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# THE EFFECTS OF FISCAL RULES ON PUBLIC INVESTMENT OVER THE CYCLE

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## ABSTRACT

This paper investigates how numerical fiscal rules affect government investment in the EU and disentangles their effect over the business cycle. Public investment seems to be generally susceptible to cutbacks during recessions. Fiscal rules demonstrate heterogeneous effects, depending on their design and on the state of the economy. Specifically, rigid fiscal rules, lacking flexibility features, restrain government investment. This detrimental effect mostly materializes during a downturn, thus exacerbating the overall negative impact of the recession. Key public investment categories, such as Economic Affairs, Housing, Health, and Social Protection, shrink during recessions when fiscal rules are implemented. It is important to design fiscal rules with enough flexibility to reduce their procyclical effect and prevent them from curtailing investment in vital areas of public economy.

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# The effects of fiscal rules on public investment over the cycle*

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**Abstract**

This paper investigates how numerical fiscal rules affect government investment in the EU and disentangles their effect over the business cycle. Public investment seems to be generally susceptible to cutbacks during recessions. Fiscal rules demonstrate heterogeneous effects, depending on their design and on the state of the economy. Specifically, rigid fiscal rules, lacking flexibility features, restrain government investment. This detrimental effect mostly materializes during a downturn, thus exacerbating the overall negative impact of the recession. Key public investment categories, such as Economic Affairs, Housing, Health, and Social Protection, shrink during recessions when fiscal rules are implemented. It is important to design fiscal rules with enough flexibility to reduce their procyclical effect and prevent them from curtailing investment in vital areas of public economy.

**Keywords:** Fiscal rules, public investment, fiscal cyclicality, EMU

**JEL Codes:** E6, H5, H6

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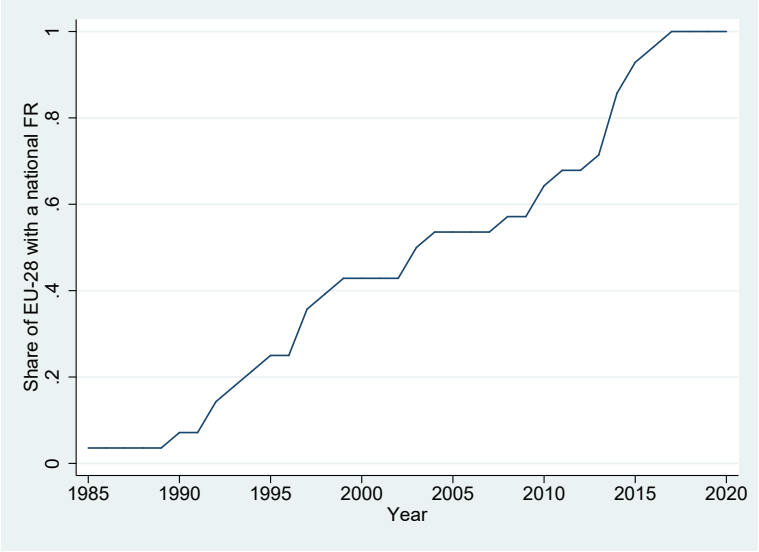
# 1 Introduction

Rules-based constraints on government budgets are meant to ensure prudent public finance (Portes & Wren-Lewis, 2015). Numerical fiscal rules have been implemented in over ninety countries in the recent decades (IMF, 2022; Schaechter, Kinda, Budina, & Weber, 2012), either on the supranational, or on the domestic level. They include (*i*) deficit rules restricting the budget balance to a specific value, (*ii*) debt rules limiting accumulation of government debt at a target level, or (*iii*) rules regarding government expenditure and (*iv*) revenue. Figure 1 shows the share of the EU-28 members which incorporated at least one numerical fiscal rule in their national legislation over the past decades. Whereas only one country (Germany) had a national fiscal rule in place in 1985, by the year 2017 all of the EU-28 countries adopted rules-based fiscal constraints as part of their national regulation.

Figure 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 (IMF, 2022).

A meta-regression analysis of empirical literature on budgetary implications of fiscal rules suggests that they can be effective in restricting public deficit levels, whereas the effect on debt levels is less clear (Heinemann, Moessinger, & Yeter, 2018). However, if fiscal rules decrease government deficits, it is vital to understand which budgetary components are concerned. If rules-based constraints hinder government investment this could be potentially harmful for the macroeconomic performance since public capital stock is a central factor of production in developed economies and government investment exhibits large short-run 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 that cutbacks on entitlement programs are associated with high political costs, whereas retrenchment of investment expenditure categories is politically easier to implement (Breunig & Busemeyer, 2012). Empirical investigations of the fiscal consolidation episodes deliver evidence that investment spending shrinks when fiscal rules exert pressure on the budget (Bamba, Combes, & Minea, 2020; Castro, 2017).

Therefore, this paper will examine whether and how fiscal rules affect public investment. Since fiscal policy can have asymmetric dynamics over the business cycle (Perotti, 1999) and investment might be cut down especially in recessions (Bamba et al., 2020), we particularly focus on separating the effects of fiscal rules in downturns and upswings. Moreover, it is important to take the design of fiscal rules into account since flexible rules could preserve public investment during consolidation episodes (Ardanaz, Cavallo, Izquierdo, & Puig, 2021). Thus, we hypothesize that specific types of fiscal rules (those lacking flexibility features) constitute a hindrance to public investment and focus on disentangling the effects over the business cycle. To address our question, we combine the data from the International Monetary Fund (IMF) Fiscal Rules Dataset (IMF, 2022; Schaechter et al., 2012) and Investment and Capital Stock Dataset (IMF, 2021b; Xiao, Amaglobeli, & Matsumoto, 2021) to obtain annual panel data for 23 EU countries over the period from 1985 to 2019.

We find that public investment in the EU is strongly procyclical and moves closely together with the economic ups and downs. This effect is especially pronounced in the downturns and is robust to the choice of the cycle variable. Fiscal rules demonstrate heterogeneous effects on public investment depending on their design and on the state of economy. Specifically, rigid fiscal rules seem to restrain government investment. Their detrimental effect mainly materializes during a downturn, thus exacerbating the essential negative effect of the recession itself. Public investment categories, such as Economic Affairs, Housing, Health, and Social Protection, tend to shrink the most during recessions when fiscal rules are implemented.

Evidence on the effect of national fiscal rules on public investment is scarce but growing. One recent contribution can be highlighted. Ardanaz et al. (2021) investigate how public investment reacts to consolidation events when fiscal rules are in place. They use data for 75 countries during from 1990 to 2018 and look into the growth rates of real government investment per capita. The authors find that flexible rules (which permit exceptions) protect public investment during consolidation episodes, whereas rigid rules do not. Especially investment friendly rules and cyclically-adjusted balance rules help shielding public investment from budget cuts.

Another branch of literature covers the impact of fiscal rules on the composition of public expenditure. Dahan and Strawczynski (2013) estimate a panel of 22 members of the Organisation for Economic Cooperation and Development (OECD) during the period 1960 to 2010. They find that the relative growth rate of social transfers to government consumption declines if a numerical expenditure rule is implemented. However, the authors do not find any statistically significant effect of fiscal rules on the relative growth rate of government investment vs. consumption. Bacchiocchi, Borghi, and Missale (2011) also employ OECD data for 29 developed countries. They analyse public gross fixed capital formation (GFCF) in developed economies by separating them into countries affected by the Stability and Growth Pact (SGP) and those not affected. The authors conclude that SGP rules do not constrain public investment.

Regarding fiscal rules on the subnational 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 subnational fiscal rules on public investment in Swiss cantons, due to investment accounts not being covered by the debt brake.

Further areas of studies, which are closely related to our research question, concern the change in public expenditure composition over the cycle and under consolidation pressure as well as the overall cyclicality of fiscal policy under fiscal rules. As mentioned above, empirical studies show 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 defence, public order, environment, housing, health, education and social protection, most of which can be classified as investment expenditures.

Concerning the impact of fiscal rules on the cyclicality of fiscal policy, the literature delivers mixed results. For example, Gali and Perotti (2003) show that the SGP did not make fiscal policy more procyclical in the EMU, although they mention that the fiscal constraints were not binding during the observed period. Furthermore, 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. However, Guerguil, Mandon, and Tapsoba (2017) make evident that not all fiscal rules are equally effective: Investment-friendly rules seem to be more suited in decreasing the procyclical effect. Their efficiency is higher in recessions and when the rule is implemented in domestic legislation.

However, some contributions 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.

The remainder of the paper is organized as follows. Section 2 presents the data and describes our empirical model. Section 3 reports the main results. Section 4 discusses an extension of our analysis concerning categories of government investment affected by fiscal rules. Section 5 provides robustness checks regarding the data choice for the variables of interest and the estimation methods. Section 6 concludes and discusses policy implications.

## 2 Data and model specification

We 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. It also provides further information, for example, whether the adopted fiscal rules are flexible, i.e. permit possible exception or adjustment cases. 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 (Schaechter et al., 2012).

Data on public investment, i.e. public GFCF, and on the Gross Domestic Product (GDP), both in constant international dollars, come from the IMF Investment and Capital Stock Dataset (IMF, 2021b; Xiao et al., 2021). 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). We also employ the OECD dataset on public GFCF categorized according to the Classification of the Functions of Government - COFOG (OECD, 2022). Additionally, we 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 population from the Penn World Table (Feenstra, Inklaar, Timmer, & Woltjer, 2021). For robustness checks, data for the output gap comes from the World Economic Outlook (IMF, 2021c) and data on the Fiscal Rule Strength Index from the Fiscal Rules Database of the European Commission (2022). Table 7 in the Appendix presents descriptive statistics of the main variables.

This provides us with an unbalanced panel of 23 EU countries[1] for the period from 1985 to 2019 and allows us to run a panel linear regression with country specific and year fixed effects. We start the estimation with the following specification:

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

where $GOVINV_{it}$ is the logarithm of public investment in country $i$ in period $t$, $FR$ is the dummy for the corresponding fiscal rule, and $\beta_1$ is the coefficient of interest that captures the effect of this fiscal rule on government investment. Furthermore, $Cycle$ indicates the fluctuations of the economic cycle. This variable is the cyclical component of real GDP obtained by the Hodrick-Prescott (HP) decomposition.[2] The coefficient $\beta_2$ measures the reaction of government investment to economic ups and downs.

[1] 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.

[2] The smoothing parameter $\lambda$ for annual data is equal to 6.25 (Ravn & Uhlig, 2002). This choice of the $Cycle$ variable allows us to use the full length of the data. The robustness check section will also show results for the $Cycle$ based on the Hamilton filter and on the output gap (however, for a shorter sample). Another possible caveat of our analysis could be the endogeneity between the public investment expenditure and the cycle variable. We will address this issue in the robustness check section.

In the next step, we will split the $Cycle$ to investigate the cyclicality of public investment in good and bad times. At the same time this will allow us to disentangle the effects of the fiscal rules in the positive and negative phases of the economic cycle. The model will take the form:

$$GOVINV_{it} = \alpha + \beta_1 FR_{it} * bad + \beta_2 FR_{it} * good + \beta_3 Cycle_{it} * bad + \beta_4 Cycle_{it} * good + \gamma^k X^k_{it-1} + \lambda_i + \delta_t + \epsilon_{it}. \quad (2)$$

$X^k_{it-1}$ is a vector of control variables which include the lagged dependent variable, the trend component of the HP decomposition of real GDP, the long-term interest rate, and the change of government debt in percent of GDP. The logic behind the control variables is as follows. The lagged dependent variable captures the inertia of public investment and is expected to show a substantially large and positive coefficient. The GDP trend should explain the overall trend of investment expenditure (it is expected to increase if the economy is growing) and therefore is also expected to show a positive coefficient. Both higher interest rates and government debt incorporate financial barriers to investment. These two variables are anticipated to come with a negative coefficient. All control variables are lagged one period to reduce endogeneity problems.

Additionally, we will look at a number of further variables widely used in the literature to control for the political decisions on public investment, such as a dummy for the election of the executive government in country $i$ and year $t$, a dummy for the left-wing party forming the government, and the lagged population level. The motivation is that governments could spend more money on investment projects in the election years to gain popularity, leftist governments could be prone to more public spending, and population growth should induce more investment spending. Lastly, $\lambda_i$ and $\delta_t$ capture country-specific and time fixed effects, correspondingly, and $\epsilon_{it}$ is the error term.

# 3 Baseline results

## 3.1 Procyclicality of public investment and the effect of fiscal rules

This section presents the results of the panel regressions. First, we investigate the general effect of fiscal rules on public investment by testing a dummy for the national fiscal rule, $NationalFR$. The dummy is equal to one if there is any fiscal rule operating which is adopted in domestic legislation. First two columns of Table 1 show the results of the within-group estimation of equation 1. It is immediately apparent that fiscal rules seem to adversely influence investment expenditure on the national level (column 1). If any national fiscal rule is operating, public investment is 2.65% lower on average in our sample, all other factors held constant. The effect is statistically significant at the 5% level. Secondly, the fluctuations in the economic cycle also have a statistically significant effect on government investment of about 0.8% for each percentage point of deviation from the overall economic trend. In other words, our findings show that public investment tends to be procyclical in the EU and moves together with the overall economy, with the elasticity somewhat below 1.

Table 1: Effects of the cycle and fiscal rules on government investment

| | Dependent variable: GovInv | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| GovInv(t-1) | 0.742*** | 0.740*** | 0.743*** | 0.741*** | 0.736*** | 0.755*** |
| | (0.0317) | (0.0327) | (0.0317) | (0.0327) | (0.0292) | (0.0332) |
| Interest(t-1) | -1.069*** | -1.071*** | -1.059*** | -1.062*** | -1.065*** | -1.031*** |
| | (0.379) | (0.379) | (0.366) | (0.367) | (0.377) | (0.342) |
| Debt(t-1) | -0.451*** | -0.453*** | -0.439*** | -0.442*** | -0.449*** | -0.432*** |
| | (0.116) | (0.116) | (0.114) | (0.114) | (0.109) | (0.102) |
| GDPtrend(t-1) | 0.391*** | 0.391*** | 0.394*** | 0.392*** | 0.404*** | 0.393*** |
| | (0.0600) | (0.0597) | (0.0593) | (0.0588) | (0.0580) | (0.0593) |
| Cycle | 0.00794** | 0.00799** | | | 0.00772** | 0.0112** |
| | (0.00365) | (0.00363) | | | (0.00357) | (0.00528) |
| NationalFR | -0.0265** | | | | -0.0295** | -0.0386** |
| | (0.0119) | | | | (0.0133) | (0.0138) |
| RIGID | | -0.0291* | | | | |
| | | (0.0142) | | | | |
| FLEX | | -0.0265 | | | | |
| | | (0.0204) | | | | |
| Cycle*bad | | | 0.00949* | 0.00973** | | |
| | | | (0.00464) | (0.00460) | | |
| Cycle*good | | | 0.00567 | 0.00582 | | |
| | | | (0.00470) | (0.00477) | | |
| NationalFR*bad | | | -0.0387*** | | | |
| | | | (0.0136) | | | |
| NationalFR*good | | | -0.0171 | | | |
| | | | (0.0148) | | | |
| RIGID*bad | | | | -0.0387** | | |
| | | | | (0.0171) | | |
| RIGID*good | | | | -0.0212 | | |
| | | | | (0.0180) | | |
| FLEX*bad | | | | -0.0338 | | |
| | | | | (0.0231) | | |
| FLEX*good | | | | -0.0173 | | |
| | | | | (0.0241) | | |
| Election | | | | | -0.0186 | |
| | | | | | (0.0185) | |
| LeftGov | | | | | 0.00988 | |
| | | | | | (0.0138) | |
| Population(t-1) | | | | | -0.0676 | |
| | | | | | (0.151) | |
| Cycle(t-1) | | | | | | -0.0119 |
| | | | | | | (0.00743) |
| Cycle(t-2) | | | | | | -0.00441 |
| | | | | | | (0.00403) |
| NationalFR(t-1) | | | | | | -0.00657 |
| | | | | | | (0.0335) |
| NationalFR(t-2) | | | | | | 0.0316 |
| | | | | | | (0.0239) |
| Observations | 668 | 668 | 668 | 668 | 668 | 668 |
| 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 |
| R-squared within model | 0.887 | 0.887 | 0.887 | 0.887 | 0.887 | 0.891 |

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

Notably, control variables exhibit statistically significant coefficients with an expected sign and of a plausible magnitude. Since we have constructed a dynamic panel (where the lagged dependent variable is one of the regressors) and apply a within-group estimator, the coefficients might be subject to Nickell's bias (Nickell, 1981). The coefficient of the lagged dependent variable is somewhat biased downwards.[3] However, this bias is minor due to the rather large number of periods in our sample. The lagged dependent variable exhibits a plausible and rather large coefficient of about 0.74. Thus, government investment demonstrates significant persistence. Furthermore, a 1 percentage point higher long-term interest rate is associated with 1% lower public investment, and a hike in public debt by 1% of GDP is related to a fall in public investment of 0.45%. An increase of the GDP trend component of 1% comes with a rise of public investment by 0.39%. The coefficients remain remarkably robust to different model specifications. Adding the political control variables to the regression (column 5) does not influence the results. None of the variables, which include the year of the executive election, the left-leaning government, and the lagged population, make any significant difference for the regression coefficients of the variables of interest. Thus, we dismiss the political variables in the reminder of the empirical analysis.

In addition, we address the question whether the effect of fiscal rules and the cycle on public investment takes place with delay. Economic fluctuations and fiscal constraints might have a long-lasting impact on investment policy. We test this hypothesis in the column 6 by adding two lags of the fiscal rule dummy and of the cycle variable. However, only the contemporaneous effect of the economic phase as well as of the fiscal rules proves to be statistically significant, thus supporting the choice of the baseline model.

In the next step, we test one of our main hypotheses that rigid fiscal rules, that do not allow for enough adjustment to the economic conditions, hinder public investment expenditure. As discussed in section 3, flexible rules include those with escape clauses for extraordinary circumstances, cyclically-adjusted balance ("stability") rules and investment-friendly ("golden") rules. Over time, an increasing number of national fiscal rules in the EU were equipped with these characteristics. We again employ the first econometric model, but separate $NationalFR$ 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 to 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. Indeed, we roughly confirm our hypothesis: Flexible rules do not show a statistically significant negative effect on government investment, whereas rigid rules do (column 2). Albeit, when the rules are separated into categories, the effect is only statistically significant at the 10%-level.

To sum up the results of this section, fiscal rules do show a detrimental effect on public investment. Apparently, fiscal rules that lack flexibility features mostly bring this effect about. Also, public investment in the EU is altogether procyclical.

[3]Since the data does 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). Nonetheless, we show GMM estimations for several subsamples in the robustness check section.

### 3.2 Variation over the cycle

Whereas the estimation of the first model suggests an overall negative effect of national fiscal rules on public investment, the second model allows to disentangle the effects of rules-based fiscal constraints in good and bad times. We thus separate the observations into *bad* and *good* phases, where *bad* is characterized by a negative change in the cycle variable compared to the previous period, and *good* is defined by a positive change.[4] Column 3 of Table 1 presents the regression coefficients.

First of all, the results indicate that the procyclicality of public investment comes about mainly in the low phase of the economic cycle. The coefficient of the cycle variable is very close to 0.01 and statistically significant at the 5%-level in bad times. This means that, if the economy is in bad shape, public investment would go down by 1% for every percentage point decrease of the cyclical fluctuation of the GDP. Second, the impact of fiscal rules also varies with the economic cycle. Implementation of a national fiscal rule seem to substantially restrain government investment when economy is in a bad shape, by almost 4%. This result is statistically significant at the 1%-level. So, although the effect of national fiscal rules on government investment is overall negative, they mostly restrain public investment in bad times, thus aggravating the adverse effect of recessions. Thus, fiscal rules tend to exacerbate the procyclicality of public investment itself. Lastly, when we disentangle the effects of the rigid and flexible rules over the cycle (column 4), we confirm our previous finding that the rigid rules restrain public investment. With the size of almost 4% and at a high statistical significance level, the detrimental impact of rigid fiscal rules on public investment comes about in the low phase of the business cycle.

To sum up, public investment in the EU is highly susceptible to cutbacks in recessions. National fiscal rules demonstrate heterogeneous effects, depending on their design and on the state of economy. Specifically, rigid fiscal rules, that lack flexibility features, restrain government investment. This detrimental effect mostly materializes during a downturn, thus aggravating the negative effect of the recession itself and deepening the overall procyclicality of investment expenditure in the EU.

[4]The robustness check section will also discuss an alternative definition of the phases, where *bad* is characterized by negative and *good* by positive observations of the *Cycle*.

# 4 Types of public investment affected by fiscal rules

This section will investigate which economic areas of public investment are affected by the fiscal rules in particular. For this purpose, we will employ another dataset which allows us to disentangle 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, Defence, Public Order, Economic Affairs, Environmental Protection, Housing, Health, Recreation and Culture, Education, and Social Protection. The data is available from the year 1995 (for Finland from 1990) onwards for all countries in our sample.

We present our regression results with the data on COFOG categories of public investment in Tables 2a and 2b. Since the values of the government investment variables in different COFOG categories are not strictly positive, we opt for expressing public investment in percent of GDP instead of the log levels. This eliminates the trend in the dependent variable, so, accordingly, we drop the trend component of GDP on the right hand side.

Table 2a exhibits the regression results with the COFOG data on government investment as total for all categories to show the consistency of this approach with the baseline analysis. The coefficients of regressions with the COFOG dataset closely confirm previous findings. Notably, the results in the Table 2a support the finding that government investment moves together with the cycle. More precisely, it tends to shrink during recessions by about 0.04 percent points for one percentage point deviation from the overall economic trend. This effect is statistically significant at the 5%-level. Moreover, we confirm the findings that national fiscal rules, in particular those lacking flexibility features, restrain public investment. To be specific, public investment tend to be on average 0.18 percentage points lower when a rigid fiscal rule is in place (column 2). There is, however, one difference to the previous findings. The detrimental effect of the rigid rules proves to be statistically significant at the 5%-level in bad as well as in good times, when measured in percent of GDP.

Concerning specific categories of public investment affected by fiscal rules, our results are displayed in Table 2b. To reduce complexity, we solely look into the regression model that separates the effects of the cycle variable and the $NationalFR$ into good and bad times. Our analysis shows that there are several investment categories negatively affected by the fiscal rules at the statistically significant level, namely, Economic Affairs, Housing, Health, and Social Protection. Again, investment expenditure in these categories seem to shrink mostly during recessions when fiscal rules are in place. This is especially unsettling for the categories that should work anticyclically and smooth the economic downturn, such as Economic Affairs and Social Protection. Furthermore, investment in health system is the category which shrinks in presence of fiscal rules not only in recessions, but also during an upswing, both coefficients being statistically significant at the 5%-level. This finding indicates that fiscal rules might have exacerbated the dismantling of the health system in the EU countries prior to the Covid-19 crisis.

Overall, this section closely confirms the baseline results with the data on COFOG categories of public investment. Also, we have identified the COFOG types of public investment which are curbed by the fiscal

Table 2a: Effects of the cycle and the fiscal rules on government investment by COFOG: Total

| | Dependent variable: GovInv by function: Total | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| GovInv:Total(t-1) | 0.681*** | 0.676*** | 0.685*** | 0.679*** |
| | (0.0631) | (0.0627) | (0.0634) | (0.0628) |
| Interest(t-1) | -1.755 | -1.694 | -1.693 | -1.649 |
| | (1.977) | (2.002) | (1.932) | (1.974) |
| Debt(t-1) | -1.134* | -1.161* | -1.111* | -1.160** |
| | (0.576) | (0.564) | (0.566) | (0.558) |
| Cycle | 0.0435** | 0.0442** | | |
| | (0.0206) | (0.0205) | | |
| NationalFR | -0.139** | | | |
| | (0.0560) | | | |
| RIGID | | -0.184*** | | |
| | | (0.0571) | | |
| FLEX | | -0.0341 | | |
| | | (0.0819) | | |
| Cycle*bad | | | 0.0404** | 0.0416** |
| | | | (0.0191) | (0.0190) |
| Cycle*good | | | 0.0400 | 0.0420 |
| | | | (0.0308) | (0.0311) |
| NationalFR*bad | | | -0.187*** | |
| | | | (0.0663) | |
| NationalFR*good | | | -0.105 | |
| | | | (0.0644) | |
| RIGID*bad | | | | -0.213** |
| | | | | (0.0778) |
| RIGID*good | | | | -0.161** |
| | | | | (0.0677) |
| FLEX*bad | | | | -0.0722 |
| | | | | (0.0722) |
| FLEX*good | | | | 0.0145 |
| | | | | (0.108) |
| Observations | 525 | 525 | 525 | 525 |
| Number of groups | 23 | 23 | 23 | 23 |
| Country FE | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES |
| R-squared within model | 0.578 | 0.580 | 0.580 | 0.581 |

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

rules. In particular, Economic Affairs, Housing, Health, and Social Protection are the categories that seem to be negatively affected, especially in bad times. Cutting down on these socially and economically highly relevant budget positions could, however, exacerbate the negative consequences of recessions and, as it is the case with the health care sector, have adverse long-term repercussions.

Table 2b: Effects of the cycle and the fiscal rules on government investment by COFOG: Categories

| VARIABLES | (1) PubService | (2) Defence | (3) PubOrder | (4) EconAffairs | (5) EnvProtect | (6) Housing | (7) Health | (8) Culture | (9) Education | (10) SocProtect |
|---|---|---|---|---|---|---|---|---|---|---|
| PubService(t-1) | 0.542*** | | | | | | | | | |
| | (0.102) | | | | | | | | | |
| Defence(t-1) | | 0.528*** | | | | | | | | |
| | | (0.123) | | | | | | | | |
| PubOrder(t-1) | | | 0.464*** | | | | | | | |
| | | | (0.0734) | | | | | | | |
| EconAffairs(t-1) | | | | 0.681*** | | | | | | |
| | | | | (0.0768) | | | | | | |
| EnvProtect(t-1) | | | | | 0.643*** | | | | | |
| | | | | | (0.0812) | | | | | |
| Housing(t-1) | | | | | | 0.666*** | | | | |
| | | | | | | (0.0734) | | | | |
| Health(t-1) | | | | | | | 0.748*** | | | |
| | | | | | | | (0.0924) | | | |
| Culture(t-1) | | | | | | | | 0.714*** | | |
| | | | | | | | | (0.0734) | | |
| Education(t-1) | | | | | | | | | 0.714*** | |
| | | | | | | | | | (0.0269) | |
| SocProtect(t-1) | | | | | | | | | | 0.564*** |
| | | | | | | | | | | (0.154) |
| Interest(t-1) | -0.991 | -0.933 | -0.0574 | -1.003 | 0.503* | 0.397* | 0.0792 | -0.218 | 0.0140 | -0.0941 |
| | (0.627) | (0.689) | (0.159) | (1.616) | (0.267) | (0.230) | (0.255) | (0.185) | (0.228) | (0.120) |
| Debt(t-1) | -0.255** | -0.134 | 0.0232 | -0.289 | -0.140 | -0.139 | -0.0430 | 0.0269 | -0.0226 | -0.129* |
| | (0.107) | (0.0996) | (0.0610) | (0.433) | (0.115) | (0.112) | (0.0885) | (0.0702) | (0.0753) | (0.0744) |
| Cycle*bad | -0.00162 | 0.000563 | 0.00561 | 0.0114 | 0.00338 | 0.0106 | 0.00438 | -5.57e-05 | 0.0107* | 0.00325 |
| | (0.00607) | (0.00989) | (0.00794) | (0.0133) | (0.00633) | (0.00901) | (0.00587) | (0.00279) | (0.00539) | (0.00209) |
| Cycle*good | 0.00915 | 0.00246 | 0.00360 | 0.00503 | 0.000706 | 0.00521* | 0.00383 | 0.00360 | 0.00823 | 0.00119 |
| | (0.00632) | (0.00541) | (0.00371) | (0.0131) | (0.00209) | (0.00287) | (0.00427) | (0.00265) | (0.00492) | (0.00152) |
| NationalFR*bad | -0.0380 | 0.00151 | -0.000104 | -0.0605* | -0.0222 | -0.0260* | -0.0175** | -0.00576 | -0.00366 | -0.0139** |
| | (0.0259) | (0.0199) | (0.00910) | (0.0351) | (0.0147) | (0.0129) | (0.00834) | (0.00768) | (0.0150) | (0.00644) |
| NationalFR*good | -0.0416 | 0.00165 | -0.000121 | -0.0117 | -0.0169 | -0.0190 | -0.0183** | -0.00672 | 0.00204 | -0.00619 |
| | (0.0265) | (0.0200) | (0.00608) | (0.0421) | (0.00996) | (0.0134) | (0.00792) | (0.00734) | (0.0135) | (0.00580) |
| Observations | 525 | 525 | 525 | 525 | 525 | 525 | 525 | 525 | 525 | 525 |
| 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 |
| R-squared within model | 0.410 | 0.451 | 0.302 | 0.515 | 0.522 | 0.556 | 0.628 | 0.545 | 0.586 | 0.368 |

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

# 5 Robustness checks

In this section, we perform a variety of tests to check the robustness of our results. First, we employ other measures of the business cycle, namely the cyclical component of real GDP produced by the Hamilton filter as well as the output gap. Also, we use an alternative definition of the dependent variable as public investment in percent of GDP. Additionally, we run a robustness check with a different definition of the bad and good phases of the business cycle. Furthermore, we make use of the Fiscal Rules Strength Index as an alternative dataset for the fiscal rules. We also present the results of two stage least squares (2SLS) and GMM estimations with our main dataset.

## 5.1 Alternative cycle and fiscal rules variables

We have previously opted for the cyclical component of real GDP obtained by the HP decomposition as the measure of economic fluctuation. This allowed us to use the full length of our datasets. Now, we will employ other measures of the cycle, where only shorter data is available for most countries in our sample. Since the HP filter is not uncontroversial, we use another GDP decomposition procedure proposed by Hamilton (2018).[5] Table 3 shows the results of this exercise. Columns 1 to 4 compare to the columns 1 to 4 of Table 1. The coefficients of the main variables remain remarkably robust. Interestingly, the cycle variable shows a statistically significant coefficient in both phases of the cycle, although the effect is much larger and more statistically significant in the downturn phase. Thus, we endorse that public investment behaves procyclically, and more so in recessions.

Importantly, we confirm the finding that fiscal rules restrain public investment in the low phase of the economic cycle (column 3). The only difference is that the coefficients of both flexible and rigid rules show some statistical significance in the bad times (column 4). In addition, we provide the results for an alternative definition of the dependent variable as public investment in percent of GDP (columns 5 and 6). While the effect of the cycle variable vanishes, we confirm the detrimental effect of the fiscal rules (especially those without the flexibility features) on public investment in bad times. All in all, the findings prove to be strongly robust to the choice of the filtering technique.

In addition, Table 8 in the Appendix presents results of the regressions with an alternative definitions of bad and good times for both cycle variables, produced by the HP filter and the Hamilton filter. We define *bad* as a negative value and *good* as a positive value of the cycle. The Hamilton filter, especially, closely confirms the previous results. Again, the cycle variable yields a coefficient with a magnitude of 1% at the highest significance level in recessions. Similarly, fiscal rules show a detrimental effect on public investment in the low phase of the cycle, and the effect comes from the rigid rules.

Furthermore, we also use the data on the output gap (IMF, 2021c) as an alternative cycle variable. Columns 1 to 4 of Table 4 compare to the columns 1 to 4 of Table 1. The findings are, again, very similar. Except for the interest rate, which loses statistical significance, all regressors show coefficients

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

Table 3: Effects of the cycle and the fiscal rules on government investment: Hamilton filter

| | Dependent variable | | | | | |
|---|---|---|---|---|---|---|
| | GovInv | | | | GovInv/GDP | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| GovInv(t-1) | 0.761*** | 0.760*** | 0.762*** | 0.760*** | | |
| | (0.0376) | (0.0386) | (0.0370) | (0.0381) | | |
| GovInv/GDP(t-1) | | | | | 0.789*** | 0.787*** |
| | | | | | (0.0355) | (0.0364) |
| Interest(t-1) | -0.827** | -0.831** | -0.855** | -0.849** | -0.575* | -0.566 |
| | (0.354) | (0.355) | (0.341) | (0.347) | (0.325) | (0.335) |
| Debt(t-1) | -0.357*** | -0.360*** | -0.369*** | -0.377*** | -0.350*** | -0.354*** |
| | (0.0947) | (0.0948) | (0.102) | (0.0996) | (0.0993) | (0.0979) |
| GDPtrend | 0.340*** | 0.339*** | 0.336*** | 0.339*** | | |
| | (0.0786) | (0.0785) | (0.0764) | (0.0777) | | |
| Cycle | 0.00793*** | 0.00791*** | | | 0.00139 | 0.00150 |
| | (0.00189) | (0.00190) | | | (0.00178) | (0.00179) |
| Cycle*good | | | 0.00588* | 0.00596** | | |
| | | | (0.00286) | (0.00287) | | |
| Cycle*bad | | | 0.00885*** | 0.00899*** | | |
| | | | (0.00185) | (0.00189) | | |
| NationalFR | -0.0250** | | | | | |
| | (0.0115) | | | | | |
| RIGID | | -0.0271** | | | | |
| | | (0.0128) | | | | |
| FLEX | | -0.0223 | | | | |
| | | (0.0215) | | | | |
| NationalFR*good | | | -0.0133 | | -0.00736 | |
| | | | (0.0150) | | (0.0150) | |
| NationalFR*bad | | | -0.0374** | | -0.0323** | |
| | | | (0.0133) | | (0.0131) | |
| RIGID*good | | | | -0.0228 | | -0.0175 |
| | | | | (0.0165) | | (0.0158) |
| RIGID*bad | | | | -0.0323* | | -0.0290* |
| | | | | (0.0158) | | (0.0152) |
| FLEX*good | | | | -0.00573 | | -0.000758 |
| | | | | (0.0251) | | (0.0239) |
| FLEX*bad | | | | -0.0423* | | -0.0344 |
| | | | | (0.0219) | | (0.0203) |
| Observations | 636 | 636 | 636 | 636 | 653 | 653 |
| 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 |
| R-squared within model | 0.877 | 0.877 | 0.878 | 0.878 | 0.729 | 0.729 |

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

of the same sign and comparable magnitude. Public investment seems to move together with the cycle as measured by the output gap, where the coefficient is somewhat below 1. Looking separately into the phases of the cycle, *OutputGap* is highly statistically significant in bad times. All in all, for a 1 percentage point drop in the cycle variable, public investment shrinks by about 1.5%. In addition, we validate the previous finding that rigid rules restrain government investment and exacerbate the procyclical effect of recessions.

Table 4: Effects of the cycle and the fiscal rules on government investment: Alternative definitions of the cycle and the design of fiscal rules

| | Dependent variable: GovInv | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| GovInv(t-1) | 0.708*** | 0.706*** | 0.708*** | 0.705*** | 0.711*** | 0.711*** |
| | (0.0385) | (0.0393) | (0.0386) | (0.0391) | (0.0367) | (0.0365) |
| Interest(t-1) | -0.186 | -0.152 | 0.00889 | 0.0519 | -0.840** | -0.846** |
| | (0.516) | (0.534) | (0.493) | (0.516) | (0.347) | (0.339) |
| Debt(t-1) | -0.370** | -0.364** | -0.324** | -0.319** | -0.445*** | -0.442*** |
| | (0.140) | (0.138) | (0.152) | (0.145) | (0.121) | (0.122) |
| GDPtrend(t-1) | 0.373*** | 0.372*** | 0.405*** | 0.399*** | 0.422*** | 0.422*** |
| | (0.103) | (0.0976) | (0.110) | (0.102) | (0.0969) | (0.0968) |
| OutputGap | 0.00878*** | 0.00902*** | | | | |
| | (0.00297) | (0.00301) | | | | |
| NationalFR | -0.0232 | | | | | |
| | (0.0135) | | | | | |
| RIGID | | -0.0346** | | | | |
| | | (0.0161) | | | | |
| FLEX | | -0.0178 | | | | |
| | | (0.0174) | | | | |
| OutputGap*bad | | | 0.0146*** | 0.0152*** | | |
| | | | (0.00412) | (0.00420) | | |
| OutputGap*good | | | 0.00531 | 0.00551 | | |
| | | | (0.00322) | (0.00325) | | |
| NationalFR*bad | | | -0.0459** | | | |
| | | | (0.0215) | | | |
| NationalFR*good | | | -0.0111 | | | |
| | | | (0.0172) | | | |
| RIGID*bad | | | | -0.0532* | | |
| | | | | (0.0261) | | |
| RIGID*good | | | | -0.0244 | | |
| | | | | (0.0225) | | |
| FLEX*bad | | | | -0.0262 | | |
| | | | | (0.0164) | | |
| FLEX*good | | | | -0.00186 | | |
| | | | | (0.0222) | | |
| Cycle | | | | | 0.0124*** | |
| | | | | | (0.00414) | |
| FRSI | | | | | -0.0337*** | |
| | | | | | (0.0105) | |
| Cycle*bad | | | | | | 0.0126** |
| | | | | | | (0.00461) |
| Cycle*good | | | | | | 0.0121** |
| | | | | | | (0.00574) |
| FRSI*bad | | | | | | -0.0312** |
| | | | | | | (0.0131) |
| FRSI*good | | | | | | -0.0353*** |
| | | | | | | (0.0120) |
| Observations | 630 | 630 | 630 | 630 | 619 | 619 |
| 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 |
| R-squared within model | 0.852 | 0.853 | 0.856 | 0.857 | 0.871 | 0.871 |

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

Lastly, we employ the Fiscal Rules Strength Index (FRSI) of the European Commission (EC, 2021) as an alternative dataset for the fiscal rules to check the robustness of our results on the effect of the fiscal rule design. The FRSI dataset offers a continuous variable instead of a fiscal rule dummy for each country

and period.[6] The score varies between -0.99 and 3.07 in the available sample. Instead of separating the fiscal rule dummies into categories, we directly apply the FRSI score as the variable for the design features of fiscal rules. Results are shown in columns 5 and 6 of Table 4.

This robustness check, once again, confirms the previous results to a large extent. We reinforce the finding that fiscal rules, as measured by the FRSI, constrain public investment. An increase in the FRSI score by 1 point is associated with, on average, 3.4% lower government investment. However, there doesn't seem to be a substantial difference between the phases of the cycle. Stricter fiscal rules show a statistically significant detrimental effect on public investment expenditure in bad as well as in good times. This is similar to our result in the section 5 where the effect of rigid rules on public investment in percent of GDP was negative and statistically significant in booms and recessions alike. In conclusion, our results prove to be highly robust to alternative definitions for the economic cycle and the design of fiscal rules.

## 5.2 Instrumented variable approach

This section will address the concern for the endogeneity of the contemporaneous business cycle variable as a regressor in our model. To tackle this, our first choice would be to opt for the 2SLS approach of Gali and Perotti (2003) which 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. Our business cycle variable exhibits frequent fluctuations with the change of algebraic sign so that its first lag alone does not suffice as a good instrument. To work around this, our choice for the instrument falls on the lag of the growth rate of private consumption, which shows more continuity and is more often in the positive domain, in addition to the lag of the cycle variable. With large t-values and an F-Statistic of 37.18 (see Table 9 in the Appendix), both variables prove to be relevant instruments for the contemporaneous cycle.

Table 5 presents the results of the second stage regressions. In a nutshell, the findings strongly resemble the baseline results. The coefficient of the instrumented cycle variable is a bit larger than 0.01 so that a 1 percentage point deviation from the economic trend would bring about a 1% change in public investment. The overall coefficient, however, lacks statistical significance. But when the separation into the different phases of the cycle is carried out, the effect of the cycle variable proves to be in fact larger and statistically significant at the 5%-level in recessions. This supports the finding that government investment expenditure seems to be subject to cuts during downturns. We also confirm that rigid rules restrain public investment, predominantly in bad times.

Furthermore, the 2SLS approach allows us to test the hypothesis of the endogeneity of the contempo-

[6]The FRSI takes 5 criteria into consideration: legal base, binding character, monitoring of compliance, correction mechanism, and resilience to shocks. The "strength" of the 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.

Table 5: Effects of the cycle and the fiscal rules on government investment: 2SLS

| | Dependent variable: GovInv | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| GovInv(t-1) | 0.723*** | 0.722*** | 0.717*** | 0.715*** |
| | (0.0344) | (0.0358) | (0.0358) | (0.0374) |
| Interest(t-1) | -0.419 | -0.401 | -0.492* | -0.483* |
| | (0.264) | (0.251) | (0.272) | (0.258) |
| Debt(t-1) | -0.426*** | -0.428*** | -0.345*** | -0.350*** |
| | (0.114) | (0.115) | (0.106) | (0.105) |
| GDPtrend(t-1) | 0.452*** | 0.451*** | 0.460*** | 0.458*** |
| | (0.0673) | (0.0669) | (0.0673) | (0.0666) |
| Cycle | 0.0119 | 0.0122 | | |
| | (0.00926) | (0.00942) | | |
| NationalFR | -0.0333*** | | | |
| | (0.0117) | | | |
| RIGID | | -0.0387*** | | |
| | | (0.0139) | | |
| FLEX | | -0.0240 | | |
| | | (0.0194) | | |
| Cycle*bad | | | 0.0360** | 0.0363** |
| | | | (0.0170) | (0.0170) |
| Cycle*good | | | -0.00804 | -0.00786 |
| | | | (0.0214) | (0.0214) |
| NationalFR*bad | | | -0.0446*** | |
| | | | (0.0158) | |
| NationalFR*good | | | -0.0258* | |
| | | | (0.0151) | |
| RIGID*bad | | | | -0.0461** |
| | | | | (0.0185) |
| RIGID*good | | | | -0.0319* |
| | | | | (0.0183) |
| FLEX*bad | | | | -0.0356 |
| | | | | (0.0236) |
| FLEX*good | | | | -0.0195 |
| | | | | (0.0230) |
| Observations | 653 | 653 | 653 | 653 |
| Number of group | 23 | 23 | 23 | 23 |
| Country FE | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES |
| R-squared within model | 0.868 | 0.869 | 0.859 | 0.859 |

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

raneous cycle variable in the first place. We test the endogeneity of the instrumented regressor directly using the option *endog* available along the *ivreg*2 command in Stata. The p-value of the statistic equals to 0.501 which signifies that the null hypothesis of the contemporaneous cycle being exogenous to the public investment cannot be rejected. Also, we apply the control function approach by adding the residuals of the first stage into the original model (see Table 9 in the Appendix). The residuals of the first stage do not reveal any statistically significant coefficient with a t-statistic of 0.09. If the chosen instruments have been exogenous and relevant, one can 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 that the endogeneity of the business cycle variable to public investment does not seem to be a serious concern.

### 5.3 GMM estimations

As a further robustness check, this section will run a GMM estimation of the baseline model specified by the equation (1) with the differentiation between rigid and flexible fiscal rules. We opt for the model with fewer regressors to limit the instruments proliferation. We 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.[7]

Table 6 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, we additionally split the sample in decades and perform the analysis for the 90's, the 2000's and the 2010's separately. This allows us to keep the number of the instruments below the number of groups, even though we include time dummies as instruments for the year fixed effects. The value of the Hansen statistic for the corresponding subsamples shows that we have at least partly alleviated the issue of too many instruments.

Table 6: Effects of fiscal rules on government investment: GMM

| | Dependent variable: GovInv | | | |
|---|---|---|---|---|
| | Full sample | 1991-2000 | 2001-2010 | 2011-2020 |
| GovInv(t-1) | 0.889*** | 0.668*** | 0.557*** | 0.787*** |
| | (0.0525) | (0.117) | (0.157) | (0.155) |
| GDPtrend(t-1) | 0.0960* | 0.295*** | 0.415*** | 0.204 |
| | (0.0504) | (0.114) | (0.134) | (0.143) |
| Interest(t-1) | -0.228 | -0.575 | 1.858 | 0.443 |
| | (0.240) | (0.386) | (1.564) | (1.451) |
| Debt(t-1) | -0.512** | 0.162 | -0.517 | -0.878 |
| | (0.114) | (0.169) | (0.515) | (0.591) |
| Cycle | 0.00784 | 0.0318 | 0.0207** | -0.0173 |
| | (0.00644) | (0.0201) | (0.0102) | (0.0434) |
| FLEX | -0.0722 | -0.0411 | -0.115 | -0.117 |
| | (0.0606) | (0.0875) | (0.435) | (0.178) |
| RIGID | -0.147*** | -0.0743 | -0.200* | -0.434*** |
| | (0.0389) | (0.0508) | (0.104) | (0.155) |
| Observations | 668 | 141 | 184 | 154 |
| Number of groups | 23 | 19 | 23 | 22 |
| AR(1) | 0.001 | 0.158 | 0.027 | 0.020 |
| AR(2) | 0.239 | 0.939 | 0.455 | 0.503 |
| Number of instruments | 73 | 23 | 23 | 21 |
| Hansen statistic | 1.000 | 0.709 | 0.351 | 0.815 |

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

First, the results of the GMM estimations generally support our baseline findings since the sign and the magnitude of most coefficients correspond to previous results. The coefficient of the lagged dependent

[7] We 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. We also restrict the number of instruments by collapsing the instrument matrix with the *collapse* option available within the *xtabond*2 command (Roodman, 2009a).

variable is somewhat higher for the full sample but is comparable to the baseline analysis for subsamples, indicating that the Nickell's bias has been minor. Second, we have also gathered some idea of 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 the late years and often replaced rigid rules. Against this background, it appears to be additional evidence in favour of the previous finding that the detrimental effect of fiscal rules on public investment comes from the rules that lack flexibility features.

To conclude the robustness check section, we have demonstrated a strong support for the baseline results. A number of alternative variables for the economic cycle and a different dataset for fiscal rules have also demonstrated a negative effect on public investment. This effect has proved to come about mainly in recessions. 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.

# 6 Conclusion

This paper investigates how numerical fiscal rules affect government investment in the EU over the economic cycle. We find that public investment is strongly procyclical and moves closely together with the economic ups and downs. This effect is especially pronounced in the downturns and is robust to the choice of the cycle variable. Fiscal rules demonstrate heterogeneous effects on public investment, depending on their design and on the state of economy. Specifically, fiscal rules that lack flexibility features seem to restrain government investment. Their detrimental effect mainly materializes during downturns, thus exacerbating the negative effect of the recession itself. These findings are robust to a series of robustness checks including several alternative definitions for the variables of interest as well as other estimation methods.

Furthermore, public investment spending in the categories, such as Economic Affairs, Housing, Health, and Social Protection, suffer the most from the detrimental effect of fiscal rules. Again, the adverse effect materializes mainly in the downturns. The procyclical effect of fiscal rules raises concerns especially in the case of expenses for economic and social aid which are meant to move against the cycle. Also, the Covid-19 pandemic has vividly demonstrated the long-term consequences of curbing the investment in health care. The findings of this paper suggest that it is crucial that fiscal rules should be designed with enough flexibility to reduce their procyclical effect and prevent them from curtailing growth-enhancing investment in key areas of public economy.

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# A Appendix

Table 7: Descriptive statistics of the main variables

| Variables | | Mean | SD | Min | 10th pct | 90th pct | Max | N |
|---|---|---|---|---|---|---|---|---|
| $GOVINV$ | (Bln USD) | 22.884 | 28.958 | 0.237 | 1.351 | 77.691 | 115.710 | 805 |
| $GDP$ | (Bln USD) | 754.637 | 983.201 | 17.494 | 46.498 | 2497.263 | 4464.492 | 775 |
| $GFCF$ (COFOG) | (% of GDP) | 3.65 | 1.08 | 0.56 | 2.22 | 5.09 | 7.69 | 600 |
| $PublicDebt$ | (% 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 |
| $Cycle$ - HP Filter | (% of GDP) | 0 | 2.29 | -12.67 | -1.98 | 1.91 | 14.18 | 775 |
| $OutputGap$ | (% of GDP) | -0.68 | 3.97 | -15.63 | -5.32 | 3.90 | 17.50 | 697 |
| $NationalFR$ | (Dummy) | 0.512 | 0.500 | 0 | 0 | 1 | 1 | 828 |
| $FRSI$ | (Index) | -0.1 | 0.86 | -0.99 | -0.99 | 1.04 | 3.07 | 594 |
| $Election$ | (Dummy) | .06 | 0.24 | 0 | 0 | 0 | 1 | 792 |
| $LeftGovernment$ | (Dummy) | 0.35 | 0.47 | 0 | 0 | 1 | 1 | 828 |
| $Population$ | (Mln) | 20.502 | 23.795 | 0.367 | 1.990 | 60.244 | 83.517 | 775 |

Table 8: Effects of the cycle and fiscal rules on government investment: Alternative definition of the economic phase ($bad = 1$ if $Cycle < 0$ and $good = 1$ if $Cycle > 0$)

| | Dependent variable GovInv | | | |
|---|---|---|---|---|
| | (1) HP | (2) HP | (3) Hamilton | (4) Hamilton |
| GovInv(t-1) | 0.742*** | 0.740*** | 0.759*** | 0.758*** |
| | (0.0314) | (0.0322) | (0.0370) | (0.0380) |
| Interest(t-1) | -1.011** | -1.006** | -0.775* | -0.777** |
| | (0.399) | (0.398) | (0.377) | (0.375) |
| Debt(t-1) | -0.441*** | -0.443*** | -0.359*** | -0.362*** |
| | (0.115) | (0.115) | (0.0963) | (0.0950) |
| GDPtrend (t-1) | 0.393*** | 0.393*** | 0.350*** | 0.350*** |
| | (0.0602) | (0.0593) | (0.0716) | (0.0712) |
| Cycle*good | 0.00341 | 0.00328 | 0.00418 | 0.00400 |
| | (0.00564) | (0.00578) | (0.00448) | (0.00450) |
| Cycle*bad | 0.0130* | 0.0136* | 0.0107*** | 0.0107*** |
| | (0.00726) | (0.00708) | (0.00276) | (0.00270) |
| NationalFR*good | -0.0251* | | -0.0215 | |
| | (0.0139) | | (0.0133) | |
| NationalFR*bad | -0.0278* | | -0.0311** | |
| | (0.0138) | | (0.0138) | |
| RIGID*good | | -0.0288* | | -0.0205 |
| | | (0.0155) | | (0.0143) |
| RIGID*bad | | -0.0295* | | -0.0364** |
| | | (0.0154) | | (0.0151) |
| FLXR*good | | -0.0288 | | -0.0241 |
| | | (0.0246) | | (0.0224) |
| FLXR*bad | | -0.0277 | | -0.0199 |
| | | (0.0218) | | (0.0215) |
| Observations | 668 | 668 | 636 | 636 |
| Number of groups | 23 | 23 | 23 | 23 |
| Country FE | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES |
| R-squared within model | 0.887 | 0.887 | 0.878 | 0.878 |

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

| | Dependent variable | |
|---|---|---|
| | Cycle | GovInv |
| | (1) | (2) |
| Cycle(t-1) | 0.168*** | |
| | (3.47) | |
| ConsGrowth(t-1) | 0.271*** | |
| | (7.64) | |
| GovInv(t-1) | 0.106 | 0.723*** |
| | (0.48) | (21.02) |
| Interest(t-1) | -2.035 | -0.419 |
| | (-0.93) | (-1.58) |
| Debt(t-1) | -2.461* | -0.426*** |
| | (-1.85) | ( -3.73) |
| GDPtrend(t-1) | 0.430 | 0.452*** |
| | (0.81) | (6.72) |
| NationalFR | 0.069 | -0.0333** |
| | (0.63) | (-2.83) |
| Cycle | | 0.0119 |
| | | (1.29) |
| RESIDUALS | | 0.001 |
| | | (0.09) |
| Observations | 653 | 653 |
| Number of groups | 23 | 23 |
| Country FE | YES | YES |
| Year FE | YES | YES |
| R-squared within model | 0.663 | 0.868 |
| First stage F-Statistic | 37.18 | |

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

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