009b). However, I will run GMM regressions for several subsamples in the robustness check section. The results of the GMM estimations confirm my baseline findings (Table 1.8).

As discussed in subsection 1.3.2 on data, flexible rules include those with escape clauses, cyclically adjusted balance rules, and investment-friendly rules. Over time, an increasing number of national fiscal rules in the EU were equipped with these characteristics. So, in the next step, I test one of my main hypotheses that rigid fiscal rules, that do not allow for enough adjustment to the economic conditions, hinder public investment expenditure. I employ the same econometric model and now separate $NatlFR$ into flexible and rigid rules. The $FLEX$ dummy is one when at least two of the flexibility features are in place; otherwise, the $RIGID$ dummy equals one. It is possible that a number of distinct rules are in place at the same time in one country where some are flexible and others are rigid, so both dummies can be equal to one simultaneously. Results are displayed in column 2 of Table 1.3. Indeed, I confirm the hypothesis that flexible rules do not show

[4] I proceed with the OLS regressions, but also show the GLS estimations in Table 1.12 in the Appendix, which is remarkably similar, signifying that there is no autocorrelation of errors.

[5] Additionally, Table 1.11 in the Appendix shows the coefficients of further control variables widely adopted in the literature. These include EU fiscal rules, additional economic and political control variables (inflation, trade openness, general elections, left-leaning government, share of dependent population (below 14 and over 65 years old), as well as two lags of the fiscal rule dummy and of the cycle variable. None of them proves to be statistically significant, supporting the choice of the baseline model.

Table 1.3: Effects of fiscal rules on government investment, log levels, HP filter

	Dependent variable: GovInv (log levels)					
	(1)	(2)	(3)	(4)	(5)	(6)
NatFR	-0.027*		-0.027*		-0.018	
	(0.016)		(0.016)		(0.017)	
FLEX		-0.008		-0.010		-0.003
		(0.019)		(0.020)		(0.020)
RIGID		-0.040**		-0.040**		-0.032*
		(0.016)		(0.016)		(0.016)
Cycle	0.011**	0.011**				
	(0.005)	(0.005)				
Cycle (bad)			-0.014**	-0.013*		
			(0.006)	(0.007)		
Cycle (good)			0.008	0.009		
			(0.007)	(0.007)		
Cycle (Bad) × NatFR (0)					-0.009	-0.009
					(0.008)	(0.007)
Cycle (Bad) × NatFR (1)					-0.016**	
					(0.007)	
Cycle (Bad) × FLEX (1)						-0.014
						(0.014)
Cycle (Bad) × RIGID (1)						-0.015**
						(0.007)
Cycle (Good) × NatFR (0)					0.012	0.013*
					(0.007)	(0.007)
Cycle (Good) × NatFR (1)					0.004	
					(0.007)	
Cycle (Good) × FLEX (1)						0.007
						(0.017)
Cycle (Good) × RIGID (1)						0.005
						(0.007)
GovInv (t-1)	0.789***	0.784***	0.788***	0.784***	0.788***	0.783***
	(0.039)	(0.040)	(0.039)	(0.040)	(0.040)	(0.040)
GDP trend (t-1)	0.013***	0.013***	0.013***	0.013***	0.012***	0.012***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
Interest (t-1)	-0.003	-0.003	-0.002	-0.002	-0.002	-0.003
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
GovDebt (t-1)	-0.004***	-0.004***	-0.004***	-0.004***	-0.004***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
GovRevenue (t-1)	-0.000	-0.000	-0.000	-0.000	-0.000	0.000
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
BCI (t-1)	-0.028*	-0.029*	-0.028*	-0.029*	-0.028*	-0.029*
	(0.015)	(0.015)	(0.015)	(0.015)	(0.014)	(0.015)
Observations	613	613	613	613	613	613
R-squared within model	0.824	0.825	0.824	0.825	0.824	0.825
Number of groups	23	23	23	23	23	23
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Notes: Fixed country and year effects and the constant are not reported for brevity.
Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

a statistically significant negative effect on government investment, whereas rigid rules do. Public investment appears to be on average 4% lower if a rigid fiscal rule is in place. The coefficient is statistically significant at the 5% level.

Moreover, I test an alternative definition of rigid and flexible rules, where flexible rules are those with at least one flexibility feature, and rigid rules are those with none. Table 1.14 (in the Appendix) shows the results of the regressions which are very similar to the baseline results. When defined in the alternative way, again, only rigid fiscal rules seem to restrict public investment. Furthermore, I regress the dependent variable on single flexibility dummies (escape clause, cyclically adjusted target, or golden rule) separately. Flexibility features neither yield a statistically significant coefficient on their own, nor change the coefficient of the rigid rule dummy in any profound way (column 2). Lastly, I employ the Fiscal Rules Strength Index (FRSI) of the European Commission (2022) as an alternative dataset for fiscal rules (column 3), which offers a continuous variable instead of a fiscal rule dummy for each country and period.[6] I reinforce the finding that stricter fiscal rules, as measured by the FRSI, constrain public investment. In conclusion, my baseline results remain stable.

Columns 3 and 4 of Table 1.3 exhibit the regression coefficients of the model specified by Equation 1.4, where I separate the effects of the cycle variable in bad and good times. Again, the coefficient of the output gap is only statistically significant in recessions, and not in upswings, and rigid fiscal rules show a negative effect on levels of public investment.

Finally, columns 5 and 6 of Table 1.3 show the estimation results of the model specified by Equation 1.5. Here, I separate the effect of both good and bad *Cycle* into periods with and without fiscal rules, while controlling for the ceteris paribus effect of the fiscal rules. Indeed, I confirm the procyclicality of public investment in the low phase of the economic cycle, but the coefficient is larger and statistically significant at the 5% level, only if there is a fiscal rule in place (column 5). Furthermore, I disentangle the effects of rigid and flexible rules (column 6). I find that while rigid fiscal rules seems to exhibit a negative effect on the levels of public investment, while keeping other factors constant, and also exacerbate the procyclicality of public investment in recessions. At the same time, public investment appears to be procyclical in good times (at a 10% level) if there are no fiscal rule in place.

Comparing these findings to the results of the regressions with the dependent variable specified in percent of GDP (Table 1.4), two conclusions can be made. First, the results are remarkably robust, and I can clearly confirm the finding that rigid fiscal rules show a pronounced and statistically significant detrimental impact on public investment and magnify its procyclicality in bad times. Second, public investment as a share of GDP measures over-procyclicality of public investment, since this variable increases only if public investment grows more than the GDP. Thus, fiscal rules

[6]The FRSI takes 5 criteria into consideration: legal base, binding character, monitoring of compliance, correction mechanism, and resilience to shocks. The "strength" of fiscal rules is therefore not the same as their rigidity, since it puts more focus on their binding character rather than on the capacity to accommodate unexpected events. Although some flexibility features are positively correlated with the FRSI in the adaptability to shocks dimension, this dimension has a small weight in the FRSI calculation (0.05). Other flexibility attributes do not correlate with the FRSI. Altogether, rigid fiscal rules exhibit a higher correlation with the FRSI, than flexible rules.

Table 1.4: Effects of fiscal rules on government investment, percent of GDP, HP filter

	Dependent variable: GovInv (% of GDP)					
	(1)	(2)	(3)	(4)	(5)	(6)
NatFR	-0.131**		-0.131**		-0.082	
	(0.052)		(0.052)		(0.059)	
FLEX		-0.080		-0.084		-0.036
		(0.069)		(0.070)		(0.076)
RIGID		-0.163***		-0.162***		-0.128**
		(0.056)		(0.057)		(0.060)
Cycle	0.037*	0.037*				
	(0.018)	(0.018)				
Cycle (bad)			-0.044*	-0.043*		
			(0.022)	(0.023)		
Cycle (good)			0.030	0.031		
			(0.031)	(0.032)		
Cycle (Bad) × NatFR (0)					-0.019	-0.018
					(0.026)	(0.025)
Cycle (Bad) × NatFR (1)					-0.058**	
					(0.026)	
Cycle (Bad) × FLEX (1)						-0.064
						(0.053)
Cycle (Bad) × RIGID (1)						-0.053*
						(0.026)
Cycle (Good) × NatFR (0)					0.049	0.049
					(0.030)	(0.030)
Cycle (Good) × NatFR (1)					0.011	
					(0.036)	
Cycle (Good) × FLEX (1)						-0.005
						(0.072)
Cycle (Good) × RIGID (1)						0.015
						(0.034)
GovInv (t-1)	0.691***	0.688***	0.691***	0.687***	0.690***	0.685***
	(0.046)	(0.048)	(0.046)	(0.048)	(0.047)	(0.048)
Interest (t-1)	0.006	0.006	0.007	0.007	0.006	0.006
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.012)
GovDebt (t-1)	-0.011***	-0.011***	-0.011***	-0.011***	-0.012***	-0.012***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
GovRevenue (t-1)	-0.006	-0.005	-0.005	-0.005	-0.004	-0.004
	(0.013)	(0.013)	(0.013)	(0.013)	(0.012)	(0.012)
BCI (t-1)	-0.132**	-0.135**	-0.130**	-0.134**	-0.129**	-0.132**
	(0.059)	(0.060)	(0.059)	(0.060)	(0.057)	(0.060)
Observations	613	613	613	613	613	613
R-squared within model	0.607	0.609	0.607	0.609	0.608	0.610
Number of groups	23	23	23	23	23	23
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Notes: Fixed country and year effects and the constant are not reported for brevity.
Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

increase the over-procyclical reaction of public investment in recessions.

In addition, the robustness test, employing the cyclical component of public investment as the dependent variable, supports my findings (Table 1.13 in the Appendix). In case fiscal rules are implemented, the *Cycle* shows a larger and more statistically significant effect on the cyclical component of public investment in bad times, and a smaller, less statistically significant coefficient in good times.

In summary, fiscal rules do show a detrimental effect on the levels of public investment in the EU. Specifically, rigid fiscal rules restrain government investment. Also, rigid fiscal rules exacerbate the (over-)procyclical reaction of public investment expenditure in recessions. This finding is supported by additional tests with alternative definitions of the dependent variable and fiscal rules.

1.4.3 Robustness tests

In this section, I perform a variety of tests to check the robustness of my results to the choice of the estimation techniques. First, I employ other measures of the business cycle, namely the cyclical component of GDP measured by Hamilton filter. I also present the results of two-stage least squares (2SLS) and GMM estimations of my econometric models. All in all, the tests demonstrate a strong support for the baseline results.

Cyclical component measured by Hamilton filter

I have previously opted for the cyclical component of real GDP obtained by HP decomposition as the measure of economic fluctuation. Since HP filter is not uncontroversial, I use another GDP decomposition procedure proposed by Hamilton (2018)[7] to measure the economic cycle. Bad and good times are now defined as the negative and positive values of the cyclical component of the Hamilton filter.

Table 1.5 and 1.6 display coefficients of the OLS regressions with *Cycle* measured by the Hamilton filter, for public investment in log levels and as a share of GDP, respectively (analogous to Table 1.3 and 1.4). All in all, my previous findings prove to be strongly robust to the choice of filtering technique. The procyclicality of public investment is large and highly statistically significant, and again it occurs in bad times. In addition, I confirm the finding that rigid fiscal rules restrain public investment measured in log levels as well as as a share of GDP. However, the regression results with the cyclical component estimated by the Hamilton filter suggest that the levels of government investment, on average, fall in recessions, whether or not fiscal rules are in place (column 6 of Table 1.5). Whereas the over-procyclicality of public investment in percent of GDP occurs, indeed, only in bad times when rigid fiscal rules are implemented, statistically significant at 1% level (column 6 of Table 1.6).

[7]The caveat is that by design of the filtering technique, I lose the first three observations per group.

Table 1.5: Effects of fiscal rules on government investment, log levels, Hamilton filter

	Dependent variable: GovInv (log levels)					
	(1)	(2)	(3)	(4)	(5)	(6)
NatFR	-0.028		-0.028		-0.012	
	(0.017)		(0.017)		(0.023)	
FLEX		-0.006		-0.009		0.004
		(0.023)		(0.022)		(0.024)
RIGID		-0.041**		-0.040**		-0.028
		(0.017)		(0.017)		(0.024)
Cycle	0.009***	0.009***				
	(0.002)	(0.002)				
Cycle (bad)			-0.013***	-0.013***		
			(0.002)	(0.002)		
Cycle (good)			0.004	0.005		
			(0.005)	(0.005)		
Cycle (Bad) × NatFR (0)					-0.011***	-0.011***
					(0.003)	(0.003)
Cycle (Bad) × NatFR (1)					-0.014***	
					(0.002)	
Cycle (Bad) × FLEX (1)						-0.012**
						(0.005)
Cycle (Bad) × RIGID (1)						-0.014***
						(0.002)
Cycle (Good) × NatFR (0)					0.008	0.008
					(0.005)	(0.005)
Cycle (Good) × NatFR (1)					0.003	
					(0.005)	
Cycle (Good) × FLEX (1)						0.001
						(0.005)
Cycle (Good) × RIGID (1)						0.003
						(0.005)
GovInv (t-1)	0.801***	0.795***	0.801***	0.796***	0.802***	0.797***
	(0.041)	(0.042)	(0.041)	(0.042)	(0.041)	(0.042)
GDP trend (t-1)	0.002	0.002	0.002	0.002	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Interest (t-1)	0.000	0.000	0.001	0.001	0.001	0.001
	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)
GovDebt (t-1)	-0.004***	-0.004***	-0.004***	-0.004***	-0.004***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
GovRevenue (t-1)	-0.000	-0.000	-0.001	-0.001	-0.001	-0.001
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
BCI (t-1)	-0.027*	-0.029*	-0.026*	-0.028*	-0.026*	-0.028*
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.015)
Observations	586	586	586	586	586	586
R-squared within model	0.815	0.816	0.817	0.818	0.817	0.818
Number of groups	23	23	23	23	23	23
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Notes: Fixed country and year effects and the constant are not reported for brevity.
Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 1.6: Effects of fiscal rules on government investment, percent of GDP, Hamilton filter

	Dependent variable: GovInv (% of GDP)					
	(1)	(2)	(3)	(4)	(5)	(6)
NatFR	-0.123**		-0.123**		-0.076	
	(0.053)		(0.053)		(0.080)	
FLEX		-0.069		-0.077		-0.062
		(0.072)		(0.068)		(0.082)
RIGID		-0.158**		-0.156**		-0.113
		(0.057)		(0.059)		(0.083)
Cycle	0.012	0.012				
	(0.009)	(0.009)				
Cycle (bad)			-0.022**	-0.021**		
			(0.010)	(0.010)		
Cycle (good)			0.002	0.002		
			(0.020)	(0.020)		
Cycle (bad) × NatFR (0)					-0.014	-0.013
					(0.014)	(0.014)
Cycle (bad) × NatFR (1)					-0.027***	
					(0.009)	
Cycle (bad) × FLEX (1)						-0.017
						(0.018)
Cycle (bad) × RIGID (1)						-0.028***
						(0.009)
Cycle (good) × NatFR (0)					0.011	0.010
					(0.022)	(0.020)
Cycle (good) × NatFR (1)					-0.002	
					(0.021)	
Cycle (good) × FLEX (1)						0.006
						(0.020)
Cycle (good) × RIGID (1)						-0.004
						(0.022)
GovInv (t-1)	0.699***	0.695***	0.700***	0.696***	0.700***	0.696***
	(0.049)	(0.050)	(0.048)	(0.050)	(0.049)	(0.050)
Interest (t-1)	0.011	0.010	0.012	0.012	0.011	0.011
	(0.014)	(0.014)	(0.012)	(0.013)	(0.013)	(0.013)
GovDebt (t-1)	-0.011***	-0.011***	-0.011***	-0.011***	-0.011***	-0.011***
	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)	(0.003)
GovRevenue (t-1)	-0.004	-0.004	-0.006	-0.005	-0.005	-0.005
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
BCI (t-1)	-0.132**	-0.135**	-0.129**	-0.133**	-0.129**	-0.137**
	(0.059)	(0.059)	(0.058)	(0.058)	(0.058)	(0.065)
Observations	605	605	605	605	605	605
R-squared within model	0.603	0.605	0.605	0.606	0.605	0.607
Number of groups	23	23	23	23	23	23
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Notes: Fixed country and year effects and the constant are not reported for brevity.
Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Instrumental variable approach

This section will address the concern for the endogeneity of the contemporaneous business cycle variable as a regressor in my model. Since public investment expenditure can affect the cyclical movements through the multiplier effects, I instrument the *Cycle* with a variable that is exogenous to government spending. To tackle this, the 2SLS approach of Galí and Perotti (2003) has been widely used in the literature on the cyclicality of fiscal policy. This practice involves instrumenting the cycle, usually with the respective own lag and with the lag of the US business cycle. Unfortunately, this approach is not feasible since the time fixed effects do not allow for using country-invariant instruments such as the US cycle. Instead, I follow another approach established in the literature that employs the weighted average of the main trading partners' output gap as the instrumental variable (Ardanaz & Izquierdo, 2022; Jaimovich & Panizza, 2007; Ilzetzki & Vegh, 2008). This method computes the weights for the output gaps of the trading partners based on their share of exports from the country in question.

In my case, I use the bilateral Direction of Trade Statistics data (IMF, 2024) for the 23 EU states I study and compute the shares of exports for each trading partner of the respective country in the dataset. This provides me with enough new information for the instruments to be country-specific and work well for my panel data. Using these weights, I compute the measure of the economic cycle of the trading partners. With large t-values (see Table 1.15 in the Appendix) and an F-statistic of 13.77, this export-weighted cycle variable proves to be a highly relevant instrument for the contemporaneous cycle. Also, the values of the weak instrument test statistic strongly reject the presence of a weak instrument in the 2SLS regressions, although less so when I divide the instruments into the phases of the cycle to fit their number to the number of the instrumented regressors.

Table 1.7 presents the results of the second stage regressions with the dependent variable specified in log levels. The estimates strongly resemble the baseline results (compare to columns 1 to 4 of Table 1.3). The coefficient of the instrumented cycle variable is larger than in the baseline results, with, on average, a change in public investment of 1.6% for every percentage point of output gap, and statistically significant at 5% level. When the separation into different phases of the cycle is carried out, the coefficient of the *Cycle* in bad times is large and statistically significant, whereas it is zero in good times. Thus, the instrumental variable regressions confirm the detrimental effect of downturns on the levels of public investment in the EU. The rest of the coefficients remain roughly the same.

Furthermore, the 2SLS approach allows me to test the hypothesis of the endogeneity of the contemporaneous cycle variable in the first place. I test the endogeneity of the instrumented regressor directly using the option *endog* available along the *xtivreg*2 command in Stata. The p-

Table 1.7: Effects of fiscal rules on government investment: 2SLS

	Dependent variable: GovInv (log levels)			
	(1)	(2)	(3)	(4)
NatFR	-0.028*		-0.029*	
	(0.016)		(0.017)	
RIGID		-0.041**		-0.040**
		(0.016)		(0.017)
FLEX		-0.009		-0.018
		(0.019)		(0.021)
Cycle	0.016**	0.015**		
	(0.007)	(0.007)		
Cycle (bad)			-0.036**	-0.033*
			(0.017)	(0.017)
Cycle (good)			0.000	0.000
			(0.016)	(0.016)
GovInv (t-1)	0.785***	0.780***	0.780***	0.776***
	(0.039)	(0.040)	(0.039)	(0.040)
GDP trend (t-1)	0.011***	0.011***	0.009**	0.009**
	(0.004)	(0.004)	(0.005)	(0.004)
Interest (t-1)	-0.002	-0.002	0.001	0.001
	(0.004)	(0.004)	(0.004)	(0.004)
GovDebt (t-1)	-0.004***	-0.004***	-0.004***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
GovRevenue (t-1)	0.000	0.000	0.001	0.001
	(0.003)	(0.003)	(0.003)	(0.003)
BCI (t-1)	-0.029*	-0.030**	-0.026*	-0.027*
	(0.015)	(0.015)	(0.015)	(0.015)
Observations	613	613	613	613
Number of groups	23	23	23	23
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Underidentification Test	19.226	19.343	13.884	14.362
Chi-sq p-value	0.000	0.000	0.000	0.000
Weak Instrument Test	49.109	49.858	11.615	11.861
R-squared within model	0.823	0.824	0.821	0.822

Clustered standard errors in parentheses. Cycle is instrumented by its lag and the lagged growth rate of private consumption. Fixed country and year effects and the constant are not reported for brevity. *** p<0.01,** p<0.05, * p<0.1. Underidentification test: Kleibergen-Paap rk LM statistic. Weak instrument test: Kleibergen-Paap rk Wald F statistic.

value of the statistic equals to 0.666, which signifies that the null hypothesis of the contemporaneous cycle being exogenous to public investment cannot be rejected. Also, I apply the control function approach by adding the residuals of the first stage into the original model (see Table 1.15 in the Appendix). The residuals of the first stage do not reveal any statistically significant coefficient. Since the chosen instrument can be considered exogenous and relevant, I conclude that the residuals lack explanatory power because the cycle variable has been itself an exogenous regressor. All in all, this section supports the baseline results and presents evidence against the endogeneity of the business cycle variable to public investment.

Another concern could be a possible endogeneity of fiscal rules through omitted variable bias or reverse causality. This could be the case, for example, if country residents react to public investment fluctuations by voting for politicians who implement stricter or laxer fiscal rules. Hence, I controlled for a number of political variables to address this issue, such as general elections, left-leaning government, and institutional quality. Furthermore, it is unlikely that the presence of a fiscal rule is endogenous to the contemporaneous investment spending of the government, since the implementation of a fiscal rule follows a political preference switch and the change of legislation may take considerable time. Therefore, a time lag can be expected between the decision to introduce a fiscal rule and its actual enforcement. Along these lines, Nerlich and Reuter (2013) and Debrun, Moulin, Turrini, Ayuso-i Casals, and Kumar (2008) anticipate the endogeneity bias of fiscal rules to be negligible. Moreover, once implemented, fiscal rules are highly persistent. This allows us to address this aspect with a GMM estimation of the model, which instruments fiscal rules with their lags, in the following robustness section (see Table 1.8). The results align with the baseline findings.

GMM estimations

As a further robustness check, in this section I will run a GMM estimation of the baseline model specified by Equation 1.3 with the differentiation between rigid and flexible fiscal rules. I opt for a model with fewer regressors to limit instrument proliferation. I use the one-step system GMM estimator suggested by Arellano and Bover (1995) and Blundell and Bond (1998). The lagged dependent variable, the cycle variable, as well as the fiscal rule dummies are treated as endogenous regressors to be instrumented with their lags, whereas the rest of the regressors are instrumented by themselves. We specify the control variables in levels since the estimator uses their first differences for the instrumenting procedure.[8]

Table 1.8 shows the results. The GMM estimation with the full sample does not satisfy the large N, fixed T condition and suffers severely under the issue of too many instruments, as the value of the Hansen statistic demonstrates. Thus, I additionally split the sample into decades and perform the analysis for the 1990's, the 2000's and the 2010's separately. This allows me to keep the number of the instruments roughly in line with the number of groups, even though I include time dummies as instruments for the year fixed effects. The value of the Hansen statistic for the corresponding subsamples shows that this has at least partly alleviated the issue of too many instruments.

First, the results of the GMM estimations generally support my baseline findings since the sign and magnitude of most coefficients correspond to previous results. Crucially, the rigid fiscal

[8] I allow the estimator to use multiple lags for instrumenting the lagged dependent variable and only one lag for the cycle and fiscal rule dummies in order to keep the number of instruments low. I also restrict the number of instruments by collapsing the instrument matrix with the *collapse* option available within the *xtabond*2 command (Roodman, 2009a).

Table 1.8: Effects of fiscal rules on government investment: GMM

	Dependent variable: GovInv (log levels)			
	Full sample	1990-1999	2000-2009	2010-2019
RIGID	-0.157***	-0.064	-0.056	-0.197**
	(0.048)	(0.074)	(0.091)	(0.086)
FLEX	-0.113	-0.112	-0.034	-0.052
	(0.077)	(0.169)	(0.174)	(0.091)
Cycle	0.013**	0.033**	0.027***	0.063***
	(0.005)	(0.016)	(0.008)	(0.021)
GovInv (t-1)	0.615***	0.361***	0.524***	0.548***
	(0.097)	(0.073)	(0.106)	(0.204)
GDP trend (t-1)	0.377***	0.623***	0.457***	0.442**
	(0.096)	(0.087)	(0.081)	(0.199)
Interest (t-1)	-0.007*	-0.007	-0.011	0.031***
	(0.004)	(0.005)	(0.014)	(0.011)
GovDebt (t-1)	-0.002***	-0.002**	-0.001	-0.003***
	(0.001)	(0.001)	(0.002)	(0.001)
Observations	687	157	206	200
Number of groups	23	19	23	23
Number of instruments	74	24	24	24
AR(1)	0.000	0.144	0.004	0.015
AR(2)	0.186	0.886	0.654	0.566
Hansen statistic	1.000	0.668	0.417	0.287

Notes: Clustered standard errors in parentheses. Year effects and the constant are not reported for brevity.
*** p<0.01, ** p<0.05, * p<0.1

rule dummy shows a statistically significant negative effect on public investment. Second, I shed some light on how the effect of fiscal rules on public investment evolved over time. The coefficient of the rigid rule dummy becomes much larger and more statistically significant over the decades, whereas the coefficient of the flexible rule dummy does not. Importantly, flexible rules have been increasingly introduced in recent years and have often replaced rigid rules. Against this background, this appears to be additional evidence in support of the previous finding that the detrimental effect of fiscal rules on public investment comes from fiscal rules that lack flexibility features. Interestingly, the interest rate has changed sign and has been positively associated with public investment in the last decade.

To sum up the robustness check section, I have shown strong support for the baseline results. Regressions with the economic cycle variable, measured with the Hamilton filtering technique, confirm the procyclicality of public investment in recessions, which is exacerbated by rigid fiscal rules. Instrumenting the cycle variable has not changed the baseline results in any noteworthy way either. The coefficients of the GMM estimations with subsamples were also in line with the baseline findings.

1.5 Types of public investment affected by fiscal rules

Some investment categories may be easier to downsize on short notice, given that the consequences of a lack of investment may not be immediate. This section will investigate in which sectors, particularly, public investment is affected by fiscal rules. For this purpose, I employ another dataset that allows me to disentangle the components of public investment by category. This is offered by the OECD dataset of public investment (GFCF) categorized according to COFOG (OECD, 2022). The categories include public service, defense, public order, economic affairs, environmental protection, housing, health, recreation and culture, education, and social protection. The data are available from the year 1995 (for Finland from 1990) onward for all countries in my sample. Since the values of the government investment variables in different COFOG categories are not strictly positive, I employ the specification with the dependent variable expressed in percent of GDP.

Table 1.16 (in the Appendix) exhibits the regression results with COFOG data on public investment as a total for all categories to show the consistency of this approach with the baseline analysis. The regression coefficients with the COFOG dataset closely confirm previous findings. Again, government investment in percent of GDP fluctuates with the cycle and, most notably, falls during recessions. Moreover, the analysis supports the previous result that fiscal rules, in particular those lacking flexibility features, restrain public investment. In addition to the ceteris paribus negative effect of rigid fiscal rules, they also exacerbate the over-procyclicality of public investment in bad times.

Regarding specific categories of public investment affected by fiscal rules, the results are displayed in Table 1.9. I present the estimations of Equation 1.5 that separates the effects of the cycle variable into good and bad times and also into the times with and without the fiscal rules. The analysis shows that most investment categories seem to be negatively affected, since the coefficients of the fiscal rule dummies exhibit a negative sign. However, only some of them decrease at a statistically significant level, namely, environment protection and healthcare. Investment expenditure in categories, such as public order, healthcare, education, and social protection, shrink during recessions when fiscal rules are in place. Investment in housing and education appears to be procyclical during an upswing. In addition, investment in culture shows a countercyclical pattern during recessions.

In light of which categories are affected, the procyclical effect of fiscal rules raises concerns, especially in the case of expenses for social aid which are meant to move against the cycle. Indeed, curtailing social protection expenditure in downturns is not desirable since it could further exacerbate the negative consequences of recessions and have adverse long-term repercussions. In addition, the COVID-19 pandemic has vividly demonstrated the consequences of reducing investment in critical infrastructure (healthcare). Again, the extent of capital stock deterioration

Table 1.9: Effects of fiscal rules on government investment by COFOG: Categories

VARIABLES	(1) PubService	(2) Defense	(3) PubOrder	(4) EconAffairs	(5) EnvProtect	(6) Housing	(7) Health	(8) Culture	(9) Education	(10) SocProtect
NatFR	-0.048	-0.000	0.011	-0.039	-0.034**	-0.014	-0.017**	0.002	0.006	-0.007
	(0.036)	(0.021)	(0.007)	(0.034)	(0.016)	(0.012)	(0.008)	(0.010)	(0.012)	(0.008)
Cycle (Bad) × NatFR (0)	-0.014	-0.008	-0.002	-0.030	-0.009*	0.004	-0.002	0.008*	-0.004	0.000
	(0.012)	(0.009)	(0.006)	(0.032)	(0.005)	(0.007)	(0.004)	(0.004)	(0.007)	(0.005)
Cycle (Bad) × NatFR (1)	-0.005	-0.003	-0.011**	-0.019	0.005	-0.009	-0.008**	-0.004	-0.007*	-0.007**
	(0.005)	(0.012)	(0.004)	(0.015)	(0.014)	(0.008)	(0.003)	(0.004)	(0.004)	(0.003)
Cycle (good) × NatFR (0)	0.012	0.007	0.006	0.024	-0.003	0.003	-0.001	0.007	0.014*	-0.000
	(0.010)	(0.012)	(0.004)	(0.024)	(0.006)	(0.006)	(0.005)	(0.006)	(0.007)	(0.002)
Cycle (good) × NatFR (1)	0.002	-0.007	0.000	0.003	0.003	0.010**	0.004	-0.001	0.009	0.001
	(0.007)	(0.009)	(0.004)	(0.024)	(0.005)	(0.004)	(0.007)	(0.003)	(0.007)	(0.003)
Observations	516	516	516	516	516	516	516	516	516	516
Number of groups	23	23	23	23	23	23	23	23	23	23
Country FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Control variables	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
R-squared within model	0.401	0.461	0.287	0.516	0.516	0.547	0.635	0.542	0.571	0.372

Notes: Clustered standard errors in parentheses. Fixed country and year effects, control variables and the constant are not reported for brevity.
*** p<0.01, ** p<0.05, * p<0.1

may be revealed only decades later, when a crisis hits, and play out as a major obstacle to economic performance and, thus, fiscal stability in the long run. Against this background, the negative effect of fiscal rules on expenditure in the health sector is disturbing. In addition, cutting investments in environment protection, which may also be central to economic stability in the face of climate change, does not appear to align with the official EU climate policy.

To conclude, using an alternative dataset on public investment and its subcategories, this section closely confirms the baseline results and identifies the COFOG types of public investment which show procyclicality. Essential categories of government investment, such as public order, health, education, and social protection, exhibit procyclical patterns during recessions, especially with fiscal rules in place. Also, fiscal rules show a ceteris paribus negative effect on public investment in environmental protection and healthcare.

1.6 Conclusion

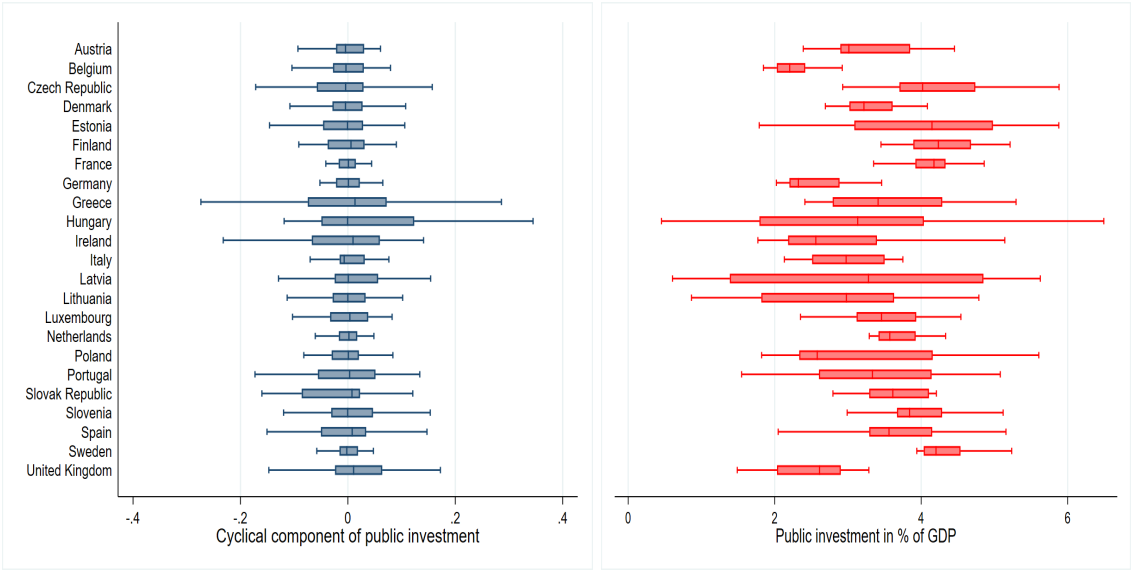
This paper investigates the procyclicality of government investment in the EU and how national fiscal rules influence it throughout the economic cycle. My findings reveal that public investment is, on average, procyclical in the EU over the sample period. More precisely, public investment levels decline during economic contractions. Also, public investment in percent of GDP falls during recessions, because public investment decreases more than the GDP, indicating over-procyclicality. Fiscal rules demonstrate heterogeneous effects on government investment, contingent on their design. Specifically, fiscal rules, that lack sufficient flexibility, exacerbate the over-procyclicality of government investment in the EU during recessions. These findings withstand a series of robustness checks with alternative estimation methods.

Furthermore, public investment categories, such as public order, environmental protection, health, education, and social protection, suffer the most from cuts under fiscal rules. Again, the negative effect materializes mainly during economic downturns. While reducing spending in these categories might yield a short-term budgetary improvement, it could evoke problematic consequences years or decades later. Yet, when a crisis finally reveals the accumulated deterioration of the capital stock, the damage cannot be repaired at short notice. Indeed, fiscal rules show a ceteris paribus negative effect on public investment in healthcare, as well as aggravate its procyclical dynamics in recessions. Hence, fiscal rules might have exacerbated the dismantling of the healthcare system in the EU prior to the COVID-19 crisis. Before the pandemic, it was not obvious how disinvestment in the healthcare system could be destabilizing for an economy, and thus be a threat to fiscal stability in the long run. Moreover, curtailing social protection during recessions appears especially unsettling, since this category should by definition develop in an anticyclical manner. Consequently, the objective of ensuring stable public finances can be jeopardized if fiscal rules hinder growth by aggravating the negative effect of recessions.

In summary, the findings of this paper suggest that a flexible design of fiscal rules is important to safeguard a higher level of public investment in critical infrastructure. These findings can therefore serve as a warning to policymakers at the supranational level in Europe, as well as to national governments that are discussing reforms of their fiscal frameworks to ensure protection for public investment. It is, however, important to weigh the merits of flexible design against possible fiscal risks, such as the lack of a precise differentiation between consumptive expenditure and investment, which could open a back door for circumventing fiscal rules via creative accounting, and bear in mind that positive effects of increased public investment on growth depend on the strengthening of the public investment management framework.

1.7 Appendix to Chapter 1

Figure 1.3: Cyclical component of public investment and public investment in percent of GDP



Source: Author's elaboration based on the IMF Investment and Capital Stock Dataset (IMF, 2021b).

Table 1.10: Descriptive statistics of the main variables

Variables		Mean	SD	Min	10th pct	90th pct	Max	N
$GOVINV$	(Bln USD)	22.88	28.96	0.24	1.35	77.69	115.71	805
$GOVINV$	(log levels)	9.17	1.46	5.47	7.21	11.26	11.66	805
$GOVINV - Cycl.comp.$	(% of GDP)	0.14	8.27	-40.97	-8.88	7.80	44.52	804
$GOVINV$	(% of GDP)	3.39	1.00	0.46	2.04	4.64	7.15	775
$GOVINV$ (COFOG)	(% of GDP)	3.65	1.08	0.56	2.22	5.09	7.69	600
GDP	(Bln USD)	754.64	983.20	17.49	46.50	2497.26	4464.49	775
GDP	(log levels)	12.69	1.37	9.81	10.75	14.73	15.32	775
Cycle - HP Filter	(% of GDP)	0	2.29	-12.67	-1.98	1.91	14.18	775
Cycle - bad	(% of GDP)	-0.72	1.38	-12.67	-1.98	0	0	775
Cycle - good	(% of GDP)	0.72	1.52	0	0	1.91	14.18	775
$NatFR$	(Dummy)	0.51	0.50	0	0	1	1	828
$RIGID$	(Dummy)	0.35	0.48	0	0	1	1	828
$FLEX$	(Dummy)	0.36	0.48	0	0	1	1	828
Gov.Debt	(% of GDP)	59.48	34.91	3.77	16.54	106.36	211.22	773
InterestRate	(in PP)	6.26	5.33	-0.51	0.81	11.71	33	743
Gov.Revenue	(% of GDP)	43.36	7.09	22.77	34.27	53.11	61.5	689
BCI	(Index)	24.37	14.91	-5.63	3.63	43.21	52.01	768
$FRSI$	(Index)	-0.1	0.86	-0.99	-0.99	1.04	3.07	594
$Inflation$	(% change)	3.85	5.39	-1.68	0.50	8.38	47.66	766
TradeOpenness	(% of GDP)	100.17	55.73	33.88	47.82	163.26	382.35	762
Election	(Dummy)	.06	0.24	0	0	0	1	792
$LeftGovernment$	(Dummy)	0.35	0.47	0	0	1	1	828
DepPopulation	(%)	33.31	1.96	27.88	30.95	35.72	40.28	828

Table 1.11: Effects of fiscal rules on government investment, additional controls

	Dependent variable: GovInv (log levels)		
	(1)	(2)	(3)
NatFR	-0.031	-0.032**	-0.037**
	(0.018)	(0.014)	(0.017)
Cycle	0.011**	0.011**	0.015*
	(0.005)	(0.005)	(0.008)
EU FR	0.031		
	(0.032)		
TradeOpen (t-1)		-0.001	
		(0.001)	
Election (t-1)		0.017	
		(0.024)	
LeftGov (t-1)		0.013	
		(0.014)	
Inflation (t-1)		-0.002	
		(0.002)	
DependPop (t-1)		0.036	
		(0.037)	
NatFR (t-1)			-0.008
			(0.036)
NatFR (t-2)			0.032
			(0.025)
Cycle (t-1)			-0.015
			(0.011)
Cycle (t-2)			-0.003
			(0.006)
GovInv (t-1)	0.780***	0.775***	0.807***
	(0.040)	(0.041)	(0.039)
GDP trend (t-1)	0.012***	0.013***	0.014***
	(0.003)	(0.004)	(0.003)
Interest (t-1)	-0.003	-0.003	0.001
	(0.004)	(0.004)	(0.004)
GovDebt (t-1)	-0.004***	-0.004***	-0.004***
	(0.001)	(0.001)	(0.001)
GovRevenue (t-1)	-0.000	-0.001	-0.001
	(0.003)	(0.004)	(0.003)
BCI (t-1)	-0.027*	-0.029*	-0.026*
	(0.015)	(0.015)	(0.014)
Observations	613	612	613
R-squared within model	0.824	0.824	0.829
Number of group	23	23	23
Country FE	YES	YES	YES
Year FE	YES	YES	YES

Notes: Clustered standard errors in parentheses. Fixed country and year effects and the constant are not reported for brevity.
*** p<0.01, ** p<0.05, * p<0.1

Table 1.12: Effects of fiscal rules on government investment: GLS

	Dependent variable: GovInv (log levels)			
	(1)	(2)	(3)	(4)
NatFR	-0.026		-0.018	
	(0.017)		(0.020)	
RIGID		-0.037**		-0.030
		(0.017)		(0.019)
FLEX		-0.010		-0.006
		(0.021)		(0.025)
Cycle	0.011**	0.011**		
	(0.004)	(0.004)		
Cycle (Bad) × NatFR (0)			-0.011	-0.010
			(0.010)	(0.010)
Cycle (Bad) × NatFR (1)			-0.016*	
			(0.008)	
Cycle (Bad) × FLEX (1)				-0.014
				(0.018)
Cycle (Bad) × RIGID (1)				-0.015*
				(0.008)
Cycle (Good) × NatFR (0)			0.013	0.013
			(0.008)	(0.008)
Cycle (Good) × NatFR (1)			0.003	
			(0.008)	
Cycle (Good) × FLEX (1)				0.006
				(0.018)
Cycle (Good) × RIGID (1)				0.004
				(0.008)
GovInv (t-1)	0.776***	0.771***	0.774***	0.770***
	(0.024)	(0.025)	(0.025)	(0.025)
GDP trend (t-1)	0.014***	0.014***	0.014***	0.014***
	(0.005)	(0.005)	(0.005)	(0.005)
Interest (t-1)	-0.000	-0.000	0.000	0.000
	(0.004)	(0.004)	(0.004)	(0.004)
GovDebt (t-1)	-0.004***	-0.004***	-0.004***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
GovRevenue (t-1)	-0.000	-0.000	-0.000	0.000
	(0.003)	(0.003)	(0.003)	(0.003)
BCI (t-1)	-0.028**	-0.029**	-0.028**	-0.029**
	(0.014)	(0.014)	(0.014)	(0.014)
Observations	590	590	590	590
Number of groups	23	23	23	23
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
R-squared within model	0.797	0.798	0.798	0.799

The Durbin-Watson estimator is used.
Standard errors in parentheses. Fixed country and year effects and the constant are not reported for brevity.
*** p<0.01, ** p<0.05, * p<0.1

Table 1.13: Effects of fiscal rules on government investment, cyclical component

	Dependent variable: GovInv (cycl. component)					
	(1)	(2)	(3)	(4)	(5)	(6)
NatFR	-1.478**		-1.477**		-1.024	
	(0.676)		(0.700)		(0.943)	
FLEX		-0.579		-0.699		-0.148
		(0.713)		(0.736)		(0.928)
RIGID		-1.684**		-1.657**		-1.306
		(0.710)		(0.739)		(0.822)
Cycle	1.878***	1.876***				
	(0.441)	(0.440)				
Cycle (bad)			2.137***	2.114***		
			(0.453)	(0.462)		
Cycle (good)			1.644**	1.661**		
			(0.672)	(0.682)		
Cycle (Bad) × NatFR (0)					1.848***	1.786***
					(0.536)	(0.549)
Cycle (Bad) × NatFR (1)					2.289***	
					(0.506)	
Cycle (Bad) × FLEX (1)						2.539**
						(1.123)
Cycle (Bad) × RIGID (1)						2.222***
						(0.461)
Cycle (Good) × NatFR (0)					1.770**	1.800**
					(0.664)	(0.678)
Cycle (Good) × NatFR (1)					1.533*	
					(0.802)	
Cycle (Good) × FLEX (1)						1.436
						(1.182)
Cycle (Good) × RIGID (1)						1.535*
						(0.781)
Interest (t-1)	-0.636**	-0.642**	-0.592**	-0.601**	-0.600**	-0.617**
	(0.251)	(0.250)	(0.263)	(0.265)	(0.273)	(0.275)
GovDebt (t-1)	-0.193**	-0.196**	-0.190**	-0.193**	-0.195**	-0.198**
	(0.089)	(0.089)	(0.087)	(0.087)	(0.088)	(0.087)
GovRevenue (t-1)	-0.090	-0.089	-0.084	-0.083	-0.076	-0.077
	(0.181)	(0.180)	(0.178)	(0.177)	(0.179)	(0.180)
BCI (t-1)	-1.150	-1.167	-1.101	-1.122	-1.073	-1.072
	(0.944)	(0.941)	(0.967)	(0.966)	(0.965)	(0.987)
Observations	613	613	613	613	613	613
R-squared within model	0.251	0.252	0.252	0.253	0.253	0.254
Number of groups	23	23	23	23	23	23
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Notes: Fixed country and year effects and the constant are not reported for brevity.
Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 1.14: Effects of fiscal rules on government investment, alternative definition of rigid and flexible rules

	Dependent variable: GovInv (log levels)		
	(1)	(2)	(3)
RIGID	-0.033**	-0.036*	
	(0.016)	(0.018)	
FLEX	0.006		
	(0.018)		
ESCAP		0.017	
		(0.021)	
STABIL		-0.016	
		(0.026)	
GR		-0.012	
		(0.019)	
FRSI			-0.032***
			(0.010)
Cycle	0.011**	0.011**	0.011**
	(0.005)	(0.005)	(0.005)
GovInv (t-1)	0.786***	0.784***	0.778***
	(0.041)	(0.044)	(0.035)
GDP trend (t-1)	0.013***	0.013***	0.014***
	(0.003)	(0.003)	(0.004)
Interest (t-1)	-0.003	-0.003	-0.003
	(0.004)	(0.004)	(0.004)
GovDebt (t-1)	-0.004***	-0.004***	-0.004***
	(0.001)	(0.001)	(0.001)
GovRevenue (t-1)	-0.000	-0.000	-0.001
	(0.003)	(0.003)	(0.006)
BCI (t-1)	-0.029*	-0.030*	-0.028*
	(0.016)	(0.017)	(0.014)
Observations	613	613	586
R-squared within model	0.824	0.825	0.816
Number of groups	23	23	23
Country FE	YES	YES	YES
Year FE	YES	YES	YES

Notes: Clustered standard errors in parentheses. Fixed country and year effects and the constant are not reported for brevity.
*** p<0.01, ** p<0.05, * p<0.1

Table 1.15: Effects of fiscal rules on government investment: 2SLS, first stage regression results and the control function approach

	Dependent variable	
	Cycle	GovInv
	(1)	(2)
Instrument	1.867***	
	(3.71)	
Cycle		0.016*
		(2.03)
NatFR	0.274*	-0.028*
	(1.95)	(-1.78)
GovInv (t-1)	0.668***	0.785***
	(3.01)	(20.33)
GDP trend (t-1)	0.267***	0.011**
	(4.55)	(2.76)
Interest (t-1)	-0.083*	-0.002
	(-1.93)	(-0.53)
GovDebt (t-1)	-0.019	-0.004***
	(-1.66)	(-3.12)
GovRevenue (t-1)	-0.070**	0.000
	(-2.70)	(0.02)
BCI (t-1)	0.084	-0.029*
	(0.61)	(-1.90)
Residuals		-0.007
		(-0.92)
Observations	613	613
Number of groups	23	23
Country FE	YES	YES
Year FE	YES	YES
R-squared within model	0.679	0.824

t-statistics in parentheses. Residuals of the first stage of the 2SLS are included in the baseline model to reproduce the second stage in column 2. Fixed country and year effects and the constant are not reported for brevity.
*** p<0.01, ** p<0.05, * p<0.1

Table 1.16: Effects of fiscal rules on government investment by COFOG: Total

	Dependent variable: GovInv by function, Total					
	(1)	(2)	(3)	(4)	(5)	(6)
NatFR	-0.170**		-0.170**		-0.129	
	(0.064)		(0.064)		(0.078)	
RIGID		-0.219***		-0.218***		-0.189**
		(0.065)		(0.067)		(0.075)
FLEX		-0.048		-0.052		0.000
		(0.091)		(0.089)		(0.092)
Cycle	0.048**	0.048**				
	(0.018)	(0.018)				
Cycle (bad)			-0.058**	-0.056**		
			(0.025)	(0.027)		
Cycle (good)			0.039	0.042		
			(0.039)	(0.040)		
Cycle (bad) × NatFR (0)					-0.043	-0.036
					(0.042)	(0.040)
Cycle (bad) × NatFR (1)					-0.064**	
					(0.024)	
Cycle (bad) × FLEX (1)						-0.085
						(0.051)
Cycle (bad) × RIGID (1)						-0.057**
						(0.025)
Cycle (good) × NatFR (0)					0.060	0.063
					(0.041)	(0.041)
Cycle (good) × NatFR (1)					0.021	
					(0.040)	
Cycle (good) × FLEX (1)						-0.004
						(0.079)
Cycle (good) × RIGID (1)						0.027
						(0.039)
Observations	516	516	516	516	516	516
Number of groups	23	23	23	23	23	23
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Control variables	YES	YES	YES	YES	YES	YES
R-squared within model	0.575	0.577	0.575	0.577	0.576	0.578

Notes: Clustered standard errors in parentheses. Fixed country and year effects, control variables and the constant are not reported for brevity. *** p<0.01, ** p<0.05, * p<0.1

Chapter 2

Deficit aversion as a path to higher debt: Sovereign debt dynamics in an SFC model with public capital[1]

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2.1 Introduction

There is a well-grounded case for risky innovation projects, research and development as well as investment-intensive infrastructure to be financed by the state (Mazzucato & Semieniuk, 2017). A readily available example is an enormous investment requirement of the looming socio-ecological transformation. The estimates of the necessary additional green investment to achieve the 2030 climate and energy targets in Europe range from 260 billion Euro per year (European Commission, 2020) up to 855 billion Euro annually (Wildauer, Leitch, & Kapeller, 2020). A notable portion of this sum falls onto the public sector. However, the capacity of the state to provide public investment has often been limited by financial constraints in recent decades. First, the leeway of the state to finance investment has diminished due to the possibility of adverse "markets' reactions". Indeed, interest rates on government bonds can be subject to negative market sentiments disconnected from the underlying economic indicators (De Grauwe & Ji, 2013). Also, institutions, such as fiscal rules, have been increasingly implemented in most developed countries to restrict the government's autonomy in decisions of public finance.

In this way, a modern state is increasingly being charged with facilitating structural change, which requires a massive public investment, while being confronted with uncertainty on the financing side resulting from restrictions on public spending. It remains unclear if there will be sufficient room for government-financed projects under the political constraints on public spending and debt during the next decades. However, can a restrictive fiscal policy achieve its goal of bringing down the debt-to-GDP ratio in the long run, if public investment is crucial to enable economic stability and growth? To shed some light on this matter, this paper examines the dynamics of public investment and sovereign debt under two different fiscal rules scenarios with the help of a stock-flow consistent (SFC) macroeconomic model which allows to model complex interactions between sectors of the economy and integrate the real and financial sides of all economic activity (Godley & Lavoie, 2012; Nikiforos & Zezza, 2017).

I employ a simple SFC model à la Dafermos and Nikolaidi (2019) with private households, firms, and the government. The model is demand-led where private investment depends on profit rate, capacity utilization rate, and leverage. The novelty of this paper is to explicitly introduce public investment into the SFC framework to analyze the dynamics of public investment and debt under spending constraints. Importantly, I make use of the assumption that public capital stock, such as mass transport, water and electricity infrastructure, streets, airports, but also educational and healthcare facilities, is a crucial factor for the productivity. I follow Tavani and Zamparelli (2016) and assume that the productivity coefficient of private capital stock is variable and depends on the supply of public capital. A weak provision of public capital results in a lower productivity of private capital stock due to congestion effects. Therefore, on the one hand, public investment

can induce growth of potential output and lead to a reduction of the debt burden in the future. On the other hand, debt-financing also piles up the outstanding liabilities in the short term and is thus subject to regulations regarding government budget and debt.

The public investment decision is accounted for in a set of fiscal rules. The first fiscal policy scenario is designed as a "Maastricht-like" fiscal rule where the government aims at achieving a balanced budget. Since government consumption is difficult to cut down in the short run due to fixed obligations, public investment must adjust to accommodate the spending ceiling in case of a shock. The second scenario implements a so-called "golden rule of public investment". In this way, government investment is growing at a given rate, whereas deficit spending must increase to accommodate it.

The modeled economy extended by the fiscal authority is then calibrated to the Euro area. Dynamic adjustments of the model are computed to investigate the development of the fiscal policy composition and the resulting path of the output growth and the debt accumulation under various fiscal scenarios. Indeed, the analysis shows that insufficient provision of public capital is a detriment to growth since expansion of the supply side is necessary for the output growth in the model. Since the growth rate is endogenous in the model, the two scenarios illustrate two distinct fiscal outcomes of the debt sustainability condition. First, increased public investment induces a growth rate above the interest rate on government bonds and allows for a negative budget balance in the long run. Second, the frugal fiscal scenario results in a growth rate below the interest rate on bonds so that the surplus is needed for the stability of the debt-to-output ratio. So, despite the association with higher public deficits, the golden rule of public investment results in lower debt-to-GDP ratios due to stronger growth and accelerated capital accumulation. The balanced budget scenario results in a higher debt-to-GDP ratio, although the government runs a fiscal surplus. In addition, the balanced budget rule induces economic instability, characterized by increased capital productivity volatility, preventing the model from fully converging to a steady state within the simulation period.

Therefore, I conclude that deficit aversion does not necessarily lead to debt reduction. Restrictive fiscal policies may not be the most effective path to achieving long-term debt sustainability, especially when public investment is pivotal to enhancing growth. Aligning government policies solely with short-term fiscal indicators, such as the budget balance, becomes problematic. A more effective policy approach would involve evaluating the economic impacts of different spending categories and prioritizing investments that promote productivity growth.

The remainder of this paper is structured as follows. Section 2.2 offers a comprehensive review of the economic literature on productive public investment. Section 2.3 describes the model. Section 2.4 presents baseline results of simulations as well as sensitivity tests. Section 2.5 concludes.

2.2 Literature review

This section reviews the literature on modeling productive public investment which includes applied research as well as theoretical models of neoclassical and heterodox flavors, with a focus on public finance outcomes. First, I will give a brief overview on econometric findings regarding the productivity of public investment and a short summary of insights from the mainstream modeling approaches. Then, I will discuss Post-Keynesian and especially SFC literature dealing with productive public investment and contrast my contribution to the established findings.

Seminal empirical research on the productivity of public investment was contributed by Aschauer (1989a, 1989b) who finds a high elasticity of output to public capital of 0.39 and presents evidence that the net effect of public investment on private investment is positive. His estimate of the elasticity of output to public capital was confirmed by Munnell (1990). In line with their research, Fernald (1999) shows that productivity of automobile-intensive industries in the US depends positively on road-building.[2]

Pereira and Flores de Frutos (1999) and Pereira (2000) show a large long-run elasticity of output to public capital and a long-run multiplier of public investment of 4.5. Positive effects on growth have been confirmed for developing countries (Easterly & Rebelo, 1993) as well as for an international panel, while addressing non-stationarity, reverse causality and country-heterogeneity (Calderón, Moral-Benito, & Servén, 2015), and specifically for the energy sector (Deleidi, Mazzucato, & Semieniuk, 2020). Finally, Bom and Ligthart (2014) performed a meta-regression analysis of empirical literature on the productivity of public capital. Their estimate for the elasticity of output to public capital amounts to approximately 0.08 in the short run and 0.12 in the long run, and it is twice as high for the core infrastructure on the local level.[3]

Coming to the neoclassical theoretical literature, Arrow and Kurz (1970) formulated an optimal public investment policy as an optimization over time while keeping the private saving rate constant. In their model, the initial debt level is important since it determines the level of interest payments and, thus, how much can be spent on investment. If the initial level of debt is low enough, financing public debt with borrowing is optimal. Baxter and King (1993) investigated public spending effects on the output in a neoclassical real business cycle model. Concerning the long-run effect, they suggest that if the labor is fixed, the direct expenditure effect of public investment is larger than the supply side effect. However, if the labor is variable, the multiplier associated with expanding the private productive capacity is higher than the immediate spending effect. Also, Barro (1990) and Barro and Sala-i Martin (1990) find that, if social returns on investment exceed private returns, tax-financed productive public spending policy may be optimal. In contrast to them, Futagami, Morita, and Shibata (1993) argue that capital stock, such as the

[2]See Gramlich (1994) for a survey of the early literature on the productivity of US infrastructure.
[3]See Ramey (2020) for an extensive review of research on the productivity of public investment.

available infrastructure and the level of public education, is more relevant to the productivity of the economy than the current expenditure. Fisher and Turnovsky (1998) analyze the role of congestion of public capital in private capital formation. In the absence of congestion, public infrastructure only leads to a higher private accumulation rate if they are complements. By modeling congestion, they show how public and private capital can have a degree of substitutability, and still, an increase in public capital stock induces an expansion of private capital, at least in the long run.

Also, neoclassical models highlight that debt-financed public investment can increase the growth rate, although there is a threshold of the government borrowing after which the positive effect on growth is offset by the detrimental effect of the higher interest payments (Greiner & Semmler, 2000); optimal public investment policy depends on the chosen budgetary stance (Ghosh & Mourmouras, 2004); and initial stock of public debt matters (Yakita, 2008; Teles & Mussolini, 2014). Furthermore, this strand of literature explores a possibility of multiple equilibria (Futagami, Iwaisako, & Ohdoi, 2008), analyses government expenditure composition (Groneck, 2010; Minea & Villieu, 2009; Agénor, 2008; Gupta & Barman, 2010) and introduces a time-to-build delay (Leeper, Walker, & Yang, 2010; Bouakez, Guillard, & Roulleau-Pasdeloup, 2017; Gallen & Winston, 2021).

Having considered mainstream literature, I focus on the Post-Keynesian approach instead and on the SFC modeling in particular. A major notion of this school of thought is the endogenous money assumption and the path dependency of the modeling outcomes instead of the optimal intertemporal allocation of resources (Lavoie, 2014). For this reason, this class of models is much more in line with the reality of economic behavior and monetary systems in practice. Especially SFC modeling is a very helpful approach when it comes to account for complex interactions between the monetary and the real sides of the economy (Godley & Lavoie, 2012).

Taking account of Post-Keynesian literature, it is important to note that government expenditure generally plays a crucial role for growth in this paradigm. The reason is that aggregate demand is central to growth in Post-Keynesian, or Kaleckian, models. See Allain (2015) for an overview of the strand of literature and for his neo-Kaleckian growth model with autonomous demand components and private investment subject to Harrodian instability (Harrod, 1939). In his model, the long-term growth rate of the economy converges to the exogenous growth rate of autonomous public spending. In addition, autonomous government spending, under certain conditions, is able to stabilize the growth expectations of firms, thus solving the Harrodian knife-edge problem.

Moving further to models with productive government expenditure, Dutt (2013) develops a model with government spending on consumption and investment. His model shows several mechanisms how government investment spending can increase growth. Besides a generally positive effect on aggregate demand, public investment also crowds in private investment and promotes technological change, thus raising the natural rate of growth. In this framework, the debt-to-output ratio can be stable even if one allows for labor shortage problems and a financial crowding-

out effect. Parui (2021) extends Dutt (2013) by introducing the dependence of private investment on the profit rate, workers' savings, and differentiation between investment categories. He is able to show that, while both public consumption and investment enhance growth, an optimal composition of public spending is determined by the (wage-led or profit-led) demand regime and the effect of public investment on labor productivity. Similarly, in a neo-Kaleckian model with government investment in human capital (Lima, Carvalho, & Serra, 2021), demand regime determines the optimal tax rate and thus the optimal human capital accumulation rate. Skott (2021) investigates the differences between developing and mature economies and argues that appropriate fiscal policies are different in one and the other case. Whereas a permanent fiscal stimulus could be helpful in mature economies where the natural growth rate is low, creating the right conditions for investment to accumulate a necessary capital stock is necessary in dual economies, thus, fiscal policy should focus on the level and the composition of aggregate demand.

Tavani and Zamparelli (2016) develop a Post-Keynesian model with two types of government expenditure: transfers and investment. They compare a fixed wage closure of the model, which allows for endogenous growth, and a fixed labor supply closure where growth is exogenously given. In the first case, the chosen tax rate does not only determine the wage and the profit share, but also the growth rate; whereas in the second scenario, the government sector can only influence income redistribution. Tavani and Zamparelli (2017a) extend this analysis with government debt. They find that public debt has no impact on the growth rate in their model; however, in order to sustain the equilibrium, the growth rate of the economy must exceed the interest rate on government bonds.[4]

Deleidi and Mazzucato (2019) make a strong case for public investment in a Sraffian Supermultiplier model. This model utilizes the notion of autonomous demand components and makes use of a private investment function dependent on the aggregate demand. Extending this framework by consumptive and "industrial policies" government spending, they are able to show that both types of public spending induce a crowding-in effect and result in a higher growth rate through the multiplier-accelerator mechanism. However, productive ("mission-oriented") government spending generates the largest effect on output, private investment, and productivity growth. They test their model on the US time series data and, indeed, find a very large long-run multiplier of the "mission-oriented" public spending (Deleidi & Mazzucato, 2021). Skott, Santos, and da Costa Oreiro (2022) compare a supermultiplier solution and an active fiscal policy guided by principles of functional finance and conclude that the latter framework delivers superior outcomes in terms of stabilization and capacity utilization rates.

Finally and centrally, relevant SFC literature will be discussed here. A large range of SFC

[4] Also, see their overview of heterodox growth models with and without public investment (Tavani & Zamparelli, 2017b).

contributions considered active fiscal policy. For a comprehensive overview refer to Caverzasi and Godin (2014) who provide classification of the SFC literature along several dimensions, such as methodological differences and main topics of research. Also, Nikiforos and Zezza (2017) revise a variety of SFC models and summarize their distinctive characteristics as well as advantages and disadvantages compared to mainstream models. All in all, SFC modeling seems to be a particularly appropriate framework to analyze the connection between fiscal regimes and public finance dynamics.

In an early work, Schlicht (2006) argues that the stock-flow consistency allows for an important insight. In SFC models, public debt plays a major role in establishing equilibrium in a closed economy since it it allocates output between private and public spending. Fiscal rules that put bounds on public debt can therefore undermine macroeconomic equilibrium. Godley and Lavoie (2007) show that even with interest rates higher than the growth rate of the economy, the ratio of real deficit to output as well the ratio of real debt to output both converge to stable values as long as public expenditure is sufficient to ensure full employment. Also, Ryoo and Skott (2013) highlight the necessity of sufficient government spending for full employment and argue that variations in public debt are the instrument to smooth out fluctuations in the private sector.

Furthermore, Brochier and Macedo e Silva (2018) analyze whether the standard results of a supermultiplier model hold in an SFC setting where the "non-capacity creating" autonomous expenditure is endogenous and depends on households' wealth. They show that changes in distribution and propensity to save will permanently affect the growth rate through the supermultiplier. For a comparison of neo-Kaleckian and Supermultiplier closures in SFC context, see Brochier and Freitas (2023). Spinato Morlin (2022) develops an open-economy model where exports and government expenditure compose autonomous demand. In this case, domestic fiscal policy plays a major role in keeping the economy from hitting the external constraint to growth.

Caiani, Catullo, and Gallegati (2018) employ an agent based SFC (AB-SFC) model of a currency union, where technological change is endogenous, and simulate various policy experiments. In their model, increased fiscal spending leads to higher labor productivity as well as higher GDP and employment. They illustrate how an austerity event can result in growing average debt-to-output ratios and exacerbate the volatility of main economic aggregates in a monetary union. Another relevant AB-SFC contribution is provided by Teglio, Mazzocchetti, Ponta, Raberto, and Cincotti (2019) who model economic dynamics under the European fiscal framework. They also come to conclusion that debt or deficit fiscal rules lead to instability and fail to achieve their ultimate goal. In recessions, counter-cyclical fiscal policies prove to be more effective in stabilizing the economy and public finances. Dafermos (2018) employs a Godley–Minsky cyclical model with a government sector. He tests two types of fiscal rules and concludes that a strict Maastricht-like debt rule exacerbates the cyclical dynamics in the model, whereas a countercyclical fiscal rule stabilizes the

output and, importantly, also the government debt-to-GDP ratio.

In addition, Bibi (2023) develops an SFC model with productive public investment. Namely, public investment adds to the capital stock and thus enhances the productivity of the labor force, increasing potential output. The author tests various fiscal policy scenarios as a reaction to an exogenous fall in private investment and concludes that a balanced budget fiscal scenario fails to reduce the debt-to-GDP level. Instead, the proactive government scenario, where the fiscal policy mix is chosen to support the macro-economy, results in the smoother recovery path, a lower debt-to-output ratio, and less interclass inequality. Kappes, Milan, and Morrone (2022) employ an SFC model to compare macroeconomic outcomes under a variety of fiscal rule scenarios. They show that an expenditure rule results in higher inflation, less unemployment, lower firms' leverage, but a higher debt-to-output ratio, than a debt rule, independent of the target values. Ioannou (2018) explores institutional actors influencing government's ability to finance its' deficit and the role of the credit rating agencies in the context of an SFC model and illustrates how a recession, followed by downgrading, can result in a fiscal crisis.

To mention SFC models extended with the environmental sector, Dafermos and Nikolaidi (2019) analyzed the government's role in socio-economic transition via direct public investment or subsidies for green investment. They provide an insight that more spending on green investment reduces government debt, because green investment stimulates growth and reduces the climate change damage in their framework. Also, Naqvi and Stockhammer (2018) develop an ecological SFC model with directed technological change. They show that a mix of tax increases and fine-tuned public spending to boost demand and private investment are necessary to achieve a structural shift towards greener technologies.

This paper connects to the above SFC literature for it follows the same modeling structures and the behavioral assumptions established in the Post-Keynesian tradition. In particular, this work builds on the model developed in Dafermos and Nikolaidi (2019) but introduces a supply side to the economy and analyses the role of government investment for maintaining and enlarging the productive capacity. Through this extension, the contribution of this paper is to augment the SFC literature with the analysis of the composition of public expenditure and its' effects on public deficit and debt dynamics.

2.3 Model

2.3.1 Stock-flow consistent model of public investment

The macroeconomic setup

I employ a simple SFC model along the lines of Dafermos and Nikolaidi (2019) with private households, firms, and the government. The model is cast in real terms so I refrain from modeling

prices. My central innovation to the model is an explicit formulation of the production function (PF) that includes public capital. This allows us to model the demand-side and supply-side effects of public investment. Indeed, public investment enters the demand side of the economy as a government expenditure, which creates more demand for investment goods, and therefore induces an increase in production and income. Although this channel can also have long-lasting repercussions through increased private investment, as in Deleidi and Mazzucato (2019), I regard it as temporary. Instead, I model a long-term supply side effect of government investment which takes place by building up public capital stock.

First of all, public capital is itself a productive input, next to the private capital. In addition, since public capital comprises major infrastructure, it determines the productivity of private capital stock. In more detail, there is a need for adequate infrastructure, which is provided on the public level, i.e. roads, bridges, energy grid, water supply, public institutions, etc., for the economy to function efficiently and to avoid congestion. Therefore, for the same level of the private capital stock, it can be more productive if the provision of public capital is higher.

To model the supply side of the economy, I start conventionally with a Leontief PF of the form:

$$Y = min\{aN, vK\}, \tag{2.1}$$

where N denotes available workforce and K stands for capital stock. Per simplifying assumption, labor does not constitute a binding constraint on output in our model. Full employment is never reached and there is a reserve army that can supply more labor, so that $Y = vK$. I follow Tavani and Zamparelli (2016), assuming that the public capital stock KG is a productive input next to the private capital stock Kpr and they are imperfect substitutes, and settle upon the following equation for the potential output:

$$Y_t^* = v_t Kpr_t^{(1-\rho)} KG_t^{\rho}. \tag{2.2}$$

The functional form is justified by the empirically observed considerable substitutability between private and public capital (for example, private vs. public schools; private vs. public highways). Also, this PF specification implies constant returns to scale, but diminishing returns to each input factor separately, since $0 < \rho < 1$.[5] Constant returns to scale is a rather conservative assumption since neoclassical literature sometimes assumes that the sum of exponents in the Coub-Douglas PF with productive public capital exceeds unity (Baxter & King, 1993).

Furthermore, I assume that the productivity coefficient of the private capital stock v_t is variable and depends on the supply of public capital, in accordance with Tavani and Zamparelli (2016).

[5] I use the estimate of Bom and Ligthart (2014) of 0.12.

The intuition behind this, as discussed above, is that better public infrastructure increases the productivity of the private capital stock through decreased congestion. This is also similar to the literature on congestion of public infrastructure (Barro & Sala-i Martin, 1990; Fisher & Turnovsky, 1998) which offers several options for modeling congestion, for example, as a share of public services to output or a ratio of public capital to private capital. I opt for the latter version, assuming that the accumulated stock of public capital, and not the flow variable of public spending, determines the productivity of private capital:

$$v_t = \left(\frac{KG_t}{Kpr_t} \right)^{(1-\sigma)}, \tag{2.3}$$

where σ determines the degree of degree of rivalry and excludability of public infrastructure. So, if $\sigma = 1$, there is no congestion at all, and in case $\sigma = 0$, public capital stock must increase in direct proportion to private capital stock, for private capital to maintain the same productivity. I assume partial congestion, i.e. $\sigma = 0.5$, since public infrastructure, such as roads, railway and the like, is a non-excludable and, to a large extent, rival good.

Importantly, explicit modeling of the supply side of the economy poses a particular challenge for the stock-flow consistency of the model since the production and the aggregate spending are determined by different factors and do not always coincide. Aggregate demand equals to the overall spending of the private and public sector in our economy:

$$Z_t = C_t + I_t + G_t. \tag{2.4}$$

In most periods, demand does not exceed potential output or $Z_t \leq Y_t^*$ and, thus, the overall income equals to the aggregate spending in the economy:

$$Y_t = Z_t. \tag{2.5}$$

However, in some periods of the simulation, aggregate demand might exceed potential output $Z_t > Y_t^*$, since it is possible to create loans and issue government bonds endogenously, and spending is not limited to current income. In this case, the overall income equals to the maximum production in the economy:

$$Y_t = Y_t^*, \tag{2.6}$$

and the excess demand must be satisfied with inventories Θ. Thus, change in inventories equals:

$$\Delta\Theta_t = Z_t - Y_t. \tag{2.7}$$

Firms

Since the model assumes that the wage share ω is constant, the wages are determined straightforwardly as a fraction of the aggregate income:

$$W_t = \omega Y_t. \tag{2.8}$$

Also, firms borrow to finance investment in addition to retained profits and pay a fixed interest rate on the outstanding loans. The loans dynamics are described as follows, where investment can partly stem from inventories (for stock-flow consistency):

$$L_t = L_{t-1} + (I_t - \Delta\Theta_t) - RP_t. \tag{2.9}$$

Therefore, firms' total profits TP equal to the profit share less interest rate expenses of the firms, where a fraction RP is retained to repay the loans:

$$TP_t = (1-\omega)Y_t - int_L L_{t-1}, \tag{2.10}$$

$$RP_t = s_F TP_t, \tag{2.11}$$

a fraction of profits is transferred to firms' offshore accounts V_O where they can neither be taxed nor consumed at a tax avoidance rate λ_P:

$$\dot{V_{Ot}} = \lambda_P(TP_t - RP_t), \tag{2.12}$$

$$V_{Ot} = V_{Ot-1} + \dot{V_{Ot}}, \tag{2.13}$$

and the rest DP is distributed to the households:

$$DP_t = (1-\lambda_P)(TP_t - RP_t). \tag{2.14}$$

As established in canonical Post-Keynesian models (Dutt, 1984; Taylor, 1985), firms decide how much to invest based on profit rate and utilization of the productive capacity. I proceed with a private investment function of this tradition extended by a simple rule to prevent unlimited expansion of credit taking similar to Brochier and Freitas (2023):

$$I_t = (\alpha_1 r_{t-1} + \alpha_2 u_{t-1} + \alpha_3 lev_{t-1}) Kpr_{t-1}, \tag{2.15}$$

assuming $\alpha_1 > 0$, $\alpha_2 > 0$, $\alpha_3 < 0$, whereas the profit rate r_t, the capacity utilization rate u_t and

the leverage ratio lev_t are specified as:

$$r_t = TP_t/Kpr_t, \tag{2.16}$$

$$u_t = Y_t/Y_t^*, \tag{2.17}$$

$$lev_t = L_t/Kpr_t. \tag{2.18}$$

Also, part of the total private investment is used to maintain inventories at the desired level, which is a fraction β of the aggregate demand Z in the previous period:

$$I_{\theta t} = \beta Z_{t-1} - \Theta_{t-1}, \tag{2.19}$$

and the rest is being invested in capital stock:

$$I_{Kt} = I_t - I_{\theta t}. \tag{2.20}$$

Stock of inventories in each period is equal to:

$$\Theta_t = \Theta_{t-1} - \Delta\Theta_t + I_{\theta t}. \tag{2.21}$$

In addition, private capital stock is subject to depreciation at rate δ_{Kpr}, so that it develops according to:

$$Kpr_t = (1 - \delta_{Kpr})Kpr_{t-1} + I_{Kt}, \tag{2.22}$$

and its growth rate equals to:

$$g_{Kprt} = \frac{Kpr_t - Kpr_{t-1}}{Kpr_{t-1}}. \tag{2.23}$$

Banks

Money is endogenous, and there are no restrictions on the amount of credit to the firms as well as the government, so the banking sector only performs the function of credit supply in my model, and banks fully redistribute the profits they make by giving out loans and holding government bonds, after paying interest on deposits, to the households:

$$BP_t = int_L L_{t-1} + int_B B_{t-1} - int_V V_{Ht-1}. \tag{2.24}$$

Households and government

Coming to the households and public finance, since the government taxes all income from wages, profits and capital gains at a fixed tax rate τ, disposable income of the household is:

$$Y_{Ht} = (1-\tau)(W_t + DP_t + BP_t + int_V V_{Ht-1}), \tag{2.25}$$

while government tax revenue is determined by:

$$T_t = \tau(W_t + DP_t + BP_t + int_V V_{Ht-1}). \tag{2.26}$$

Private consumption is a fraction of disposable income and deposits:

$$C_t = c_1 Y_{Ht-1} + c_2 V_{Ht-1}, \tag{2.27}$$

where deposits develop according to:

$$V_{Ht} = V_{Ht-1} - C_t + Y_{Ht}. \tag{2.28}$$

Government consumption is a fixed proportion of the aggregate income in the previous period:

$$CG_t = \gamma_{CG} Y_{t-1}. \tag{2.29}$$

In addition, government investment is determined by:

$$IG_t = T_{t-1} - CG_t + \gamma_{IG} KG_{t-1}, \tag{2.30}$$

where γ_{IG} is specified by a fiscal rule which is the central part of modeling public finance dynamics. I run simulations with two alternative fiscal rules. The first one corresponds to a rule where the government pursues a balanced budget, meaning $G_t = T_{t-1}$ and, correspondingly, $\gamma_{IG} = 0$. The second scenario is defined as an investment-friendly fiscal rule where public investment is determined by the exogenous public capital accumulation rate $\gamma_{IG} > 0$, thus allowing for non-zero fiscal deficits. In total, government expenditure is the sum of government consumption and investment:

$$G_t = CG_t + IG_t. \tag{2.31}$$

Public capital stock is determined as:

$$KG_t = (1-\delta_{KG}) KG_{t-1} + IG_t, \tag{2.32}$$

where δ_{KG} is the depreciation rate of the public capital stock; and the growth rate of the public capital stock equals to:

$$g_{KGt} = \frac{KG_t - KG_{t-1}}{KG_{t-1}}. \tag{2.33}$$

The stock of outstanding government bonds develops according to the following equation, where the interest payments are serviced by issuing new bonds:

$$B_t = B_{t-1} + G_t - T_t + int_B B_{t-1}, \tag{2.34}$$

with the debt-to-GDP ratio and the government deficit in terms of output defined as:

$$debt_t = B_t / Y_t, \tag{2.35}$$

$$deficit_t = (T_t - G_t)/Y_t. \tag{2.36}$$

The stock-flow consistency of the model implies that the financial flows add up in each given period, according to:

$$\Delta V_{Ht} + \Delta V_{Ot} = \Delta B_t + \Delta L_t, \tag{2.37}$$

and the bank accounts balance:

$$V_{Ht} + V_{Ot} = B_t + L_t. \tag{2.38}$$

Tables 2.1 and 2.2 represent the balance sheet and the transaction matrices of the modeled economy.

Table 2.1: Balance sheet matrix

	Households	Firms	Commercial banks	Government	Total
Deposits	$+V_H$		$-V_H$		0
Loans		$-L$	$+L$		0
Treasury bills			$+B$	$-B$	0
Firms' offshore accounts		$+V_O$	$-V_O$		0
Capital		$+K_{pr}$		$+K_g$	$+K$
Inventories		$+\Theta$			$+\Theta$
Total (net worth)	$+V_H$	$+V_f$	0	$+V_g$	$+V$

Table 2.2: Transaction matrix

	Households	Firms		Commercial banks		Government	Total
		Current	Capital	Current	Capital		
Pr. investment in capital		$+I_K$	$-I_K$				0
Pr. investment in inventories		$+I_\theta$	$-I_\theta$				0
Pr. consumption	$-C_{pr}$	$+C_{pr}$					0
Gov. investment		$+I_g$				$-I_g$	0
Gov. consumption		$+C_g$				$-C_g$	0
Gov. revenue	$-T$					$+T$	0
Wage bill	$+W$	$-W$					0
Interest on deposits	$+int_v V_{Ht-1}$			$-int_v V_{Ht-1}$			0
Interest on loans		$-int_l L_{t-1}$		$+int_l L_{t-1}$			0
Interest on treasury bills				$+int_b B_{t-1}$		$-int_b B_{t-1}$	0
Firms' profits	$+DP$	$-TP$	$+RP$				
			$+\dot{V}_O$		$-\dot{V}_O$		0
Com. banks profits	$+BP$			$-BP$			0
Change in deposits	$+\dot{V}_H$				$-\dot{V}_H$		0
Change in loans			$-\dot{L}$		$+\dot{L}$		0
Change in treasury bills					$+\dot{B}$	$-\dot{B}$	0
Change in inventories		$-\dot{\Theta}$	$+\dot{\Theta}$				0
Total	0	0	0	0	0	0	0

2.3.2 Steady state implications

Due to the complexity of the model's supply side, only a few things can be said about the long-term dynamics in the model. Since private investment depends on the capacity utilization rate (Equations 2.16 and 2.17), output and potential output must increase at the same rate in the steady state:

$$g_Y = g_{Y^*}. \tag{2.39}$$

From the functional form of the PF (Equations 2.2 and 2.3) it follows, that the productivity of capital must be constant in the long run. It implies that the steady state conditions of the model are given when the growth rate of output, private capital stock, and public capital stock are all equal:

$$g_Y = g_{Kpr} = g_{KG}. \tag{2.40}$$

Equating the growth rates of private and public capital yields:

$$\frac{I_{Kt}}{Kpr_{t-1}} - \delta_{Kpr} = \frac{IG_t}{KG_{t-1}} - \delta_{KG}. \tag{2.41}$$

Rearranging, the ratio of private capital investment to private capital stock must exceed the ratio of public investment to public capital to cover the difference in the depreciation rates:

$$\frac{I_{Kt}}{Kpr_{t-1}} - \frac{IG_t}{KG_{t-1}} = \delta_{Kpr} - \delta_{KG}. \tag{2.42}$$

Writing out Equations 2.15 and 2.20 and finding the equilibrium value for capacity utilization:

$$u^* = \frac{1}{\alpha_2}\left(g_{KG} + g_{I_\theta} + \delta_{Kpr} - \alpha_1 r^* - \alpha_3 lev^*\right), \tag{2.43}$$

where $g_{I_\theta} = I_\theta / Kpr$ in the long run and r^*, lev^* are equilibrium values of the profit rate and the private leverage rate. Plugging the rest of Equations 2.16, 2.17, 2.18, 2.19, and 2.30 into Equation 2.41 yields:

$$(\alpha_1 \frac{TP_{t-1}}{Kpr_{t-1}} + \alpha_2 \frac{Y_{t-1}}{v_{t-1} Kpr_{t-1}^{(1-\rho)} KG_{t-1}^{\rho}} + \alpha_3 \frac{L_{t-1}}{Kpr_{t-1}}) - \frac{\beta Z_{t-1} - \Theta_{t-1}}{Kpr_{t-1}} - \delta_{Kpr} = \frac{(T_{t-1} - \gamma_{CG} Y_{t-1})}{KG_{t-1}} + \gamma_{IG} - \delta_{KG}. \tag{2.44}$$

Due to the expression for the supply side of the model, which enters this equation, the condition for the growth rates in the steady state cannot be usefully simplified to deduce a concise formulation for the equilibrium values of the key variables. However, two crucial observations can be made. First, the growth rates go up with the parameter of the fiscal rule γ_{IG}. Second, due to the firms' intention to maintain a stock of inventories, an increase in aggregate demand does not only boost private investment, but also leads to building up inventories, thus also negatively affecting investment in

private capital.

Considering the dynamics of public debt, it follows from :

$$B_t = (1 + int_B)B_{t-1} + G_t - T_t, \tag{2.45}$$

Dividing by Y_t and assuming the growth rate constant in the long run:

$$\frac{B_t}{Y_t} = \frac{(1 + int_B)}{(1 + g_Y)} \frac{B_{t-1}}{Y_{t-1}} + \frac{G_t - T_t}{Y_t}, \tag{2.46}$$

In the long run:

$$\frac{B_{t+n}}{Y_{t+n}} = \left(\frac{1 + int_B}{1 + g_Y}\right)^{n+1} \frac{B_{t-1}}{Y_{t-1}} + \sum_{s=0}^{n-1} \left(\frac{1 + int_B}{1 + g_Y}\right)^{n-s-1} \frac{G_{t+s} - T_{t+s}}{Y_{t+s}}, \tag{2.47}$$

Thus, for non-explosive dynamics due to compounding, the interest rate on government bonds must not exceed the steady state growth rate of output:

$$int_B < g_Y. \tag{2.48}$$

This is reminiscent of the debt sustainability condition (Domar, 1944). However, unlike Domar's original work, the growth rate of output is endogenous to the interest rate on government bonds in the model, because of the stock-flow consistency. Since interest payments on government bonds enter the disposable income and the tax revenue as bank profits, and thus private consumption and public expenditure (Equations 2.24, 2.25, 2.26, 2.27), it follows:

$$\frac{\partial g_Y}{\partial int_B} = \frac{\partial(\dot{C}_t + \dot{I}_t + \dot{G}_t)/Y_{t-1}}{\partial int_B} \neq 0. \tag{2.49}$$

Thus, whether the debt dynamics are stable in the model will depend on the effect of the interest rate on growth as well as other factors that affect the dynamics of public debt and output.

Furthermore, rewriting the equation in terms of the change in debt ratio $\frac{B_t}{Y_t} - \frac{B_{t-1}}{Y_{t-1}}$ yields:

$$\Delta debt_t = \frac{(int_B - g_Y)}{(1 + g_Y)} debt_{t-1} + \frac{G_t - T_t}{Y_t}. \tag{2.50}$$

A constant debt-to-GDP ratio then implies that the primary deficit equals the public debt to output scaled by the relationship between the interest rate on government bonds and the growth rate of output:

$$deficit = \frac{(int_B - g_Y)}{(1 + g_Y)} debt. \tag{2.51}$$

It follows that a stable positive debt-to-GDP ratio is possible in two cases: First, if the deficit is

negative (government spending exceeds tax revenue), then it is necessary that the growth rate is higher than the interest rate on government bonds. Vice versa, if the interest rate is above the growth rate, the government needs to run a surplus to keep the debt-to-GDP ratio stable. This result is in line with Tavani and Zamparelli (2017a).

Due to the limited analytical conclusions from the model, I follow the simulation practice in the SFC literature (Caverzasi & Godin, 2014) and proceed with numerical experiments with calibrated parameter values in order to analyze the development of the main variables in the model. Two fiscal policy scenarios will be simulated to explore the dynamics of the growth rates, the capacity utilization rate, and the debt-to-GDP ratio. Centrally, the experiments show not only the long-run outcomes but also the adjustment path. In addition, the simulations will investigate the implications of the Domar condition.

2.3.3 Calibration of parameters

In the course of the following numerical simulations, the parameters of the model are calibrated to the Euro area. Table 2.3 (in Appendix) lists the parameters and the initial values of the main variables. Initial variables are normalized to $Y_1 = 1$. This section will briefly describe the parametrization. First, I use the main national accounts data from Eurostat (2023a) to determine the propensity to consume out of disposable income. For the value of the propensity to consume out of deposits, I turn to the literature (Dafermos & Nikolaidi, 2019). I use a long-term value for the wage share (ECB, 2023a) and the recent increased interest rate values from the ECB database (ECB, 2023b, 2023e).

I calibrated the saving rate out of profits, although somewhat lower than the empirically observed, to prevent a negative private leverage value under the chosen set of parameters. This is necessary since the firms in my model retain profits to invest and pay off the loans, which is not the same in the real business practice. Also, the parameter of the firms' profits transferred to offshore accounts λ_P is assumed to be rather low and induces a tax revenue loss of below 0.5% of GDP in the model, whereas the recent estimate for Europe of tax revenue loss through tax havens is at 0.82% (Tax Justice Network, 2023).

As mentioned earlier, I opt for the median long-term value of ρ found in the meta-regression analysis (Bom & Ligthart, 2014). The values for the depreciation rate of the public and private capital are estimates from an IMF study (IMF, 2015). The desired level of inventories is set to be 5 % of demand. The tax rate is calibrated to fit the data for the tax revenue in percent of output (Eurostat, 2023b). The set of the private investment function parameters α_1, α_2, α_3 to produce a plausible multiplier and growth rates in a reasonable range. The parameter of the government consumption share is calculated to fit the initial values of public consumption and investment. Last but not least, the parameter of the fiscal rule, i.e. the public investment target parameter

γ_{IG}, is determined by the fiscal rule scenario.

Coming to the initial values of the main variables, I use the data from Eurostat (2023a) for the aggregate output and spending. Potential output is calculated from Equation 2.1, and our economy is assumed to start from operating below full capacity. Private investment is taken from the main national accounts (Eurostat, 2023a), and private consumption is calculated as a residual component of the aggregate spending (next to private investment and government spending).

The values of public and private capital stock are taken from the IMF Capital Stock Dataset (IMF, 2021b), and the productivity parameter of the private capital stock is determined by their relationship as indicated earlier. The factors affecting the private investment, that is the profit rate, the capacity utilization rate, and the private leverage, are calculated according to Equations 2.16, 2.17, and 2.18. Again, tax revenue is provided by Eurostat (2023b). Government expenditure is assumed to be equal to the tax receipts since I start from a balanced budget in the first period of the simulation. Therefore, the initial value of the public deficit is, per assumption, equal to zero. Government consumption is calculated according to Equation 2.29, and government investment is obtained by Equation 2.30. Lastly, I consult the ECB databases (ECB, 2023c, 2023d) to determine the value of outstanding loans and government securities as well as the current debt-to-GDP ratio. The value of deposits in the first period is calculated as a residual from Equation 2.38, assuming that the initial value of the firms' offshore accounts is zero.

2.4 Results

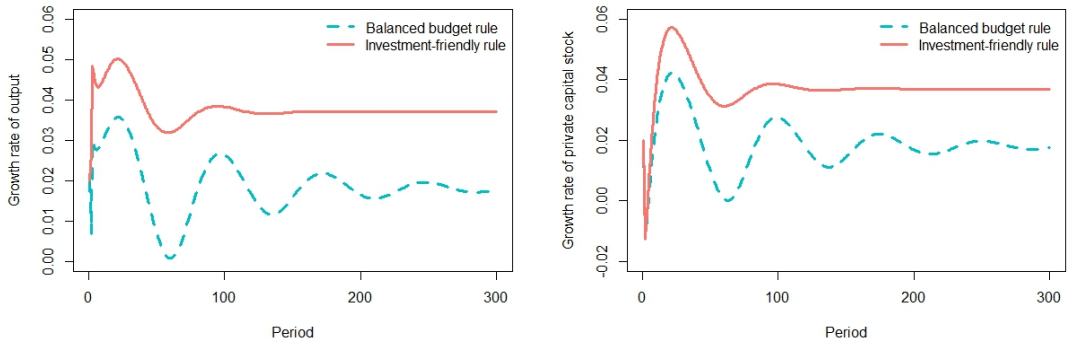
2.4.1 Baseline results

I begin with a simulation of the model, as described above, over 300 periods. This section presents the baseline simulation results of two fiscal rule scenarios, a balanced budget rule, where $\gamma_{IG} = 0$, and an investment-friendly "golden" rule with $\gamma_{IG} = 0.02$. Figure 2.1 displays the growth rates of output and of private capital stock under the two chosen fiscal rule scenarios. The yearly growth rates peak at 5% after 20 periods in the case of the investment-friendly fiscal rule and gradually converge to approximately 3.7% in the long run. However, growth remains much lower than that until the end of the simulation exercise in the case of the balanced budget fiscal rule, only reaching a maximum of 3.7% and fluctuating around 1.7% over the long term. This is the first central observation in the simulation exercise.

The second crucial result here is the difference in volatility of the growth rates under the two scenarios. Indeed, in the case of the investment-friendly fiscal rule, the variance of the growth rate is significantly lower, and it is converging to the long-term value much sooner, than under the balanced budget fiscal rule. Under the scenario where the government is primarily focused on balancing the budget, the volatility of the growth rates is large and persistent, with periods of

low economic growth, and the convergence to the long-term growth rate values is not completed within the simulation period. Thus, not only growth, but also economic stability is lower under the balanced budget scenario.

Figure 2.1: Baseline results: Growth rates



(a) Output

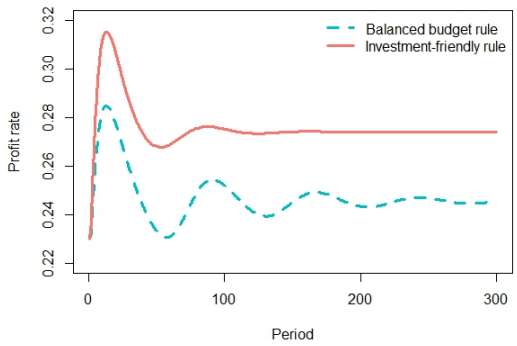
(b) Private capital

The higher growth rates, as well as their lower volatility under the scenario where public investment is exempt from the spending ceiling, are explained by the factors determining the accumulation of private capital in the model, i.e. profit rate, capacity utilization, and firms' leverage. These variables, after a short adjustment period, converge to their long-term values in the case of investment-friendly fiscal rule (see Figure 2.2). The profit rate increases significantly from the initial level to about 27%, whereas it fluctuates around a lower level of about 25% under the balanced budget fiscal rule (2.2(a)). Furthermore, the rate of capacity utilization, after a temporary increase, falls significantly and then oscillates around the initial level under the restrictive fiscal policy scenario. On the contrary, it converges to a higher long-term level about 91% long-term in the golden rule scenario (2.2(b)). Thus, the scenario of the investment-friendly fiscal policy results not only in higher growth of private capital, but also in a more intensive usage of productive capacity. Although this has not been modeled explicitly, it is worth mentioning that a higher and more stable capacity utilization rate would imply a higher and more stable employment under the golden rule scenario. Therefore, social transfers for the unemployed would also be sustained at a lower level in this case. Moreover, a larger increase in profits under the investment-friendly fiscal rule allows firms to reduce their leverage a bit further, notwithstanding an accelerated investment activity (2.2(c)). To conclude, all three factors determining the investment rate of the private firms are more favorable under the investment-friendly fiscal rule, resulting in a faster private capital accumulation and output growth.

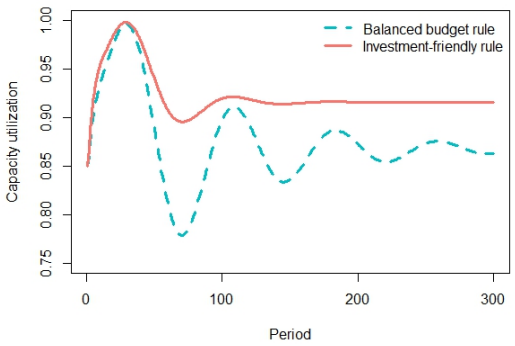
The dynamics of the productivity coefficient of private capital v_t is crucial for the results of

the simulation (2.2(d)). Since public capital stock is subject to depreciation, the productivity of capital is lower under the balanced budget rule, and it exhibits a more volatile behavior. On the contrary, the productivity coefficient converges to a higher value under the investment-friendly rule and is more stable, since sufficient government investment is undertaken to maintain the public capital stock. To sum up, public investment ensures a faster and more stable growth of the supply side which is necessary for the overall growth in the model.

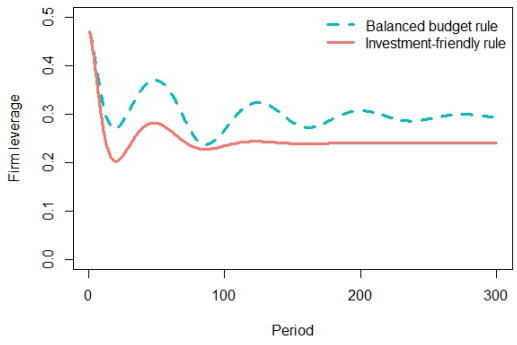
Figure 2.2: Baseline results: Private investment determinants and capacity utilization



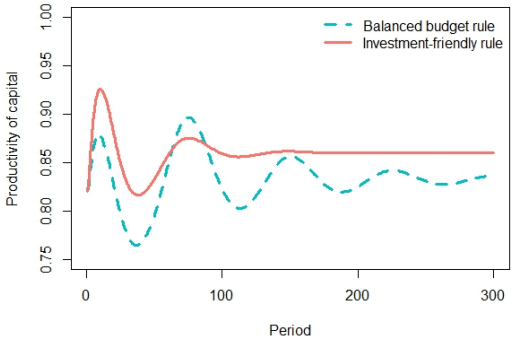
(a) Profit rate



(b) Capacity utilization



(c) Loans to private capital ratio



(d) Productivity coefficient v

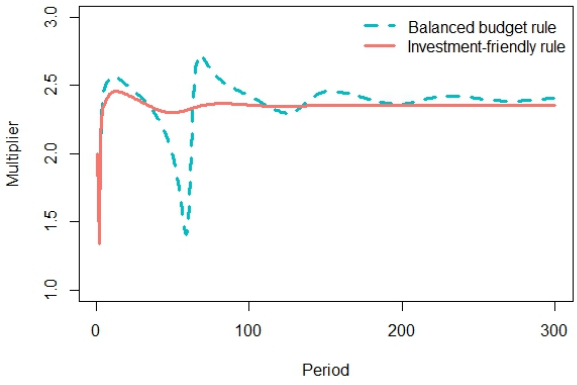
To provide an economic interpretation for this result, the balanced budget scenario would depict an empirically observed phenomenon that private capital cannot be highly productive when public infrastructure is in a state of deterioration. Vice versa, the investment-friendly fiscal rule scenario illustrates how barriers to private economic activity can be reduced by increasing the productivity of private capital through improved infrastructure. A stable productivity coefficient lowers the uncertainty for firms, thus creating more favorable business conditions. As a result, private investment activity is accelerating.

Figure 2.3 depicts the fiscal multiplier defined as the change of output in relation to the change in public spending:

$$M_t = \frac{Y_t - Y_{t-1}}{G_t - G_{t-1}}. \tag{2.52}$$

The fiscal multiplier ranges between 1.5 and 2.5, and its dynamics are countercyclical in the model, meaning that the multiplier is larger in the periods when economic growth is lower, and vice versa. The multiplier is higher in the long run under the balanced budget rule since the growth rate is continuously lower. So, the dynamics and the magnitude of the fiscal multiplier are roughly in line with empirical evidence (Gechert & Rannenberg, 2018).

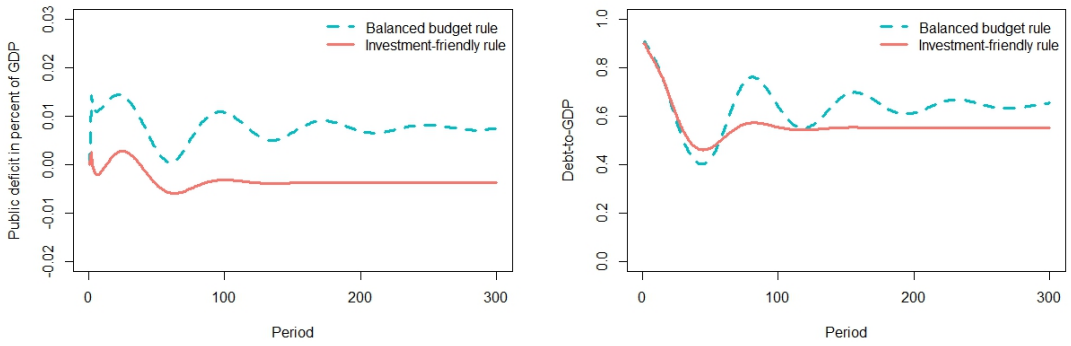
Figure 2.3: Baseline results: Fiscal multiplier



Finally, Figure 2.4 presents the development of the key public finance variables. First, government runs primary deficits in the scenario of the golden rule, amounting to roughly 0.3% of GDP in the long run, whereas the debt-to-output ratio converges to about 55% of GDP. In the balanced budget scenario, primary deficits are positive and the surplus fluctuates around 0.7% for the major part of the simulation period. However, as a consequence of low growth, the debt-to-output ratio, after an initial decline, when it sinks below the level of the golden rule scenario, goes up again. Eventually, when the growth rates reach the long-term value and stabilize there, public debt fluctuates at about 64% of output. It is thus considerably higher than under the investment-friendly fiscal rule and also much more volatile. In conclusion, aiming to achieve a balanced budget does not result in a lower public debt ratio.

Indeed, as Equation 2.51 indicated, the debt-to-GDP ratio converges to a stable positive value in two cases: Either if public deficit is negative, the debt to output is stable if the growth rate is higher than the interest rate on government bonds, or if the interest rate is above the growth rate, the government needs to run a surplus to keep the debt-to-GDP ratio constant. Since the

Figure 2.4: Baseline results: Public finance variables



(a) Primary deficit

(b) Public debt

growth rate is endogenous to public spending in the model, the simulated scenarios correspond to these opposite outcomes. The fiscal policy of increased public investment induces a higher growth rate which allows for a negative budget balance in the long run; whereas the frugal fiscal scenario results in the growth rate below the interest rate on bonds so that the surplus is needed for the stability of the debt-to-output ratio.

To conclude, the balanced budget rule scenario demonstrates lower growth rates of output as well as public and private capital. This scenario exhibits a lower profitability and a lower capacity utilization, a somewhat higher firms' leverage and a persistently lower productivity of capital stock. Notwithstanding a budget surplus, the balanced budget rule scenario results in a public debt-to-GDP ratio which stays significantly higher than under the investment-friendly rule in the long run, thus missing the objective of fiscal sustainability. In addition, it induces economic instability since the macroeconomic variables show much more volatile dynamics under the balanced budget rule. On the contrary, higher growth rates and accelerated capital accumulation under the golden rule of public investment, although associated with public deficits, result in a lower debt-to-output ratio.

2.4.2 Fiscal expansion scenario

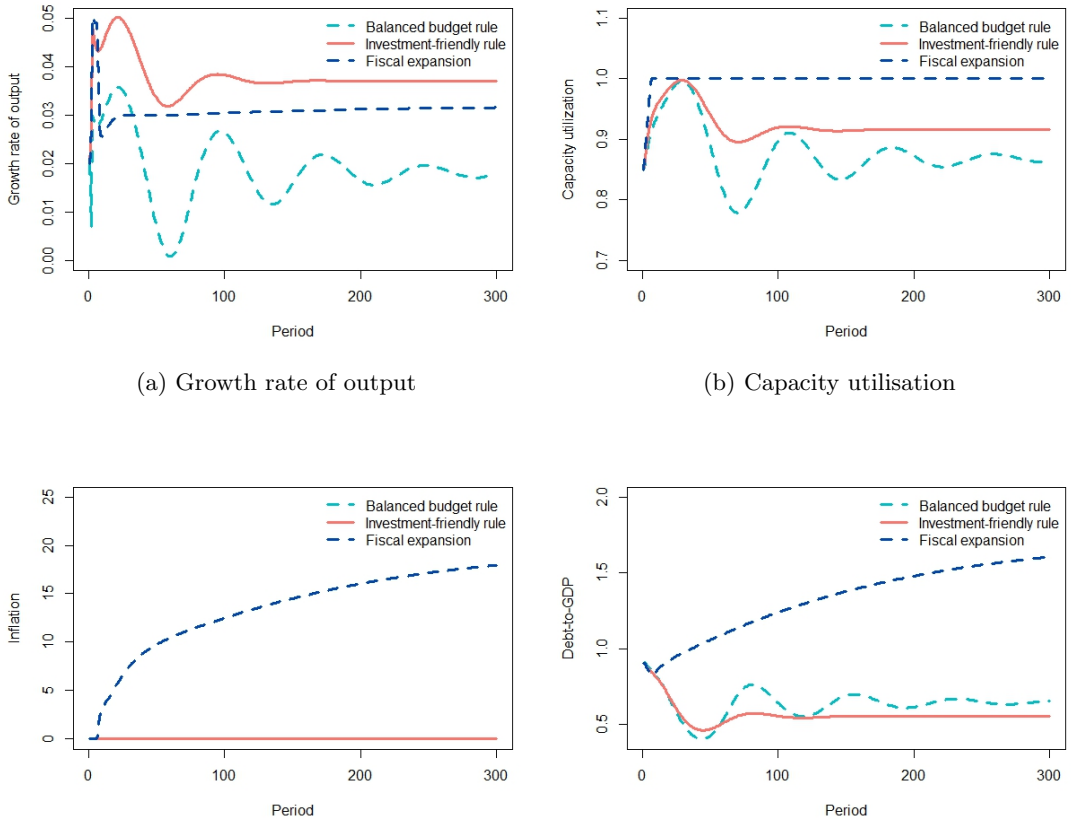
Baseline results section contrasts two scenarios: the balanced budget rule and the investment-friendly fiscal rule, where the latter induces a higher growth and a lower debt in terms of GDP. However, would an elevated public consumption have a similar growth effect and lead to a declining debt-to-output ratio? In this section, I test a further scenario of expansive fiscal policy, where an additional government stimulus of the same magnitude, as under the golden rule, $F_t = \gamma_{IG} KG_{t-1}$, is ejected into the economy, but not invested in public capital stock. This can be formally written down as:

$$IG_t = T_{t-1} - CG_t, \tag{2.53}$$

$$G_t = IG_t + CG_t + F_t. \tag{2.54}$$

Figure 2.5 presents the main variables of interest under the two baseline fiscal rules and the additional fiscal expansion scenario. First of all, fiscal expansion results in a higher growth rate than the balanced budget rule, albeit not as high as under the investment-friendly fiscal rule (2.5(a)). Yet, since government expenditure boosts consumption, but increases neither the public capital stock nor the productivity of private capital, potential output does not grow at the same rate as the aggregate demand, and the economy soon starts to operate at full capacity (2.5(b)).

Figure 2.5: Results of the fiscal expansion scenario



(a) Growth rate of output

(b) Capacity utilisation

(c) Inflation

(d) Public debt

As a result, investment in inventories goes up rapidly in the fiscal expansion scenario. However, even an ever-increasing stock of inventories is not sufficient to cover the excess demand so that firms accumulate open orders that they cannot fulfill. In such an overheated economy, inflation is

inevitable. There is no formal equation of inflation in the model, but the price increases could be modeled as a function of the excess demand, such as:

$$\Delta P_t = f(Z_t/Y_t). \tag{2.55}$$

Figure 2.5(c) illustrates inflation rates under the two main scenarios and the fiscal expansion case as percentage points of excess demand in the economy. Since demand is a flow variable, the inflation rates can be interpreted as increases in prices per period. Both the balanced budget and the investment-friendly fiscal rule do not exhibit any inflation since aggregate demand does not exceed potential output. However, under the fiscal expansion scenario, prices grow at accelerating rates, soon reaching 10 percentage points and going further up.

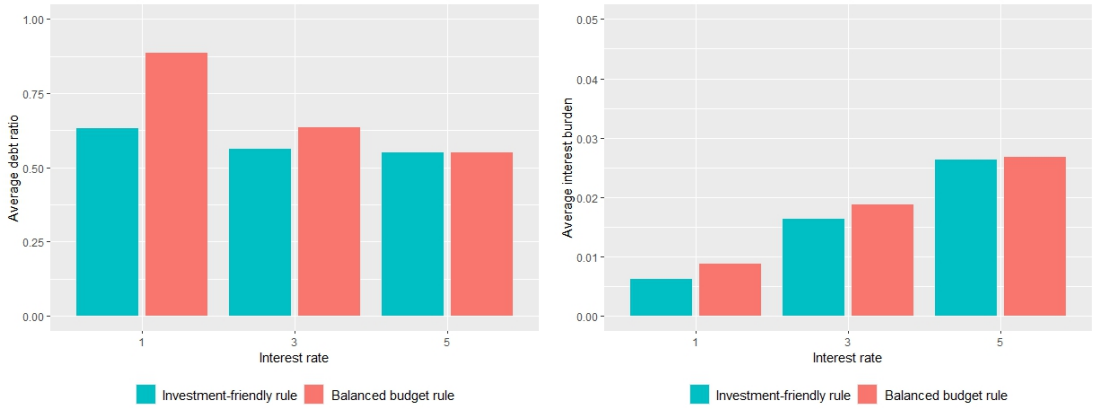
At the same time, the public debt-to-GDP ratio starts to rise under the fiscal expansion scenario after a few initial periods (2.5(d)), since the aggregate output cannot be increasing at the same rate as government expenditure due to the supply-side constraints. Thus, the scenario of expansive public consumption is not effective in stabilizing fiscal variables, while it could jeopardize economic stability through macroeconomic imbalances and inflationary dynamics. This finding highlights that it is of central importance whether the additional expenditure boosts the productivity of the economy or not. Indeed, caution is advised in evaluating public spending categories with respect to their productivity effect.

2.4.3 Interest rate on bonds and the Domar condition

In this section, I investigate the sensitivity of the results to the interest rate on government bonds. In the baseline scenario, the interest rate on government bonds amounted to 3%. Now I simulate the model for the interest rate values of 1 and 5%. Crucially, debt service payments are modeled as a transfer from the government to the population since interest payments enter the bank profits which are directly distributed as income to the households. Therefore, a higher interest rate will induce an increase in this transfer and, thus, an increase in disposable income and government revenue.

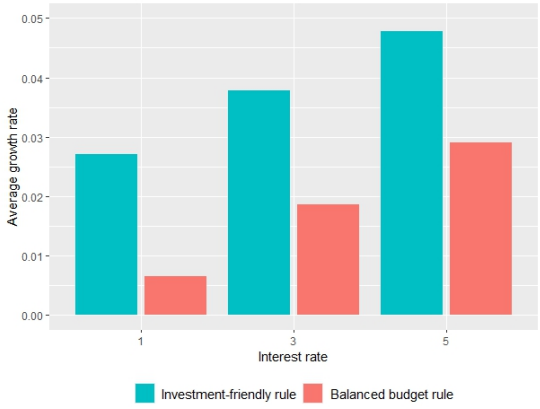
Figure 2.6 presents the results of the interest rate simulations. Figure 2.6(a) displays the debt-to-GDP averages under the different fiscal rules and the values for the interest rate. The debt-to-output ratio is higher with a lower interest rate, especially so for the balanced budget scenario. At first, this might seem at odds with the Domar debt sustainability condition (Domar, 1944). However, the analysis in Domar's original work assumed that the growth rate is exogenously given and does not depend on the interest rate. This is different in the model outlined in this paper. The growth rate is endogenous to the interest rate due to the stock-flow consistency of the model. Also, the modeled economy is closed so that the debt service flows enter the disposable income of households in their entirety.

Figure 2.6: Sensitivity of results to interest rate on government bonds



(a) Government debt

(b) Interest burden



(c) Growth rate

By consulting the graphs for the interest burden and the growth rate (2.6(b) and 2.6(c)), it becomes obvious that, although the interest burden is predictably larger with an increased interest rate, the growth rates are, however, also higher. This is due to the increased disposable income, tax revenue, and thus also aggregate spending. The effect on the growth rate is more than proportional to the change in interest rate, so the sustainability of debt improves with a higher (and worsens with a lower) interest rate.

The assumption that interest payments flow to disposable income and tax revenue can be relaxed to contrast its effect on debt sustainability. In what follows, I assume that debt service payments are not spent in their entirety. Instead, bondholders transfer a share of interest payments to offshore accounts, instead of firms that distribute their entire profits to households. Formally:

$$\dot{V_{Ot}} = \lambda_B(int_B B_{t-1}),^6 \tag{2.56}$$

[6] $\lambda_B = 0.75$. Note that λ_B equal to 1 would mean that all the interest payments are saved offshore. This produces explosive dynamics of public debt in the model.

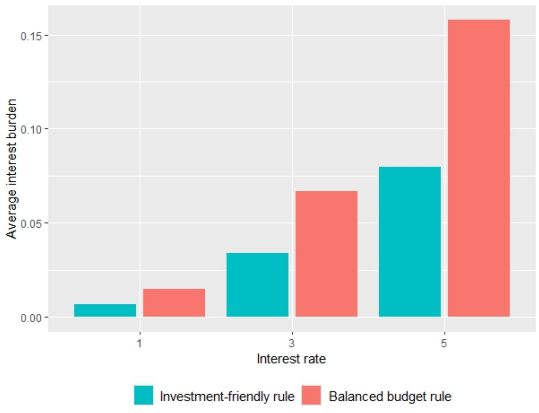
$$BP_t = int_L L_{t-1} + (1 - \lambda_B) int_B B_{t-1} - int_V V h_{t-1}. \tag{2.57}$$

$$DP_t = TP_t - RP_t. \tag{2.58}$$

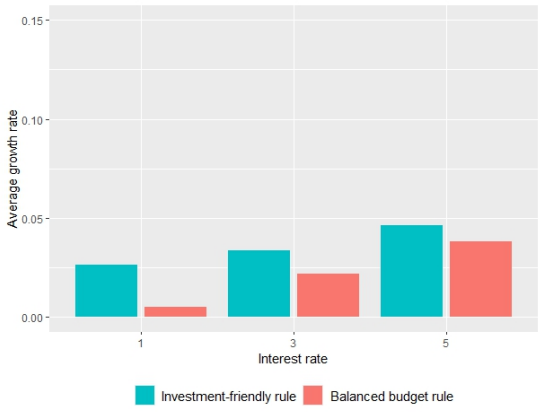
Figure 2.7 presents the results of the simulation under these alternative assumptions. Now, higher debt service does not result in stronger growth. Thus, the additional interest burden is larger in relation to output. As a result, the public debt ratio is higher for scenarios with a higher interest rate. This would be in line with the Domar condition under the assumption that the growth rate is exogenous to the interest rate on government bonds. In conclusion, the stock-flow consistency and the closed nature of the modeled economy allow for an illustration of the interaction between the monetary and real variables in the context of the Domar condition. Indeed, higher interest rates on bonds only lead to an increase in the debt-to-GDP ratio if the interest payments do not increase the aggregate demand.

Figure 2.7: Sensitivity of results to interest rate on government bonds, alternative assumptions

(a) Government debt



(b) Interest burden



(c) Growth rate

2.4.4 Sensitivity of results to parameters

The results of the baseline simulations possibly depend on the parameters of the key equations: the production function and the private investment function. Their values have been set exogenously, based on the available data and theoretical arguments. However, values of these parameters as well as assumptions can significantly influence outcomes of the simulations. Therefore, this section will investigate the sensitivity of results to variation in these factors.

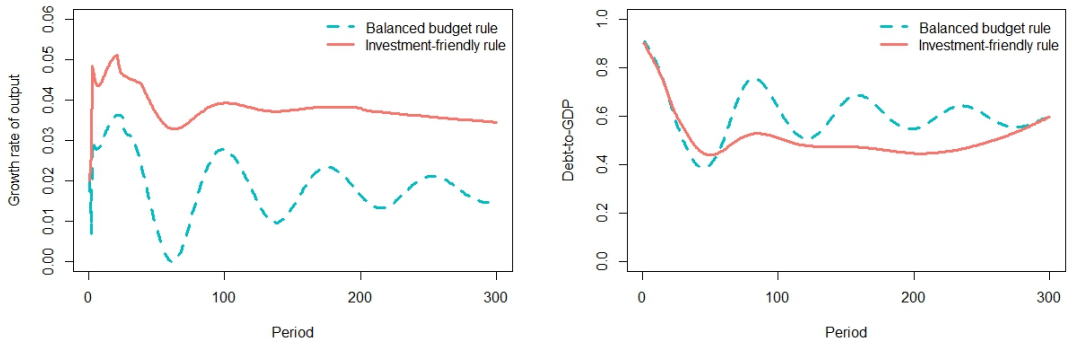
Returns to scale

Up to now, the results hinge on the parameters of the PF:

$$Y_t^* = v_t K p r_t^{\kappa} K G_t^{\rho}, \tag{2.59}$$

which has been assumed to exhibit constant returns to scale, $\kappa + \rho = 1$. This has been a rather conservative approach since some neoclassical models assume increasing returns to scale (Baxter & King, 1993). However, if there is a limit to growth that can be achieved through investment in public capital stock, the result will change. To illustrate this, the assumption of the constant return to scale can be relaxed. In this section, I repeat the baseline simulation assuming diminishing returns to scale, with $\kappa = 0.88$ and $\rho = 0.11$, thus, $\kappa + \rho < 1$.

Figure 2.8: Sensitivity of results to parameters of PF



(a) Growth rate of output

(b) Public debt

Figure 2.8 presents the results of the scenarios with the balanced budget and investment-friendly fiscal rules under the assumption of diminishing returns to scale. Since the effect of improved public infrastructure on output declines over time, the growth rate under the golden rule scenario, although being higher than under the balanced budget rule, starts to fall after about 200 periods, whereas public debt starts to increase in terms of GDP, thus going up beyond the scenario of the balanced budget rule.

This result is plausible since initial investment in infrastructure as well as in education and other public goods probably yields higher gains than the following investments due to saturation of basic needs. Moreover, there is a limit to resources and land use, so that more advanced technology might be needed to sustain the same rate of growth. So, keeping public investment at a stable pace will eventually reach a ceiling of efficiency gains. In this case, fiscal policy may be corrected to avoid unproductive spending. But up to that point, the scenario of the investment-friendly fiscal rule still yields a lower debt-to-output ratio than the balanced budget rule. To conclude, also under the assumption of declining returns to scale, the result of the baseline scenarios holds for the main part of the simulation period.

Parameters of the private investment function

Finally, I test the robustness of the results to the parametrization of the private investment function. I specified private investment as a function of the profit rate, the capacity utilization, and the leverage (see Equation 2.15). The elasticities of the private investment to these factors (correspondingly, α_1, α_2 and α_3) were chosen in order to induce a plausible multiplier and growth rates in a reasonable range, since reliable empirical estimates for them are not available.

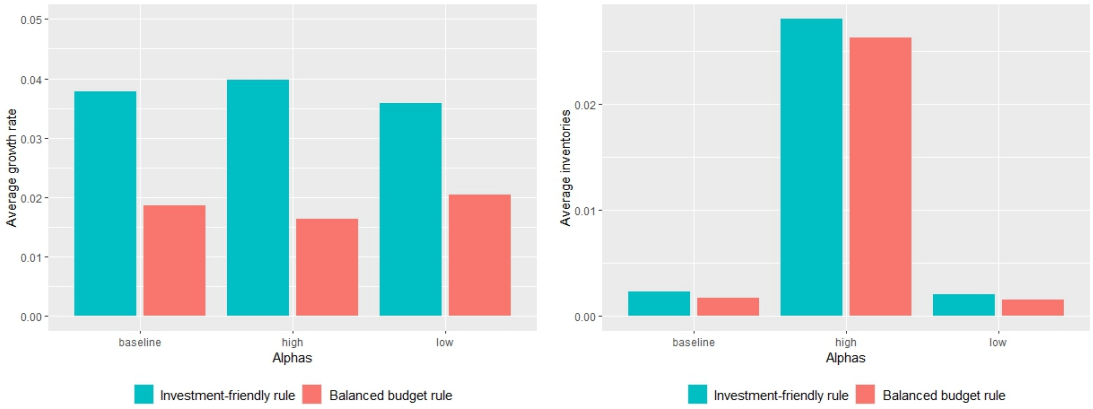
Figure 2.9 examines the sensitivity of results to the size of alphas. The baseline scenario corresponds to $\alpha_1 = 0.15$, $\alpha_2 = 0.15$ and $\alpha_3 = -0.15$. The simulations with these values result in an average growth rate amounting to about 3.7% under the investment-friendly fiscal rule and 1.7% under the balanced budget rule. Also, in this case, the simulations deliver average private capacity utilization rates of a magnitude between 75 and 95 % and a large but reasonable fiscal multiplier of 2.4.

Now I test two alternative sets of alphas: "low" and "high". Namely, the low alphas scenario is a set of parameters 20% lower than the baseline scenario ($\alpha_1 = 0.12$, $\alpha_2 = 0.12$ and $\alpha_3 = -0.12$), and the high alphas scenario tests a set of parameters 20% larger than the baseline ($\alpha_1 = 0.18$, $\alpha_2 = 0.18$ and $\alpha_3 = -0.18$).

The alternative sets of alphas induce similar growth rates to the baseline (2.9(a)). However, in the scenario of larger alphas, private investment is greater than in the baseline. Expanded private investment brings the economy to its capacity limit where aggregate demand exceeds potential output. Firms start to invest in inventories at a much higher rate, on average over 2.5 % of GDP each period (2.9(b)). Contrarily, the low alphas scenario differs from the baseline scenario in lower private investment activity. In fact, firms become net lenders to the rest of the economy since retained earnings exceed investment expenditure. None of these alternative scenarios seems to be plausible in the long run.

Figure 2.10 shows the average debt-to-GDP ratios under the alternative sets of alphas. The debt ratio proves to be sensitive to the parametrization of the private investment function. Indeed,

Figure 2.9: Sensitivity of results to parameters of the private investment function



(a) Average growth rate

(b) Average investment in inventories

the debt ratio is considerably smaller (larger) in the case of higher (lower) alphas. Still, in all cases, it holds that the fiscal rule, that allows for additional public investment, induces a lower debt ratio than the balanced budget rule. All things considered, the findings in this section confirm the plausibility of the initial set of alphas for the baseline scenario since it delivered the most moderate result. Centrally, the baseline results remained stable under the alternative specifications of the model.

Figure 2.10: Sensitivity of public debt to parameters of the private investment function

2.5 Conclusion

I develop a macroeconomic SFC model that incorporates public sector in the economy. In this model, government can consume and invest; both spending categories enter the aggregate income, however, government investment adds up to the public capital stock. The productivity of the private capital depends on the public capital stock due to congestion effects. The composition of

public spending, in turn, depends on the fiscal rules. Two fiscal scenarios are then simulated: the one where the government is aiming to attain a balanced budget and the one where the government invests at a constant rate.

Baseline results show that the investment-friendly fiscal rule induces a higher profitability of private capital, a more intensive capacity utilization, a lower firms' leverage, and, as a consequence, stronger growth. The higher growth rates and accelerated capital accumulation under the golden rule of public investment, although associated with higher public deficits, result in a lower debt-to-output ratio. The balanced budget scenario results in a higher debt-to-GDP ratio, although the government runs a fiscal surplus. In addition, the balanced budget rule induces economic instability due to a high volatility of the productivity of capital so that the model does not converge to the steady state within the simulation time span. An additional scenario of fiscal expansion demonstrates that increased public expenditure fails to ensure fiscal stability unless directed towards capital investment. Furthermore, the stock-flow consistent nature of the model facilitates an investigation of the Domar condition under the premise that the growth rate is endogenous to the interest rate. Finally, sensitivity tests confirm that the results are fairly robust to parametrization of the production function and private investment function.

To conclude, deficit aversion does not necessarily bring about a reduction in debt. A restrictive fiscal policy does not seem to be the most efficient way to achieve a long-term debt sustainability if public investment is crucial for productivity. Moreover, not only the economic, but also the ecological and political dimensions of the society may become more and more fragile in the current multi-crisis, leaving less time and room for maneuver. Therefore, aligning government policy to the short-term indicators of the public finance, such as the deficit, and neglecting the long-term outcomes becomes problematic. A more effective policy would include looking at the economic effects of various spending categories and prioritizing projects that boost productivity.

Lastly, the model can be extended in a variety of ways to delve into further topics, for example, by implementing additional fiscal regime scenarios or alternative sets of fiscal rules. Moreover, interest rates on government bonds can be hinged on a set of variables, such as the debt-to-output ratio, the growth rate, and others. This would make the model suitable to investigate some behavioral reactions in financial markets discussed in the literature. Furthermore, the model could make an appropriate tool to analyze the dynamics of the green transition by introducing carbon emissions and climate-relevant investment to the developed framework. Last but not least, a useful extension to the model could be implementing "delays to build". Imposing lags on the adjustment of these variables would mimic the time needed for the construction work. This would enable simulation of the temporal discrepancy between the fiscal policy and the real economy effects of infrastructure, potentially invoking insightful dynamics.

2.6 Appendix to Chapter 2

Table 2.3: Parameters and initial values of variables

Parameter	Definition	Value	Source
c_1	Propensity to consume out of disposable income	0.88	Main national accounts (Eurostat, 2023a)
c_2	Propensity to consume out of deposits	0.05	Dafermos and Nikolaidi (2019)
ω	Wage share	0.624	Long-term value (ECB, 2023a)
int_V	Interest rate on deposits	0.02	Bank interest rates (ECB, 2023b)
int_B	Interest rate on government bonds	0.03	Yield curves (ECB, 2023e)
int_L	Interest rate on loans	0.05	Bank interest rates (ECB, 2023b)
s_F	Saving rate out of profits	0.47	Calculated to fit lev_t
λ_P	Rate of tax avoidance	0.02	Tax Justice Network (2023)
ρ	Output elasticity of public capital	0.12	Bom and Ligthart (2014)
$1-\rho$	Output elasticity of private capital	0.88	Calculated from $1-\rho$
δ_{Kpr}	Depreciation rate of private capital	0.1041	Estimated from data (IMF, 2015)
δ_{KG}	Depreciation rate of public capital	0.0459	Estimated from data (IMF, 2015)
β	Desired inventories level	0.05	Per assumption
τ	Tax rate	0.5	Calculated to fit T_1
α_1	Investment function coefficient of profit rate	0.15	Selected from a plausible range
α_2	Investment function coefficient of cap. utilization	0.15	Selected from a plausible range
α_3	Investment function coefficient of firms' leverage	-0.15	Selected from a plausible range
γ_{CG}	Consumption spending coefficient of government	0.36	Calculated to fit CG_1
γ_{IG}	Government investment target	0 / 0.02	Determined by fiscal rules

Variable	Definition	Initial value	
Y_1	Aggregate output	1	Main national accounts (Eurostat, 2023a)
Y_1^*	Potential output	1.18	Calculated from Equation 2
Z_1	Aggregate spending	1	Main national accounts (Eurostat, 2023a)
I_1	Total private investment	0.14	Main national accounts (Eurostat, 2023a)
C_1	Private consumption	0.44	Calculated to fit Z_1
KG_1	Public capital stock	1	IMF Capital Stock Dataset (IMF, 2021b)
Kpr_1	Private capital stock	1.5	IMF Capital Stock Dataset (IMF, 2021b)
v_1	Productivity coefficient of capital stock	0.82	Calculated from Equation 3
r_1	Profit rate	0.23	Calculated from Equation 16
u_1	Capacity utilization	0.85	Calculated from Equation 17
T_1	Tax revenue	0.42	Total receipts from taxes (Eurostat, 2023b)
G_1	Government expenditure	0.42	Calculated to fit $deficit_1$
CG_1	Government consumption	0.36	Calculated from Equation 29
IG_1	Government investment	0.06	Calculated from Equation 30
L_1	Loans	0.7	Sector accounts (ECB, 2023d)
lev_1	Leverage	0.47	Calculated from Equation 18
V_{H_1}	Households' deposits	1.6	Calculated from Equation 38
V_{O_1}	Firms' offshore deposits	0	No estimate
Θ_1	Stock of inventories	0.05	Per assumption
B_1	Bonds outstanding	0.9	Government debt (ECB, 2023c)
$debt_1$	Debt-to-GDP ratio	0.9	Government debt (ECB, 2023c)
$deficit_1$	Government deficit	0	Determined by fiscal rules

Chapter 3

Passing the partisan filter: Political narratives, partisan bias and opinions on public finances[1]

[1]This article is currently under review in the Scottish Journal of Political Economy. This chapter is based on joint work with Prof. Dr. Sebastian Gechert. I appreciate comments of discussants at the 2023 EAEPE Conference, the 2023 Young Economist Conference, the 2024 FMM Conference, and other workshops, on earlier versions of this paper.

3.1 Introduction

Intergenerational fairness and sustainability of public finances pose a trade-off between fiscal consolidation and public investment. This paper investigates how voters form their opinions about public finances. We use recent data from a representative survey among the German populace to study the opinions of German residents on public spending, deficit and debt. In particular, we test whether influential political narratives affect the general public's preferences on government debt and deficit and attempt to understand the mechanism of their impact on individuals' views.

According to Shiller's "narrative economics" theory, societal narratives exhibit significant influence on economic behavior (Shiller, 2017). Preferences and decisions of individuals could be influenced by the stories they hear and believe, even if those are over-simplified or even misleading. The theory provides a possible explanation for an observed behavior, such as policy support or opposition, which may seem less than rational from an economic vantage point. We hypothesize that political narratives on public debt and public investment influence opinions of laypeople. We investigate their impact in the context of the so-called partisan bias in opinion formation, which refers to the empirically observed differences in how individuals evaluate facts and form opinions, depending on their political preferences.

Along these lines, we conduct a survey experiment to test whether fiscal policy preferences of German residents react to political narratives. We confront randomly selected subsamples of our respondents with one of the election program statements, taken from the 2021 election campaigns of a major fiscally conservative party (the Christian Democrats, CDU) and from a major fiscally liberal party (the German Green party, B90/Greens). The conservative statement stresses that fiscal consolidation promotes intergenerational fairness, while the liberal statement emphasizes the need for additional deficit-financed public investment in Germany. We use the verbatim statements from the party manifestos though without a reference to the party to avoid mental activation effects, i.e. activation of cognitive pathways associated with the party. We then estimate the narrative treatment effect on respondents' concerns about public debt in Germany. More precisely, survey participants were asked whether they agreed that the level of public debt in Germany was a major problem (on a linear scale of 1=fully disagree to 5=fully agree). Additionally, we test the treatment effect on their preferences of how best to handle a public budget deficit. Furthermore, we investigate interactions between treatments and political party preferences.

Concerning socio-demographic characteristics, the data confirm a number of expectable patterns and correlations. Most respondents consider the level of public debt in Germany to be a severe problem; more educated and more financially literate survey participants find public debt less of a problem; people with children and older participants are more concerned of public debt; a lower trust in government as well as concerns about the general economic situation also positively

correlate with considering the level of public debt in Germany as a major problem; a preference for parties on the left of the political spectrum comes with less agreement that the level of public debt in Germany is a major problem in comparison to centrist voters, while the opposite is true for right-wing voters, who are more likely to consider public debt in Germany to be a severe problem. In addition, party preferences strongly correlate with respondents' opinions about public deficit. Predictably, voters on the left prefer a tax increase or borrowing to cutting expenditure. Supporters of the far-right party favor spending cuts, but not tax increases. Those, who declared a party preference, were generally less likely to not know how to deal with the public deficit.

Our narrative treatment experiment sheds some light on the opinion formation and the stability of preferences of the survey participants. We do not find a pronounced and uniform impact of the narratives on the respondents' opinions. However, we identify an asymmetry in the treatment effects interacted with respondents' party preferences. The pro-consolidation narrative affects left-leaning voters to increase the likelihood that they consider public debt to be a severe problem. This interaction brings the assessment of public debt of left-leaning voters in the same range as centrist or non-partisan voters, while the conservative position of right-wing voters is even reinforced. The pro-investment narrative does not have a statistically significant interaction effect with party preferences.

To put our findings in the context of the existing research, our paper partly confirms and partly challenges findings from the literature on preferences for public finance. Previous surveys on fiscal policy preferences in Germany find that the majority of respondents supports fiscal consolidation and the German debt brake, especially if they were older, wealthier, male, educated, and employed (Heinemann & Hennighausen, 2012; Hayo & Neumeier, 2019). Similarly, the majority of our survey participants agreed with the statement that the level of public debt in Germany is a major problem; however, male and more educated respondents were *less likely* to find sovereign debt problematic. A companion paper by Behringer, Dräger, Dullien, and Gechert (2024), based on the same survey, further investigates the effects of education and information treatments about public finances, showing that more accurate prior knowledge or additional information helps people contextualize public finance figures.

Surveys often reveal that laypersons' knowledge of economic issues like inflation, tax policy and public finances is fragmented (D'Acunto, Malmendier, Weber, & Weber, 2022; Stantcheva, 2021; Roth, Settele, & Wohlfart, 2022). Male, older, more educated respondents show better knowledge on average, while supporters of the welfare state are more likely to demonstrate greater levels of knowledge about public policy (Eichhorn, Kenealy, & Bennett, 2024). Additionally, reasoning about fiscal matters is prone to the "more for less paradox" (Welch, 1985) where respondents desire more spending together with lower taxes and lower deficits. Bremer and Bürgisser (2023) show that exposing respondents to clear trade-offs between deficit reduction, tax cuts and spending

increases, reduces preferences for debt repayment. They find that expenditure-based and even more so revenue-based consolidation are unpopular. Also, Hübscher, Sattler, and Wagner (2021) find that voters generally dislike austerity policy. Other studies confirm low willingness to accept higher tax contributions for debt reduction, although richer respondents claim to be more open to it (Berger, Blesse, Heinemann, & Janeba, 2017; Hayo & Neumeier, 2017). Beliefs about the fiscal policy situation play an important role in shaping opinions (Hayo & Neumeier, 2017), as does respondents' knowledge about debt levels and their perception of being personally affected (Zabler, 2017). Crucially, the receipt of contextualizing information as well as framing play an important role in opinion formation (Behringer et al., 2024; Roth et al., 2022; Stix, 2013).

Empirical evidence also demonstrates a partisan bias on economic policy questions. People gather information about the world through the lens of their political opinions (Campbell, Converse, Miller, & Stokes, 1960; Jerit & Barabas, 2012). Early evidence shows significantly diverging perceptions of objective economic facts about inflation, unemployment, and the size of the deficit, between liberals and conservatives in the US (Bartels, 2002). Likewise, residents of republican and democratic states have different inflation expectations depending on the party affiliation of the current president (Bachmann, Gründler, Potrafke, & Seiberlich, 2021). Political affiliation also influences inflation expectation formation in Australia (Gillitzer, Prasad, & Robinson, 2021) and Germany (Coleman & Nautz, 2022). According to Gerber and Huber (2009), consumers' economic expectations, influenced by their political leaning and election outcomes, translate into real changes in consumer behavior.

How does partisan bias relate to moral factors, information and narratives? According to Goren (2005), party identification is more stable than political and moral values of respondents, influencing policy preferences. Experimental data show that a treatment-induced increase in self-identification with one of the parties makes subjects shift their political views (Gerber, Huber, & Washington, 2010). Likewise, Dias and Lelkes (2022) argue that partisanship as a social identity, rather than actual (dis)agreements on policy questions, drives the polarization between conservatives and liberals in the US, which points in the direction of party preference being predominant to the views on economic policy. Bullock and Lenz (2019) suggest that differences in survey responses of voter groups might indicate support for the respective party instead of actual differences in opinions. Financial incentives for correct answers and including the option "don't know" can reduce partisan bias (Bullock, Gerber, Hill, & Huber, 2015).

Flynn, Nyhan, and Reifler (2017) reviews research on psychological aspects of partisan bias and misperceptions about political topics, suggesting that expert opinions and media narratives play a key role in promoting false political beliefs. Bursztyn, Rao, Roth, and Yanagizawa-Drott (2023) indeed document differences in the adoption of preventive behaviors between viewers of TV-shows broadcasting significantly diverging narratives about the COVID-19 crisis. In the context of

fiscal policy, Barnes and Hicks (2018) demonstrate that laypeople's attitudes towards government deficits were correlated with their favorite newspaper's framing. In their survey experiment they show that a positive media narrative about government borrowing makes people less concerned about the size of government deficits in the UK, while a narrative framing public borrowing as problematic shows no effect.

Conservatives and liberals not only hold different views of the inheritance tax in the US, but they also react differently to factual information about it (Sides, 2016). Stantcheva (2021) argues that differences in tax policy preferences can be explained by divergent social values and views of the government between Democrats and Republicans. Besides, she identifies a minor partisan bias in reactions to information treatments. Glaser and Berry (2018) find asymmetry in willingness to compromise over policy between republicans and democrats, which they explain with the help of prospect theory. Since conservatives defend the status quo, they are more rigid about their position, than the progressives, who are pushing for change and, thus, are more open to a compromise.

Sears and Funk (1999) show that individual political preferences are remarkably consistent, and only few people experience a shift in their views over their lifetime. Also, Kiley and Vaisey (2020) demonstrate that empirical data on cultural beliefs are generally more consistent with stable attitudes than active updating models. However, while political party affiliation is strikingly stable, preferences for public spending and other concrete policy issues could be subject to updating.

In summary, the literature presents a complex picture on the determinants of laypeople's preferences towards fiscal consolidation and debt. Survey respondents seemingly have stable attitudes correlated with partisanship, but opinions can partly be influenced by media narratives, framing and information provision. Our findings align with the partisan bias literature, as we observe substantial differences in public debt preferences in line with partisanship, remaining largely unaltered by narrative treatments. In line with the literature, the pro-consolidation narrative slightly reduces the preference of respondents to incur new debt and the pro-investment narrative reduces the preference to cut spending, but the coefficients are small and statistical significance is low. Again, there is a much stronger correlation with party preferences in the expected direction that left-leaning voters favor tax hikes and deficit financing over spending cuts while the opposite is true for right-wing voters.

However, the pro-consolidation narrative has an asymmetrical effect on the concerns regarding public debt, depending on political beliefs of survey participants. We hypothesize that the pro-consolidation narrative might have crossed ideological boundaries and particularly affected left-leaning voters because of its moral framing. Self-identification with a particular political party could serve as an anchor or a "filter" to accepted narratives. The pro-consolidation narrative may have passed the partisan filter because it taps into deep ethical values when framed as "intergenerational justice". Left-leaning voters, who otherwise support additional deficit spending,

may feel compelled by the moral framing to reevaluate their stance. In sum, our findings nuance the narrative economics theory and provide new evidence for the literature on partisan bias as well as insights for effective communication strategies regarding public finance policy, especially in times of political polarization.

The remainder of this paper is organized as follows. The next section 3.2 explains our data and the survey experiment. Section 3.3 presents and discusses the results. Section 3.4 concludes.

3.2 Data and survey experiment

The data come from a German representative computer-assisted online survey of people aged 18 to 75 administered in the weeks after the general election in Germany in September 2021. Participants were recruited to represent the German working age population according to age, gender, federal state and household income. A total of 8,483 people were asked a series of questions on their demographics, education, knowledge and attitudes, as well as their views on public finances. Their preferences on public debt and deficit were surveyed simultaneously with attitudes to public investment to avoid the "more for less paradox."

Figure 3.1: Flowchart of the survey and the experiment

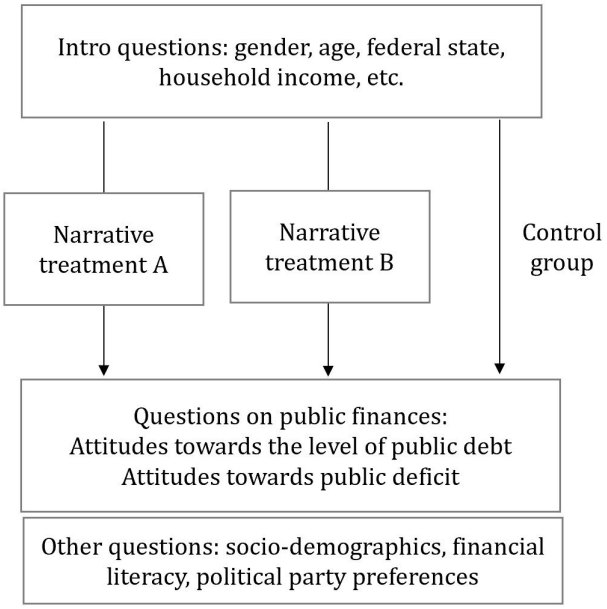


Figure 3.1 shows the flowchart of the survey and the experiment. In the preamble, we query respondents regarding their socio-demographic characteristics. In the main part of the survey, we ask respondents to reveal their opinions on public spending, debt and deficit. In particular, they were asked whether they agreed that the level of public debt in Germany was a major problem (on a linear scale of 1=fully disagree to 5=fully agree) and how the government should deal with public

deficit (they could choose one option among "cut spending", "increase tax", "take on debt", "I don't know"). As explained below, some of the survey participants were exposed to political narrative treatments within our survey experiment at this stage. Finally, we collect further information about our respondents, such as level of education and whether they have children, but also regarding their political party preferences, trust in government (on a scale from 1 to 7), financial literacy score (on a scale from 0 to 3), and concerns about the general economic situation (on a scale from 1 to 3). We collect the data on the time needed to complete the survey and remove those who spent less than half of the median time to account for "speeder" issues common in survey research (Greszki, Meyer, & Schoen, 2014).

For the regression analysis, we use a subsample of the data that includes a control group (not exposed to any treatments) and the two groups, selected for our experiment. The control group comprises a total of 2034 respondents, and each treatment group includes 659 participants. The rest of the survey participants (exposed to other information treatments not included in this study) have been removed from our sample. Table 3.1 shows the main socio-demographic characteristics of our final sample of 3352 respondents. The average age in our sample is 47.6 years. Almost 51 percent of participants are male. An average participant had graduated from secondary school. About 26 percent of the surveyed individuals indicate that they have children. The political party preferences are plausibly split between the largest German political parties, whereas about 46 percent of the respondents do not declare their support for any of the main parties.

Table 3.2 shows the comparison of the distribution of party preferences in our sample to the overall population which is measured by the so-called "Sonntagsfrage" ("Which party would you vote for if there was a general election next Sunday"?) which is a regular representative survey of the current political preferences in Germany (Infratest dimap, 2021). The party preferences among the participants of our survey are roughly in line with the German population at around the time of our survey.

Since the experiment treatments were assigned randomly, the descriptive statistics of the control and the treatment groups are nearly identical. Table 3.7 and Table 3.8 in Appendix A to this chapter entail balance tests showing that the treated groups are not different to the control group in observed characteristics, with only a minor deviation in the share of respondents without finished school, the voters for the Left party (treatment A) and AfD supporters (treatment B), which might be explained by the small subsamples.

At the stage of the experiment, we randomly confronted two subgroups of respondents with political narratives regarding public investment and debt. The treatments were given as an introduction to the question regarding respondents' attitude towards public debt. One treatment group saw a statement from the election program of a fiscally conservative party (Christian Democrats, CDU), the other a statement from the fiscally liberal green party (B90/Greens).

Table 3.1: Descriptive statistics of socio-demographic characteristics in the sample

Variable	Description	N	Mean	Min	Max
Age	Age in years	3352	47.61486	18	79
Gender (Male)	1 if male	3352	.5068616	0	1
Education	Education in levels	3306	2.329099	0	3
	0=No school (yet)	3306	.0275257	0	1
	1=Lower secondary school	3306	.1194797	0	1
	2=Secondary school	3306	.3493648	0	1
	3=Upper secondary school	3306	.5036298	0	1
Children	1 if having children	3219	.2618826	0	1
Party	Self-declared political preference	3352	2.796539	1	7
	1=None/Other	3352	.4630072	0	1
	2=Left party	3352	.0462411	0	1
	3=Social Democrats (SPD)	3352	.1434964	0	1
	4=Green Party	3352	.099642	0	1
	5= Conservative party (CDU/CSU)	3352	.1261933	0	1
	6=Liberal party (FDP)	3352	.0689141	0	1
	7=Far-right party (AfD)	3352	.052506	0	1
Control group	Not exposed to any treatment	2034			
Treatment A	1 if exposed to Treatment A	659			
Treatment B	1 if exposed to Treatment B	659			

Table 3.2: Comparison of the distribution of political preferences in the sample to the overall population

Party	Sample*	Population**
Left	7.47	6
Social Democrats (SPD)	23.18	25
Green	16.10	16
Conservative (CDU/CSU)	20.38	20
Liberal (FDP)	11.13	13
Far-right (AfD)	8.48	12
Other	13.26	8

*Refers to the distribution of preferences in the control group and both treatment groups together, among respondents who indicated a party preference. **Refers to the distribution of answers in the representative survey on September 2, 2021 (Infratest dimap, 2021).

The conservative statement stresses that fiscal consolidation promotes intergenerational fairness (Treatment A), while the liberal statement emphasizes the need for additional deficit-financed public investment in Germany (Treatment B). Note that we did not mention the origin of the statements in order to avoid mental activation effects regarding the respective political party. The exact wording of the treatments is presented below:

Treatment A:

After the general election, the new government must decide on fiscal policy priorities for the coming years. Politicians' opinions often differ on whether the state should take on debt for public investment. Some want to get by without new debt as quickly as possible. They argue that this is intergenerational justice in practice.

Treatment B:

After the general election, the new government must decide on fiscal policy priorities for the coming years. Politicians' opinions often differ on whether the state should take on debt for public investment. Some want to allow limited borrowing in the amount of investments. They argue that the investment backlog in our country needs to be addressed and that climate protection, digitization and education need to be significantly strengthened.

We hypothesize that the pro-consolidation narrative should lead treated respondents to consider public debt to be a more severe problem and to reduce the willingness to finance a budget deficit with new debt. Regarding the pro-investment narrative, we would expect treated respondents to consider public debt to be a smaller problem and to increase the support for public spending financed by additional borrowing.

3.3 Baseline results

Our dependent variable is the agreement with the claim: "The level of public debt in Germany is a major problem" on a linear scale from 1 ("Strongly disagree") to 5 ("Strongly agree"). Figure 3.2 shows the distribution of the values of the dependent variable for the control group. The distribution exhibits a bell curve shape with a mean of about 3.7. Most survey participants expressed that they strongly agree or somewhat agree with the statement.

How do the treatments affect respondents' assessment of public debt and how do respondents' characteristics relate to assessment? Table 3.3 presents the results of Ordinary Least Squares (OLS) regressions of the variable of interest on the treatments and the control variables, with the following linear regression model:[2]

$$OpinionDebt_i = \beta_0 + \beta_1 NarrativeTreatment + \beta^k X_i^k + \epsilon_i. \tag{3.1}$$

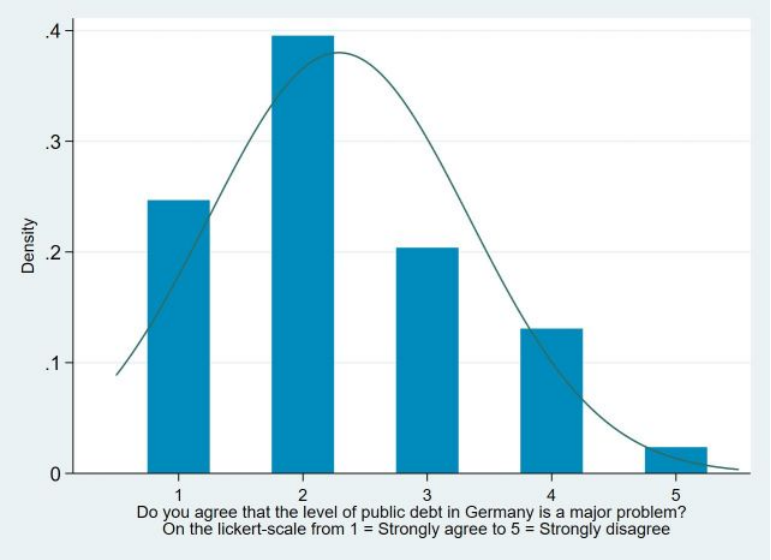
Coefficients with a positive sign represent a ceteris paribus stronger agreement with the statement that public debt is a major problem, and vice versa. Columns 1 and 2 show the treatment effect of

[2] As a robustness check, we also estimate an ordered logistic regression model, where the probability of a particular outcome for the dependent variable is specified as:

$$Pr(OpinionDebt_i = j) = Pr(\alpha_{j-1} < OpinionDebt_i^* < \alpha_j) = F(\alpha_j - x_i^{'}\beta) - F(\alpha_{j-1} - x_i^{'}\beta),$$

where F is the logistic cdf $F = e^z/(1+e^z)$.

Figure 3.2: Distribution of attitudes towards public debt



the pro-consolidation narrative (Narrative A) on the opinions about public debt, against the control group, whereas columns 3 and 4 display the results for the pro-investment treatment (Narrative B), again in comparison to the control group with and without control variables respectively. As control variables, we use age, gender, level of education, a dummy for having children, a standard financial literacy test score[3] between 0 (all answers incorrect) and 3 (all answers correct), as well as trust in government (on a scale between 1 - "no trust at all" and 7 - "very high trust") and concern about the general economic situation (1 - "not concerned at all", 2 - "somewhat concerned", 3 - "very concerned").

The results of the OLS regressions show that both narrative treatments do not have a statistically significant effect on the dependent variable (columns 1 and 3). Thus, we cannot reject the null hypothesis that such political statements do not, on average, affect public opinion on sovereign debt. Adding controls to the regressions does not change this result (columns 2 and 4). The control variables mostly exhibit expected coefficients. On average, older participants and those with children agreed with the statement, that public debt is a major problem, more often. More educated persons and those with a higher financial literacy score were less likely to consider public debt a problem. Likewise, a higher trust in government is associated with lower concerns about public debt, while larger concerns about the general economic situation are correlated with stronger concerns about public debt.

Since political narratives did not show any statistically significant effect on their own, we dive deeper into investigating how political preferences shape the opinions on sovereign debt. Table 3.4

[3]We use three standard test questions on interest rate compounding, real interest rates and portfolio diversification (Lusardi & Mitchell, 2014) and sum up correct (+1) and incorrect (0) answers.

Table 3.3: Effect of treatments on preferences for public debt

	Narrative A: Consolidation		Narrative B: Investment	
	(1)	(2)	(3)	(4)
Narrative A	0.015	0.032		
	(0.047)	(0.046)		
Narrative B			0.005	0.017
			(0.047)	(0.046)
Age		0.004***		0.004**
		(0.001)		(0.001)
Gender (male)		-0.062		-0.012
		(0.041)		(.041)
Children		0.108**		0.133**
		(0.048)		(0.047)
Education		-0.107***		-0.107***
		(0.026)		(0.026)
Financial literacy		-0.070**		-0.079***
		(0.023)		(0.023)
Trust in government		-0.088***		-0.070***
		(0.012)		(0.012)
Concern economy		0.365***		0.394***
		(0.032)		(0.032)
Constant	3.707***	3.446***	3.707***	3.325***
	(0.023)	(0.138)	(0.023)	(0.135)
Observations	2,693	2,549	2,693	2,556
R-squared	0.000	0.112	0.000	0.112

Notes: The Table presents results of OLS regressions. Dependent variable refers to respondents' agreement that 'the level of public debt in Germany is a major problem' (on a linear scale of 1=fully disagree to 5=fully agree). Explanatory variables: Narrative A is a dummy=1 when the respondent is exposed to the pro-consolidation narrative. Narrative B is a dummy=1 when the respondent is exposed to the pro-investment narrative. Age (in years), Gender (1=male, 0=other), Education (1=lower, 2=secondary, 3=upper secondary), Children (1=household with children, 0=no children), Financial literacy (linear scale, 0 to 3 correct answers), Trust in government (linear scale, from 1=no trust to 7=profound trust), Concern economy (linear scale, from 1=no concerns to 3=big concerns). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

presents the results of OLS regressions of concern about public debt on the dummies for political preferences (left, centrist, or right-leaning) in addition to the previous set of regressors. We code the dummy for *Left* as supporters of the Left and the Green party, *Centrist* as preferring the Social Democrats, the Christian Democrats, or the Free Liberals, and *Right* as the followers of the far-right party AfD.

Indeed, political party preferences seem to be strongly aligned with the attitudes of the respondents towards public debt (columns 1 and 3). Those preferring a party on the left of the political spectrum (the Left or Green Party), are generally much less concerned with public debt. Respondents, who identified as far-right voters (AfD), report a ceteris paribus higher concern with public debt. Survey participants, who sympathize more with the parties of the political center (SPD, CDU/CSU, FDP), do not express any significantly different views on public debt than the participants without a specific party preference.

Table 3.4: Effect of treatments on preferences for public debt, depending on political views

	Narrative A: Consolidation		Narrative B: Investment	
	(1)	(2)	(3)	(4)
Narrative A	0.028	-0.029		
	(0.045)	(0.068)		
Narrative B			0.011	-0.034
			(0.045)	(0.068)
Left	-0.290***	-0.358***	-0.370***	-0.367***
	(0.060)	(0.068)	(0.059)	(0.068)
Centrist	0.014	0.012	0.019	-0.009
	(0.046)	(0.053)	(0.046)	(0.053)
Right	0.239**	0.192*	0.243***	0.213**
	(0.093)	(0.107)	(0.090)	(0.107)
Left*Narrative A		0.291**		
		(0.137)		
Centrist*Narrative A		0.013		
		(0.102)		
Right*Narrative A		0.192		
		(0.212)		
Left*Narrative B				-0.011
				(0.134)
Centrist*Narrative B				0.115
				(0.103)
Right*Narrative B				0.111
				(0.192)
Age	0.004***	0.004***	0.004***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
Gender (male)	-0.079*	-0.081**	-0.034	-0.033
	(0.041)	(0.041)	(0.040)	(0.040)
Children	0.088*	0.089*	0.110**	0.109**
	(0.048)	(0.048)	(0.047)	(0.047)
Education	-0.096***	-0.096***	-0.091***	-0.091***
	(0.026)	(0.026)	(0.026)	(0.026)
Financial literacy	-0.060***	-0.059***	-0.069***	-0.069***
	(0.023)	(0.023)	(0.023)	(0.023)
Trust in government	-0.076***	-0.077***	-0.057***	-0.057***
	(0.013)	(0.013)	(0.013)	(0.013)
Concern economy	0.358***	0.356***	0.381***	0.380***
	(0.032)	(0.032)	(0.032)	(0.032)
Constant	3.429***	3.446***	3.309***	3.326***
	(0.138)	(0.138)	(0.134)	(0.135)
Observations	2,549	2,549	2,556	2,556
R-squared	0.125	0.126	0.132	0.133

Notes: Table presents results of OLS regressions. Dependent variable refers to respondents' agreement that 'the level of public debt in Germany is a major problem' (on a linear scale of 1=fully disagree to 5=fully agree). Explanatory variables: Narrative A is a dummy=1 when the respondent is exposed to the pro-consolidation narrative. Narrative B is a dummy=1 when the respondent is exposed to the pro-investment narrative. Left is a dummy=1 when the respondent reported preference for Left or Green party, Centrist is a dummy=1 when the respondent reported preference for SPD, CDU/CSU or FDP, Right is a dummy=1 when the respondent reported preference for AfD. Age (in years), Gender (1=male, 0=other), Education (1=lower, 2=secondary, 3=upper secondary), Children (1=household with children, 0=no children), Financial literacy (linear scale, 0 to 3 correct answers), Trust in government (linear scale, from 1=no trust to 7=profound trust), Concern economy (linear scale, from 1=no concerns to 3=big concerns). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Interestingly, as shown in column 2, the pro-consolidation treatment (Narrative A) has a statistically significant and strong effect on left-wing voters. Their comparatively low concern with public debt drastically increases after being confronted with the statement from the CDU program, with the treatment almost neutralizing the gap between left and centrist voters. The concerns of right-wing voters about public debt are even slightly reinforced even though the effect is statistically insignificant. However, the pro-investment treatment does not have any mirroring effect (column 4): left voters do not respond to this narrative at all, while centrist and right-wing voters have even slightly increased concerns with public debt (not statistically significant). Thus, the influence of political narratives on the general public seems to exhibit an interesting asymmetry: whereas the pro-consolidation narrative can alter the sovereign debt preferences of the left-wing voters, the pro-public investment statement does not seem to persuade the centrists or the far-right.

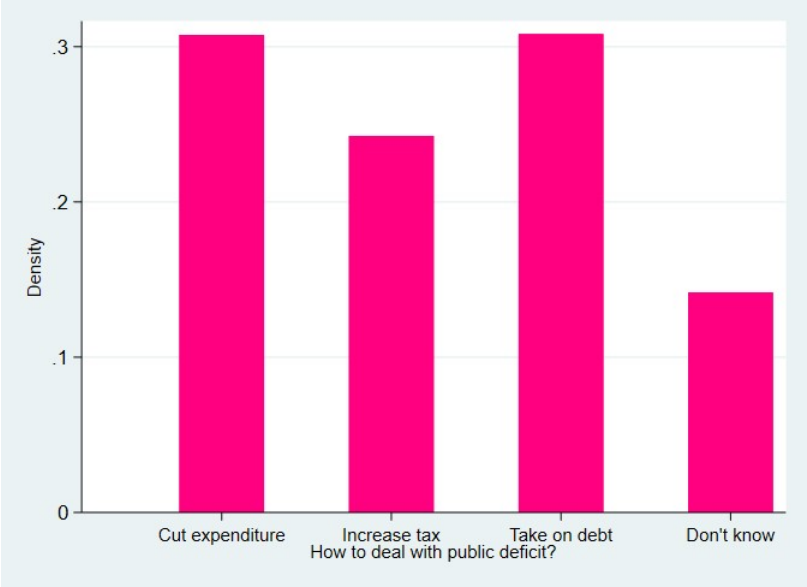
Although the dependent variable exhibits a bell-curved distribution, it is an ordinal variable. For this reason, we also run an ordered logit regressions with the same sets of regressors to confirm that the OLS estimator does not distort the findings. Table 3.9 and 3.10 in Appendix B to this chapter correspond to Table 3.3 and 3.4. All the coefficients exhibit the same sign and roughly the same level of statistical significance (albeit the interpretation differs), supporting the main results.

We perform a further robustness check, i.e., we reduce the sample to the respondents who named their party preference. Table 3.11 in Appendix B to this chapter, corresponding to Table 3.4, presents the results of the regressions. Now, we compare answers of the left-leaning and right-wing survey participants to responses of the centrists. This exercise confirms the main results: again, ceteris paribus, respondents on the left tend to be much less concerned with public debt, and those on the right are more likely to consider public debt to be a major problem. Also, we confirm the finding that the pro-consolidation narrative has a statistically significant effect of increasing the concerns about public debt of left-leaning voters.

We also test if the treatments had any significant effect on the views regarding the public deficit. This has been done in a holistic way, so that the respondents were confronted with the questions: "How should the government deal with public deficit?" and had to choose between the answers "Cut expenditures", "Increase taxes", and "Borrow", or "I don't know". Figure 3.3 shows the distribution of the values of the answers for the control group. The shares of the preferred ways to deal with the public deficit are almost evenly split, with a somewhat lower preference for a tax hike. About 15% of participants chose the answer "I don't know".

Table 3.5 and 3.6 present the marginal effects of the multinomial logit regressions of respondents' opinion on how to deal with a budget deficit on the treatment dummies A and B, respectively, as well as the control variables. The model assumes that the probability of each outcome of the

Figure 3.3: Distribution of opinions on how to deal with public deficit



dependent variable is determined as:

$$Pr(OpinionDeficit_i = k) = \frac{e^{x_i' \beta_k}}{1 + \sum_{j=1}^{K-1} e^{x_i' \beta_j}}, 1 \leq k < K. \tag{3.2}$$

Again, we find that the party preference strongly correlates with respondents' answers to this question. As might be expected, voters on the left of the political spectrum are much less likely to endorse cutting expenditure and prefer a tax increase or borrowing, instead. At the same time, respondents, who prefer the far-right party, more often prefer to cut spending and not increase taxes. Importantly, the survey participants, who indicated a specific party preference, were overall much less inclined to answer that they don't know how to deal with the public deficit. This supports our suspicion that the attitudes of respondents towards public finance issues aligned strongly with the ideology of the preferred political party. The narrative treatments do not seem to affect these opinions by much. The consolidation narrative A does not lead to a relevant and statistically significant treatment effect (Table 3.5). The pro-investment treatment (Table 3.6) slightly decreases the preference for cutting expenditure, in line with our hypothesis, since it emphasized the need for increased public spending. Still, in this case, the respondents did not express an alternative preferred solution for the public deficit and were more likely to answer "I don't know" instead.

From this finding, we could again conclude that party preferences strongly align with budgetary priorities in expected ways, and exposing the respondents to political statements does not essen-

tially change their views. Again, partisan bias may partially explain this finding. If the treatment weakened alignment with their preferred party, it might have increased uncertainty about the best approach to managing government deficits.

Table 3.5: Effect of treatments on preferences for public deficit. Narrative A

	(1)	(2)	(3)	(4)
	Cut Spending	Increase Tax	New Debt	Don't know
Age	-0.003***	0.001	0.001	0.002***
	(0.001)	(0.001)	(0.001)	(0.000)
Gender (male)	0.030	0.023	-0.007	-0.047***
	(0.019)	(0.017)	(0.012)	(0.014)
Children	-0.003	0.005	-0.034	0.031**
	(0.022)	(0.021)	(0.023)	(0.016)
Education	-0.021*	-0.000	0.038***	-0.017**
	(0.012)	(0.011)	(0.012)	(0.008)
Financial literacy	-0.011	0.011	0.034***	-0.034***
	(0.011)	(0.010)	(0.011)	(0.007)
Trust in government	-0.008	0.026***	-0.009	-0.009**
	(0.006)	(0.005)	(0.006)	(0.004)
Concern economy	0.035**	-0.004	-0.030**	-0.000
	(0.015)	(0.014)	(0.015)	(0.011)
Left	-0.112***	0.085***	0.085***	-0.057**
	(0.031)	(0.024)	(0.027)	(0.023)
Centrist	0.045**	0.018	-0.008	-0.055***
	(0.021)	(0.020)	(0.022)	(0.016)
Right	0.175***	-0.129**	-0.028	-0.018
	(0.041)	(0.057)	(0.049)	(0.030)
Narrative A	0.019	-0.008	-0.019	0.007
	(0.021)	(0.020)	(0.021)	(0.015)
Observations	2,549	2,549	2,549	2,549

Notes: Table presents average marginal effects of a multinomial logit regression. Dependent variable refers to respondents' answer to the question "How should the government deal with public deficit?" Explanatory variables: Age (in years), Gender (1=male, 0=other), Education (1=lower, 2=secondary, 3=upper secondary), Children (1=household with children, 0=no children), Financial literacy (linear scale, 0 to 3 correct answers), Trust in government (linear scale, from 1=no trust to 7=profound trust), Concern economy (linear scale, from 1=no concerns to 3=big concerns). Left is a dummy=1 when the respondent reported preference for Left or Green party, Centrist is a dummy=1 when the respondent reported preference for SPD, CDU/CSU or FDP, Right is a dummy=1 when the respondent reported preference for AfD. Narrative A is a dummy=1 when the respondent is exposed to the pro-consolidation narrative. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

In addition, Table 3.12 and 3.13 in Appendix B present the results of the marginal effects of the multinomial logit regressions for the treatments A and B, respectively, with the interactions of the treatment and the dummies for political preferences (left, centrist, or right-leaning). The interactions are not as strong as in Table 3.4 and largely statistically insignificant, but they point in a similar direction: left-wing voters turn more to conservative policy options (cut spending instead

Table 3.6: Effect of treatments on preferences for public deficit. Narrative B

	(1) Cut Spending	(2) Increase Tax	(3) New Debt	(4) Don't know
Age	-0.003***	0.001	0.001	0.002***
	(0.001)	(0.001)	(0.001)	(0.000)
Gender (male)	0.036*	0.039**	-0.027	-0.047***
	(0.018)	(0.017)	(0.09)	(0.014)
Children	-0.030	0.032	-0.028	0.026*
	(0.021)	(0.020)	(0.022)	(0.016)
Education	-0.013	0.004	0.020*	-0.012
	(0.012)	(0.011)	(0.012)	(0.008)
Financial literacy	-0.005	0.010	0.038***	-0.044***
	(0.010)	(0.010)	(0.011)	(0.007)
Trust in government	-0.004	0.022***	-0.010	-0.008*
	(0.006)	(0.005)	(0.006)	(0.004)
Concern economy	0.031**	-0.012	-0.023	0.004
	(0.015)	(0.014)	(0.015)	(0.011)
Left	-0.146***	0.124***	0.082***	-0.061***
	(0.031)	(0.024)	(0.027)	(0.023)
Centrist	0.030	0.035*	-0.001	-0.065***
	(0.021)	(0.020)	(0.022)	(0.016)
Right	0.147***	-0.069	-0.049	-0.030
	(0.038)	(0.049)	(0.046)	(0.029)
Narrative B	-0.039*	0.013	0.001	0.025*
	(0.021)	(0.019)	(0.021)	(0.015)
Observations	2,556	2,556	2,556	2,556

Notes: Table presents average marginal effects of a multinomial logit regression. Dependent variable refers to respondents' answer to the question "How should the government deal with public deficit?" Explanatory variables: Age (in years), Gender (1=male, 0=other), Education (1=lower, 2=secondary, 3=upper secondary), Children (1=household with children, 0=no children), Financial literacy (linear scale, 0 to 3 correct answers), Trust in government (linear scale, from 1=no trust to 7=profound trust), Concern economy (linear scale, from 1=no concerns to 3=big concerns). Left is a dummy=1 when the respondent reported preference for Left or Green party, Centrist is a dummy=1 when the respondent reported preference for SPD, CDU/CSU or FDP, Right is a dummy=1 when the respondent reported preference for AfD. Narrative B is a dummy=1 when the respondent is exposed to the pro-investment narrative. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

of increasing taxes or incur new debt) while the preferences of right-wing voters are reinforced. Narrative B, which is more positive about debt-financed investment, does neither make left nor right-wing voters prefer new debt in comparison to their peers in the control group. Table 3.14 and 3.15 in Appendix B show the same regressions for the sample reduced only to the respondents who named their party preference. The results stay fairly robust.

All in all, our experiment does not confirm the hypothesis that political narratives per se have a strong influence on views about sovereign debt. However, it is apparent that the political leaning is strongly correlated with these views. Along the lines of the partisan bias theory, the

self-identification with a specific party is a powerful predictor for the revealed opinions on the topic of public debt. A further explanation for this finding might be that the opinions on sovereign debt were already politicized at the time of the survey due to the election, so that the treatments did not convey any new information for the respondents. In this case, the preference for a specific party is more closely linked to opinions about public debt than our treatments.

We interpret these findings as a conjunction of the narratives economics theory (Shiller, 2017) and the partisan bias literature. Self-identification with a political party could serve as a narrative anchor. As the partisan bias research shows, partisan identity comes with a set of pre-established meta-narratives that provide a stable framework for interpreting new information. This also resonates with Shiller's idea that narratives are especially potent when they resonate with pre-existing values. Individuals interpret or accept narratives that align with their beliefs and resist those that contradict them. If people strongly identify with a political group, they are likely to be skeptical of narratives presented by, or perceived as beneficial to, opposing groups. Thus, party preference can serve as a "filter" to accepted narratives. However, if narratives trigger fundamental emotionally charged values, they can become more powerful. This is reflected in the so-called concept of "narrative contagion" where the most emotionally engaging stories are the most convincing (Shiller, 2017). Against this background, the asymmetrical effect of the conservative narrative is particularly interesting. The consolidation narrative may have crossed ideological boundaries because it taps into very deep ethical values when framed as "intergenerational justice". Left-leaning voters, who might otherwise support additional deficit spending, may feel compelled by the moral framing to reevaluate their stance.

3.4 Conclusion

This paper investigates whether political narratives influence people's preferences for public finances. It employs the data from a new representative survey and a survey experiment that shed some light on the attitudes of laypersons towards public deficit and debt. We treat two randomly selected subsamples of survey participants with political statements taken from the CDU and the Green Party election programs. We do not identify a general effect of these treatments on the public opinion of sovereign debt. To the contrary, our data reveal that self-declared political party preferences strongly align with opinions on public debt and deficit in expected ways. Moreover, people with a party preference are less likely to have no opinion or idea about the best way to handle public deficits. Therefore, we conclude that the attitudes of the participants align strongly with the preferred party's views, which confirms the notion of a significant partisan bias in matters of public finance. This seems plausible also because the survey was conducted in the weeks after the general election in Germany in the year 2021, and opinions could have been already highly politicized.

Even though the treatments did not impact the views on public debt in general, we found some influence on the attitudes of specific voter groups. The pro-consolidation narrative increased concerns about public debt of the Green and the Left party voters. As this treatment equates fiscal consolidation with "intergenerational justice" it might have transcended ideological boundaries by appealing to deeply rooted ethical principles. We thus interpret our findings in the way that only emotionally charged narratives pass the partisan filter. Future research could explore conditions for "narrative contagion" in more detail, as well as possible asymmetries in openness to conflicting narratives across the political spectrum.

To conclude, our results nuance the narrative economics theory and provide novel evidence for the partisan bias literature. Our findings may have implications for policy making. In increasingly polarized political landscapes, "narrative filters" may have become more rigid, making it more challenging to engage individuals across ideological divides. Under these conditions, the most effective communication strategy about necessary reforms would be a universally compelling storyline which resonates with the broader population on a deeper emotional level.

3.5 Appendices to Chapter 3

A Balance tests

Table 3.7: Balance tests for treatment (Narrative A) vs. control group

	Control	Treated	t-statistic	p-value	N
Male	0.508	0.511	-0.114	0.909	2,581
Age	47.720	47.886	-0.237	0.813	2,581
Education					
No graduation (yet)	0.032	0.017	1.899	0.058*	2,581
Lower secondary school	0.121	0.108	0.914	0.361	2,581
Secondary school	0.346	0.354	-0.395	0.693	2,581
Upper secondary school	0.489	0.506	-0.736	0.462	2,581
Party preference					
Die Linke	0.052	0.035	1.744	0.081*	2,581
SPD	0.140	0.160	-1.258	0.209	2,581
B90/Die Grünen	0.098	0.108	-0.698	0.486	2,581
CDU/CSU	0.125	0.133	-0.506	0.613	2,581
FDP	0.072	0.065	0.595	0.552	2,581
AfD	0.050	0.051	-0.087	0.931	2,581
Other or no preference	0.464	0.449	0.634	0.526	2,581
Children	0.260	0.252	0.401	0.688	2,581
Financial literacy	2.226	2.214	0.287	0.774	2,581
Trust in government	3.588	3.650	-0.812	0.417	2,581
Concern economy	2.068	2.043	0.865	0.387	2,581

Table presents results of t-tests. Statistical significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table 3.8: Balance tests for treatment (Narrative B) vs. control group

	Control	Treated	t-statistic	p-value	N
Male	0.508	0.500	0.371	0.711	2,587
Age	47.720	47.708	0.016	0.987	2,587
Education					
No graduation (yet)	0.032	0.020	1.494	0.135	2,587
Lower secondary school	0.121	0.107	0.987	0.324	2,587
Secondary school	0.346	0.345	0.046	0.693	2,587
Upper secondary school	0.489	0.516	-1.148	0.251	2,587
Party preference					
Die Linke	0.052	0.042	0.960	0.337	2,587
SPD	0.140	0.139	0.004	0.997	2,587
B90/Die Grünen	0.098	0.108	-0.740	0.459	2,587
CDU/CSU	0.125	0.133	-0.529	0.597	2,587
FDP	0.072	0.067	0.379	0.705	2,587
AfD	0.050	0.067	-1.709	0.088*	2,587
Other or no preference	0.464	0.442	0.960	0.337	2,587
Children	0.260	0.279	-0.963	0.336	2,587
Financial literacy	2.226	2.221	0.113	0.910	2,587
Trust in government	3.588	3.699	-1.428	0.154	2,587
Concern economy	2.068	2.061	0.228	0.820	2,587

Table presents results of t-tests. Statistical significance levels: *** p<0.01, ** p<0.05, * p<0.1.

B Robustness tests

Table 3.9: Effect of treatments on preferences for public debt, Ordered Logit Model

	Narrative A: Consolidation		Narrative B: Investment	
	(1)	(2)	(3)	(4)
Narrative A	0.031	0.046		
	(0.081)	(0.085)		
Narrative B			0.013	0.049
			(0.082)	(0.085)
Age		0.009***		0.009***
		(0.003)		(0.003)
Gender (male)		-0.069		0.022
		(0.075)		(0.075)
Children		0.196**		0.250***
		(0.088)		(0.086)
Education		-0.181***		-0.185***
		(0.048)		(0.048)
Financial literacy		-0.104**		-0.128***
		(0.042)		(0.042)
Trust in government		-0.177***		-0.146***
		(0.023)		(0.023)
Concern economy		0.720***		0.788***
		(0.062)		(0.062)
Observations	2,693	2,549	2,693	2,556
LR chi2	0.15	315.68	0.02	330.49
p-value	0.702	0.000	0.877	0.000
Pseudo R-squared	0.000	0.045	0.000	0.047

Notes: Table presents results of logit regressions. Dependent variable refers to respondents' agreement that 'the level of public debt in Germany is a major problem' (on a linear scale of 1=fully disagree to 5=fully agree). Explanatory variables: Narrative A is a dummy=1 when the respondent is exposed to the pro-consolidation narrative. Narrative B is a dummy=1 when the respondent is exposed to the pro-investment narrative. Age (in years), Gender (1=male, 0=other), Education (1=lower, 2=secondary, 3=upper secondary), Children (1=household with children, 0=no children), Financial literacy (linear scale, 0 to 3 correct answers), Trust in government (linear scale, from 1=no trust to 7=profound trust), Concern economy (linear scale, from 1=no concerns to 3=big concerns). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.10: Effect of treatments on preferences for public debt, depending on political views, Ordered Logit Model

	Narrative A: Consolidation		Narrative B: Investment	
	(1)	(2)	(3)	(4)
Narrative A	0.031	-0.064		
	(0.085)	(0.13)		
Narrative B			0.027	-0.044
			(0.085)	(0.126)
Left	-0.523***	-0.654***	-0.668***	-0.670***
	(0.111)	(0.125)	(0.110)	(0.125)
Centrist	0.043	0.044	0.050	0.006
	(0.087)	(0.099)	(0.088)	(0.099)
Right	0.619***	0.588***	0.664***	0.624***
	(0.183)	(0.212)	(0.179)	(0.212)
Left*Narrative A		0.593**		
		(0.258)		
Centrist*Narrative A		0.009		
		(0.191)		
Right*Narrative A		0.128		
		(0.410)		
Left*Narrative B				0.009
				(0.251)
Centrist*Narrative B				0.179
				(0.193)
Right*Narrative B				0.152
				(0.385)
Age	0.009***	0.009***	0.009***	0.009***
	(0.003)	(0.003)	(0.003)	(0.003)
Gender (male)	-0.109	-0.113	-0.030	-0.028
	(0.076)	(0.076)	(0.076)	(0.076)
Children	0.158*	0.158*	0.203**	0.202**
	(0.088)	(0.088)	(0.087)	(0.087)
Education	-0.162***	-0.162***	-0.158***	-0.158***
	(0.048)	(0.048)	(0.048)	(0.048)
Financial literacy	-0.087**	-0.087**	-0.109***	-0.110***
	(0.042)	(0.043)	(0.042)	(0.042)
Trust in government	-0.151***	-0.152***	-0.116***	-0.116***
	(0.025)	(0.025)	(0.025)	(0.025)
Concern economy	0.715***	0.716***	0.779***	0.777***
	(0.062)	(0.062)	(0.062)	(0.063)
Observations	2,549	2,549	2,556	2,556
LR chi2	357.15	362.97	392.88	393.88
p-value	0.000	0.000	0.000	0.000
Pseudo R-squared	0.050	0.051	0.055	0.055

Notes: Table presents results of logit regressions. Dependent variable refers to respondents' agreement that 'the level of public debt in Germany is a major problem' (on a linear scale of 1=fully disagree to 5=fully agree). Explanatory variables: Narrative A is a dummy=1 when the respondent is exposed to the pro-consolidation narrative. Narrative B is a dummy=1 when the respondent is exposed to the pro-investment narrative. Left is a dummy=1 when the respondent reported preference for Left or Green party, Centrist is a dummy=1 when the respondent reported preference for SPD, CDU/CSU or FDP, Right is a dummy=1 when the respondent reported preference for AfD. Age (in years), Gender (1=male, 0=other), Education (1=lower, 2=secondary, 3=upper secondary), Children (1=household with children, 0=no children), Financial literacy (linear scale, 0 to 3 correct answers), Trust in government (linear scale, from 1=no trust to 7=profound trust), Concern economy (linear scale, from 1=no concerns to 3=big concerns). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.11: Effect of treatments on preferences for public debt, depending on political views, subsample with a party preference, "centrist" as reference group

	Narrative A: Consolidation		Narrative B: Investment	
	(1)	(2)	(3)	(4)
Narrative A	0.073	-0.014		
	(0.063)	(0.079)		
Narrative B			0.046	0.084
			(0.063)	(0.080)
Left	-0.298***	-0.365***	-0.391***	-0.358***
	(0.064)	(0.073)	(0.064)	(0.073)
Right	0.269**	0.225*	0.273***	0.274**
	(0.106)	(0.120)	(0.103)	(0.120)
Left*Narrative A		0.273*		
		(0.146)		
Right*Narrative A		0.164		
		(0.222)		
Left*Narrative B				-0.133
				(0.144)
Right*Narrative B				-0.009
				(0.203)
Age	0.003*	0.003*	0.001	0.001
	(0.002)	(0.002)	(0.002)	(0.002)
Gender (male)	-0.085	-0.091	-0.024	-0.022
	(0.057)	(0.057)	(0.057)	(0.057)
Children	0.081	0.083	0.088	0.088
	(0.068)	(0.068)	(0.067)	(0.067)
Education	-0.095***	-0.096***	-0.092**	-0.091**
	(0.036)	(0.036)	(0.036)	(0.036)
Financial literacy	-0.087**	-0.085**	-0.086**	-0.087***
	(0.034)	(0.034)	(0.033)	(0.034)
Trust in government	-0.054***	-0.055***	-0.034*	-0.034*
	(0.018)	(0.018)	(0.018)	(0.018)
Concern economy	0.369***	0.368***	0.370***	0.368***
	(0.046)	(0.046)	(0.046)	(0.047)
Constant	3.424***	3.455***	3.435***	3.429***
	(0.210)	(0.211)	(0.209)	(0.210)
Observations	1,382	1,382	1,392	1,392
R-squared	0.129	0.131	0.132	0.132

Notes: Table presents results of OLS regressions. Dependent variable refers to respondents' agreement that 'the level of public debt in Germany is a major problem' (on a linear scale of 1=fully disagree to 5=fully agree). Explanatory variables: Narrative A is a dummy=1 when the respondent is exposed to the pro-consolidation narrative. Narrative B is a dummy=1 when the respondent is exposed to the pro-investment narrative. Left is a dummy=1 when the respondent reported preference for Left or Green party, Centrist is a dummy=1 when the respondent reported preference for SPD, CDU/CSU or FDP, Right is a dummy=1 when the respondent reported preference for AfD. Age (in years), Gender (1=male, 0=other), Education (1=lower, 2=secondary, 3=upper secondary), Children (1=household with children, 0=no children), Financial literacy (linear scale, 0 to 3 correct answers), Trust in government (linear scale, from 1=no trust to 7=profound trust), Concern economy (linear scale, from 1=no concerns to 3=big concerns). Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.12: Effect of treatments on preferences for public deficit, depending on political views. Narrative A

	(1)	(2)	(3)	(4)
	Cut Spending	Increase Tax	New Debt	Don't know
Age	-0.003***	0.001	0.001	0.002***
	(0.001)	(0.001)	(0.001)	(0.000)
Gender (male)	0.030	0.024	-0.007	-0.047***
	(0.019)	(0.017)	(0.019)	(0.014)
Children	-0.003	0.005	-0.034	0.032**
	(0.0215)	(0.0205)	(0.0225)	(0.0159)
Education	-0.020*	-0.000	0.038***	-0.017**
	(0.012)	(0.011)	(0.012)	(0.008)
Financial literacy	-0.011	0.011	0.034***	-0.034***
	(0.011)	(0.010)	(0.011)	(0.007)
Trust in government	-0.0082	0.026***	-0.009	-0.009**
	(0.006)	(0.005)	(0.006)	(0.004)
Concern economy	0.034**	-0.004	-0.030**	-0.001
	(0.015)	(0.014)	(0.015)	(0.011)
Left	-0.129***	0.098***	0.091***	-0.059**
	(0.036)	(0.027)	(0.030)	(0.026)
Centrist	0.038	0.020	-0.006	-0.052***
	(0.0241)	(0.0226)	(0.0247)	(0.0183)
Right	0.159***	-0.107*	-0.018	-0.033
	(0.047)	(0.063)	(0.055)	(0.035)
Narrative A	-0.002	0.006	-0.010	0.005
	(0.031)	(0.030)	(0.032)	(0.020)
Narrative A*Left	0.069	-0.054	-0.024	0.008
	(0.069)	(0.057)	(0.062)	(0.051)
Narrative A*Centrist	0.027	-0.007	-0.011	-0.009
	(0.046)	(0.044)	(0.048)	(0.035)
Narrative A*Right	0.076	-0.098	-0.038	0.060
	(0.099)	(0.148)	(0.122)	(0.066)
Observations	2,549	2,549	2,549	2,549

Notes: Table presents average marginal effects of a multinomial logit regression. Dependent variable refers to respondents' answer to the question "How should the government deal with a public deficit?". Explanatory variables: Age (in years), Gender (1=male, 0=other), Education (1=lower, 2=secondary, 3=upper secondary), Children (1=household with children, 0=no children), Financial literacy (linear scale, 0 to 3 correct answers), Trust in government (linear scale, from 1=no trust to 7=profound trust), Concern economy (linear scale, from 1=no concerns to 3=big concerns). Left is a dummy=1 when the respondent reported preference for Left or Green party, Centrist is a dummy=1 when the respondent reported preference for SPD, CDU/CSU or FDP, Right is a dummy=1 when the respondent reported preference for AfD. Narrative A is a dummy=1 when the respondent is exposed to the pro-consolidation narrative. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.13: Effect of treatments on preferences for public deficit, depending on political views. Narrative B

	(1)	(2)	(3)	(4)
	Cut Spending	Increase Tax	New Debt	Don't know
Age	-0.003***	0.001	0.001	0.002***
	(0.001)	(0.001)	(0.001)	(0.000)
Gender (male)	0.036*	0.038**	-0.027	-0.047***
	(0.018)	(0.017)	(0.019)	(0.014)
Children	-0.030	0.032	-0.028	0.026*
	(0.021)	(0.020)	(0.022)	(0.016)
Education	-0.012	0.003	0.021*	-0.012
	(0.012)	(0.011)	(0.012)	(0.008)
Financial literacy	-0.005	0.011	0.038***	-0.043***
	(0.010)	(0.010)	(0.011)	(0.007)
Trust in government	-0.004	0.021***	-0.010	-0.008*
	(0.006)	(0.005)	(0.006)	(0.004)
Concern economy	0.032**	-0.012	-0.023	0.004
	(0.015)	(0.014)	(0.015)	(0.011)
Left	-0.134***	0.100***	0.095***	-0.061**
	(0.035)	(0.028)	(0.031)	(0.027)
Centrist	0.032	0.023	-0.001	-0.054***
	(0.024)	(0.023)	(0.025)	(0.019)
Right	0.164***	-0.117*	-0.017	-0.030
	(0.046)	(0.063)	(0.055)	(0.036)
Narrative B	-0.024	-0.031	0.019	0.036*
	(0.031)	(0.032)	(0.032)	(0.020)
Narrative B*Left	-0.052	0.099*	-0.052	0.005
	(0.077)	(0.055)	(0.064)	(0.049)
Narrative B*Centrist	-0.008	0.050	-0.002	-0.041
	(0.047)	(0.045)	(0.048)	(0.036)
Narrative B*Right	-0.053	0.150	-0.098	0.001
	(0.08)	(0.100)	(0.102)	(0.060)
Observations	2,556	2,556	2,556	2,556

Notes: Table presents average marginal effects of a multinomial logit regression. Dependent variable refers to respondents' answer to the question "How should the government deal with public deficit?"Explanatory variables: Age (in years), Gender (1=male, 0=other), Education (1=lower, 2=secondary, 3=upper secondary), Children (1=household with children, 0=no children), Financial literacy (linear scale, 0 to 3 correct answers), Trust in government (linear scale, from 1=no trust to 7=profound trust), Concern economy (linear scale, from 1=no concerns to 3=big concerns). Left is a dummy=1 when the respondent reported preference for Left or Green party, Centrist is a dummy=1 when the respondent reported preference for SPD, CDU/CSU or FDP, Right is a dummy=1 when the respondent reported preference for AfD. Narrative B is a dummy=1 when the respondent is exposed to the pro-investment narrative. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.14: Effect of treatments on preferences for public deficit, depending on political views, subsample with a party preference, "centrist" as reference group. Narrative A

	(1)	(2)	(3)	(4)
	Cut Spending	Increase Tax	New Debt	Don't know
Age	-0.003***	0.001	0.001	0.001**
	(0.001)	(0.001)	(0.001)	(0.001)
Gender (male)	0.019	0.047*	-0.018	-0.047***
	(0.025)	(0.024)	(0.026)	(0.017)
Children	-0.029	0.026	-0.046	0.049**
	(0.030)	(0.029)	(0.032)	(0.020)
Education	-0.026*	0.008	0.027	-0.010
	(0.016)	(0.016)	(0.017)	(0.010)
Financial literacy	-0.025*	0.011	0.035**	-0.021**
	(0.015)	(0.015)	(0.016)	(0.009)
Trust in government	-0.006	0.026***	-0.005	-0.015***
	(0.008)	(0.008)	(0.008)	(0.005)
Concern economy	0.052**	-0.013	-0.025	-0.014
	(0.020)	(0.020)	(0.021)	(0.013)
Left	-0.166***	0.082***	0.095***	-0.012
	(0.035)	(0.030)	(0.032)	(0.022)
Right	0.128**	-0.135**	0.009	-0.001
	(0.051)	(0.069)	(0.060)	(0.031)
Narrative A	0.026	-0.000	-0.021	-0.004
	(0.033)	(0.034)	(0.037)	(0.023)
Narrative A*Left	0.044	-0.051	-0.010	0.017
	(0.069)	(0.061)	(0.065)	(0.044)
Narrative A*Right	0.049	-0.092	-0.020	0.063
	(0.100)	(0.158)	(0.128)	(0.055)
Observations	1,382	1,382	1,382	1,382

Notes: Table presents average marginal effects of a multinomial logit regression. Dependent variable refers to respondents' answer to the question "How should the government deal with public deficit?"Explanatory variables: Age (in years), Gender (1=male, 0=other), Education (1=lower, 2=secondary, 3=upper secondary), Children (1=household with children, 0=no children), Financial literacy (linear scale, 0 to 3 correct answers), Trust in government (linear scale, from 1=no trust to 7=profound trust), Concern economy (linear scale, from 1=no concerns to 3=big concerns). Left is a dummy=1 when the respondent reported preference for Left or Green party, Centrist is a dummy=1 when the respondent reported preference for SPD, CDU/CSU or FDP, Right is a dummy=1 when the respondent reported preference for AfD. Narrative A is a dummy=1 when the respondent is exposed to the pro-consolidation narrative. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.15: Effect of treatments on preferences for public deficit, depending on political views, subsample with a party preference, "centrist" as reference group. Narrative B

	(1)	(2)	(3)	(4)
VARIABLES	Cut Spending	Increase Tax	New Debt	Don't know
Age	-0.004***	0.001	0.001	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)
Gender (male)	0.022	0.065***	-0.032	-0.055***
	(0.025)	(0.025)	(0.026)	(0.017)
Children	-0.051*	0.064**	-0.048	0.035*
	(0.029)	(0.029)	(0.031)	(0.019)
Education	-0.024	0.014	0.014	-0.004
	(0.015)	(0.016)	(0.017)	(0.010)
Financial literacy	-0.007	0.004	0.036**	-0.033***
	(0.014)	(0.015)	(0.016)	(0.009)
Trust in government	0.000	0.022***	-0.007	-0.016***
	(0.008)	(0.008)	(0.00)	(0.005)
Concern economy	0.042**	-0.002	-0.026	-0.013
	(0.020)	(0.020)	(0.021)	(0.013)
Left left	-0.163***	0.085***	0.092***	-0.014
	(0.034)	(0.030)	(0.032)	(0.022)
Right	0.147***	-0.156**	0.010	-0.000
	(0.049)	(0.071)	(0.061)	(0.031)
Narrative B	-0.030	0.020	0.017	-0.007
	(0.034)	(0.034)	(0.036)	(0.023)
Narrative B*Left	-0.041	0.054	-0.052	0.039
	(0.076)	(0.060)	(0.066)	(0.042)
Narrative B*Right	-0.048	0.108	-0.101	0.041
	(0.089)	(0.108)	(0.106)	(0.050)
Observations	1,392	1,392	1,392	1,392

Notes: Table presents average marginal effects of a multinomial logit regression. Dependent variable refers to respondents' answer to the question "How should the government deal with public deficit?" Explanatory variables: Age (in years), Gender (1=male, 0=other), Education (1=lower, 2=secondary, 3=upper secondary), Children (1=household with children, 0=no children), Financial literacy (linear scale, 0 to 3 correct answers), Trust in government (linear scale, from 1=no trust to 7=profound trust), Concern economy (linear scale, from 1=no concerns to 3=big concerns). Left is a dummy=1 when the respondent reported preference for Left or Green party, Centrist is a dummy=1 when the respondent reported preference for SPD, CDU/CSU or FDP, Right is a dummy=1 when the respondent reported preference for AfD. Narrative B is a dummy=1 when the respondent is exposed to the pro-investment narrative. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

C Survey questions

This section provides the English translation of the survey questions we use to construct the variables for our empirical analysis. We list the original survey numbers of the questions. The full questionnaire can be found at `https://www.boeckler.de/pdf/p_2021_fragebogen_staatsverschuldung_imk.pdf`

A2. Age
How old are you?
__ Age in years

A3. Gender
What is your gender?

[ ] Male

[ ] Female

[ ] Other

E1. Opinion on public debt
To what extent do you agree with the following statement: "The level of public debt in Germany is a major problem"?

[ ] Fully agree

[ ] Tend to agree

[ ] Undecided

[ ] Tend to disagree

[ ] Fully disagree

[ ] No answer

E5. Opinion on public deficit [randomized sequence of answers]
Suppose there is a deficit in the government budget (i.e. revenues are lower than expenditures). How should the Federal Government deal with this deficit?
Please choose the answer that suits best.

[ ] Cut spending (e.g. on social security, health care, education, infrastructure, security)

[ ] Raise taxes (e.g. income taxes, value added taxes, business taxes)

[ ] Borrow money

[ ] Don't know

H1. Level of education
What is your highest level of education?

[ ] Still in school

[ ] Lower secondary education (*Hauptschulabschluss*)

[ ] Intermediate secondary education (*Realschulabschluss*)

[ ] Upper secondary education (*Abitur/Allgemeine Hochschulreife*)

[ ] Other education

[ ] No graduation

[ ] No answer

H5. Household size
How many people permanently live in your household (including yourself)? Please also consider all children.

[ ] People above age 18: __ Number

[ ] People from above age 14 to below age 18: __ Number

[ ] People below age 14: __ Number

[ ] No answer

I2. Party preference – general
Many people in Germany lean towards one party over a longer time span, even if they occasionally vote for another party. What about you? Do you lean towards a particular party in Germany?

[ ] Yes

[ ] No

I3. Party preference – specific party [randomized sequence of answers]
Which party do you lean toward?

[ ] SPD

[ ] CDU

[ ] CSU

[ ] FDP

[ ] B90/Die Grünen

[ ] Die Linke

[ ] AfD

[ ] Other

[ ] No answer

I4. Trust in government
How much do you trust the following public institution or organization?

a The Federal Government

[ ] 1 = No trust at all

[ ] 2–6

[ ] 7 = Very high level of trust

[ ] No answer

J5. Concerns
How concerned are you about the following issues?

a The economy in general

[ ] Very concerned

[ ] Somewhat concerned

[ ] Not concerned at all

K1. Financial literacy – interest effect
Let us assume you have a balance of 100 € in your savings account. This balance bears interest at an annual rate of 2 percent, and you leave it there for 5 years. What do you think: How high is your balance after 5 years?

[ ] Higher than 102 €

[ ] Exactly 102 €

[ ] Lower than 102 €

[ ] Don't know

K2. Financial literacy – inflation
Let us assume that the interest paid on your savings account is 1 percent per year and consumer prices increase by 2 percent per year. What do you think: After a year, will you be able to buy just as much, more or less than today with the balance in your savings account?

[ ] More than today

[ ] Just as much as today

[ ] Less than today

[ ] Don't know

K3. Financial literacy – diversification
Do you agree with the following statement: "The investment in the stock of a single company is riskier than investing in a fund with stock in similar companies"?

[ ] I agree.

[ ] I do not agree.

[ ] Don't know

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