

Weber, Philipp; Zell, Laura A.; Feld, Lars P.; Schaltegger, Christoph A.

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Functionality of Fiscal Rules in a Low Interest Rate Environment – New Empirical Results for Swiss Cantons

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Philipp Weber, Laura A. Zell, Lars P. Feld, Christoph A. Schaltegger

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Poschingerstr. 5, 81679 Munich, Germany

Telephone +49 (0)89 2180-2740, Telefax +49 (0)89 2180-17845, email office@cesifo.de

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Abstract

The zero lower bound era introduced a new perspective on the functionality of fiscal rules. With such low interest rates, the argument goes, extending debt financed public investment spending would be reasonable and thus existing fiscal rules too restrictive. Using data of Swiss cantonal public finances between 1990 and 2020, we investigate as to how fiscal rules affect fiscal variables in an environment with low interest rates. In addition to a dynamic model with a bias-corrected least square dummy variable (LSDVC) estimator, the Forecasted Average Treatment (FAT) approach allows us to exploit Switzerland's unexpected and substantial interest rate drop in 2015 following the termination of the Swiss Franc-Euro peg. The methodological novelty of this approach lies in the investigation of an exogenous shock in absence of a control group. Our results show, first, that fiscal rules constrain public debt and total spending, but not investment spending. Second, variation in the interest rate level has opposing effects on different types of public deficits, but fiscal rules retain their overall constraining effect in a low interest rate environment. Third, we find varying reactions to the interest rate shock depending on rule stringency, but public investment is not systematically more constrained by strict rules.

JEL-Codes: E430, E620, H540, H630, H740.

Keywords: fiscal rules, zero-lower-bound, interest rate shock, public investment.

Philipp Weber
Walter Eucken Institute
Freiburg / Germany
weber@eucken.de

*Lars P. Feld**
Walter Eucken Institute & University of
Freiburg / Germany
feld@eucken.de

Laura A. Zell
Institute for Swiss Economic Policy &
University of Lucerne / Switzerland
laura.zell@unilu.ch

Christoph A. Schaltegger
Institute for Swiss Economic Policy &
University of Lucerne / Switzerland
christoph.schaltegger@unilu.ch

*corresponding author

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1. Introduction

For several decades, whether and how fiscal rules restrain fiscal policy has been controversially discussed in politics and academia alike leading to manifold theoretical and empirical analyses. However, after the Global Financial Crisis (GFC), low interest rates became a second aspect that fostered the debate as to whether debt financing of public expenditure should be expanded in order to cope with generational challenges like global warming, demographic change, or national security. The advocates for such a fiscal policy argue that a period of low interest rates is ideal for accumulating cheap public debt, which can then be used wisely to address these challenges. In this line of argument, fiscal rules are an obstructive institutional setting that needs to be eased or at least to be more flexible in order to finance public investment by debt. Yet, it remains an open question as to how the two key variables – fiscal rules and interest rates – interact with each other and how they affect fiscal policy decisions.

This leads to our research question: *How do fiscal rules affect fiscal policy in a low interest rate environment?* More precisely, we focus on fiscal policy at a subnational level analyzing the effects of fiscal rules on Swiss cantons' public finances between 1990 and 2020. Since Swiss federalism offers many advantages for empirical research, the literature on cantonal fiscal rules and their impact on fiscal variables is extensive. First, we summarize the related literature and provide the theoretical arguments as a starting point for our analysis. Next, we describe the data base and descriptively analyze the most relevant variables in Section 3. Section 4 outlines the methodology for our empirical analysis. We propose a dynamic model corrected for potential Nickell bias (LSDVC) and introduce a novel approach that relies on forecasted counterfactuals in order to estimate a Forecasted Average Treatment (FAT) effect.

In Section 5, we present our results. We find a consistent and robust constraining effect of fiscal rule stringency on cantonal debt. The most stringent fiscal rules also constrain public spending, but not investment expenditures. The FAT approach shows that cantons reacted differently to the unexpected interest rate shock of 15th January 2015 (termination of the Swiss Franc-Euro peg). Public deficits and expenditures increased in cantons with loose fiscal rules but decreased in cantons with strict fiscal rules. Again, this effect cannot be observed for investment spending. In Section 6, we report the robustness tests of our results and discuss limitations as well as alternative empirical approaches. Section 7 concludes.

2. Literature Review

The econometric analysis in this paper is based on two distinct theoretical derivations and their empirical assessments: the first strand of literature addresses the theoretical rationales behind fiscal rules and the subsequent empirical assessment of these theories. The second strand of literature studies public investment in a low interest rate environment, closely linked to theoretical arguments which suggest a hampering effect of fiscal rules on public investment.

Fiscal Rule Introduction and Its Consequences

The theoretical arguments for fiscal rules, the *deficit bias*, can be summarized in three distinct pillars: *time inconsistency*, the *common pool problem* and *moral hazard* (electoral cycles).¹

Many undesirable outcomes in fiscal policy arise from a *time inconsistency* problem that has been identified by Kydland and Prescott (1977) or Barro and Gordon (1983). They show that economic planning cannot lead to welfare maximizing outcomes as the planner (a government) acts in an environment of other rational agents who adapt their own expectations according to the planner's actions. To form stable expectations over time, government actions need to be in line with certain rules, hence time consistent rules make government actions predictable. While this concept is generally accepted in monetary policy, it is regularly challenged in the context of fiscal policy. Mooslechner (2006) argues that the examples presented by Kydland and Prescott offer stronger support for rule-based fiscal policy than for rule-based monetary policy. Woodford (2001) and Blanchard (2019) stress the importance of stable expectations as well, and both emphasize that fiscal rules can prevent bad equilibria due to misguided expectations.

The government budget is a limited resource, and its inefficient overuse is a game-theoretic *common pool problem*. Velasco (2000) uses a game-theoretic design from Levhari and Mirman (1980) and Benhabib and Radner (1992) to model the common pool problem for fiscal policy. He shows that government transfers exceed the welfare maximizing level such that public debt becomes excessively high over time. Government deficits exceed the amount reasonable for tax smoothing purposes (Barro, 1979). Velasco emphasizes that this problem is caused by the strategic behavior of competing groups, and in this regard fiscal policy is comparable to the general analysis provided by Levhari and Mirman (1980) and Benhabib and Radner (1992).

The interaction between *electoral cycles* and macroeconomic outcomes as proposed by Alesina (1987, 1989) focuses primarily on consequences for inflation and unemployment in a setting of

¹ Badinger and Reuter (2017) name five distinct problems which can be managed in a rule-based fiscal policy regime: *common pool theory*, *information asymmetry*, *short-sightedness*, *political competition*, and *outside pressure*. They can be summarized in the three pillars named here.

political rivalry and opposing political ideology. Rogoff (1990) shifts the focus to the effects of electoral cycles on fiscal policy like taxation, transfers, and public consumption. Shi and Svensson (2006) built their own theoretical and empirical analysis on Rogoff's work. They emphasize that information availability for voters and restrictions on rent seeking by politicians affect the political budget cycle's magnitude. In this context, Shi and Svensson highlight the importance of a well-functioning institutional framework to mitigate moral hazard.

Empirical Assessment of Fiscal Rules

The existing empirical literature does not just test the theoretical arguments above (summarized by Kopits and Symansky, 1998), but provides an understanding of the extensive margin of fiscal rules' constraining power and the generalizability of empirical findings due to similar findings in multiple settings. Yared (2019) and Potrafke (2023) review the relevant macroeconomic and political economics literature regarding the rules' *raison d'être* as well as the consequences of rule introduction. Heinemann et al. (2018) provide a meta-regression with 30 papers on fiscal rules' functionality. They show that fiscal rules have a constraining effect on public deficits and debt, but this effect vanishes with more sophisticated identification strategies.

For the U.S. case, Bayoumi and Eichengreen (1995) and Bohn and Inman (1996) provide early empirical evaluations on fiscal rules' functioning on subnational (states) level. Bayoumi and Eichengreen (1995) find reduced fiscal balance variation over the business cycle. Bohn and Inman show that well-designed balanced budget rules reduce state deficits and that most adaptations made to comply with the rules result in lower current account spending.

Deroose et al. (2006), Nerlich and Reuter (2013), Iara and Wolff (2014), Reuter (2015), Afonso and Guimarães (2015), and Bergman et al. (2016) investigate the effects of fiscal rules in European countries. They analyze different independent variables like rule design, enforcement or supervision and use varying dependent variables like government debt, deficits, or sovereign bond yields. While they suggest improvements of fiscal rule design on the EU level in order to increase the rules' credibility, they find significant constraining effects on various fiscal variables. Thornton and Vasilakis (2017), Asatryan et al. (2018), Eyraud et al. (2018), Afonso and Jalles (2019), Caselli and Reynaud (2020), and Sawadogo (2020) report similar results for multinational datasets beyond the European context and for emerging markets as well.

Another strand of literature focuses on fiscal rules' effect on information asymmetry, hence the common pool problem, and distortions that arise from the electoral cycle. Von Hagen (1992), Beetsma et al. (2009), Lüchinger and Schaltegger (2013), and Chatagny (2015) report findings that fiscal rules support projection accuracy in the budgetary process and reduce the need for

adjustments during budget execution. The authors argue that fiscal rules thus support finance ministers in the budgeting process. Rules make it easier for them to reject spending proposals by other ministers or lobby groups because of the fiscal constraint. Picchio and Santolini (2020) find similar results for Italian municipalities, but they ascribe increased budgeting precision rather to severe sanctions than political economics arguments. Hansen (2020) points out that alternative fiscal rules can be an effective tool for the opposition to discipline the executive because the rule itself gives the opposition a mandate to insist on prudent fiscal policy.

The Swiss Case

In addition, the effect of fiscal rules has been investigated for Switzerland, both at the federal and cantonal levels. Brändle and Elsner (2023) present a survey of the respective empirical literature. Schaltegger (2002) connects literature on US budget rules with the Swiss case. Feld and Kirchgässner (1999, 2001a, 2001b) and Feld and Matsusaka (2003) investigate the effect of different budgetary procedures on cantonal debt and public spending. They find that “top down” procedures in representative democracies are less effective to control public debt than “bottom up” procedures in form of fiscal referendums. In this context, fiscal referendums do not only reduce public debt but also public spending. Furthermore, Feld and Kirchgässner (2001b) are the first to quantify cantonal fiscal rule stringency in a four-steps fiscal rule index.

Switzerland introduced a federal debt brake on 1st January 2003. Asatryan et al. (2018), Salvi et al. (2020) and Pfeil and Feld (2024) evaluated this rule by applying a synthetic control group method. Asatryan et al. (2018) report a negative effect of the rule introduction on federal public debt and expenditure. Salvi et al. (2020) confirm these findings and provide more detailed results by considering potential expenditure shifts to sub-national levels and general spending decisions. They explain their findings by referring to the rule’s transparency and simplicity, its comprehensive scope, its mandatory sanctions and the strong public support, articulated in the respective public referendums. Pfeil and Feld (2024) focus more on the cyclically adjusted budget balances and thereby focusing on the variable which is directly restricted by the rule. Their results fit in well to the earlier contributions. They show that the rule introduction improved the cyclically adjusted budget balances by 3.7 percentage points of GDP, thereby lowering the government’s structural deficit substantially and ensuring sound public finances.

On the sub-national level, many cantons introduced fiscal rules much earlier than the federal level. The respective empirical investigation of these rules is therefore extensive. Feld and Kirchgässner (2008) use a panel dataset over 19 years (1980-1998) and all 26 cantons and investigate the effect of fiscal decentralization, direct democracy and formal fiscal restraints on

public deficits and debt in a pooled cross-section times-series model. According to their results, direct democratic measures and more decentralized expenditures support lower cantonal debt. Furthermore, formal fiscal constraints reduce budget deficits. In the context of interactions between different federal tiers, Feld et al. (2017) exploit a quasi-experimental design to show that the reestablishment of credible no-bailout clauses regarding municipalities' debt as well as fiscal rules reduce cantons' bond yields. Burret and Feld (2018a) investigate the interaction between cantonal and municipal tiers in Switzerland by analyzing vertical spillovers from cantonal fiscal rules to the municipal level. The empirical approach uses a panel dataset with all 26 cantons and 139 Swiss municipalities over a 31-year observation period (1980-2011). It is a generalized difference-in-difference approach with jurisdictions with an active debt brake as treatment group. Contrary to common concerns that fiscal rules may increase fiscal distress for lower federal tiers, Burret and Feld cannot find spillover effects from the cantonal to the municipal level. If anything, cantonal fiscal rules support sound municipal public finances and fiscal centralization. Yerly (2013) systematically gathers legal norms defining cantonal fiscal rules and provides this information in a fiscal rule index. On this basis, she finds a significantly negative effect of cantonal fiscal rule stringency on budget deficits.

Fiscal Rules, Low Interest Rates and Public Investment

Some of the most recognized macroeconomic publications in the last decade call for higher public debt in a low interest rate environment. Summers (2014), Blanchard (2019) and Furman and Summers (2020) argue that public debt had been too low during the last decade. And indeed, a series of theoretical papers finds negative effects of fiscal rules on public investment. Based on a dynamic general equilibrium model, Bom and Ligthart (2014) show that revenue-financed investment causes short-term contractions as labor tax distortions outweigh the long-term positive output multiplier. The negative short-term effect can be mitigated substantially by allowing for debt-financed public investment, i.e., smoothing tax rate adaptation. Blanchard and Giavazzi (2004) and Krogstrup and Wyplosz (2006) warn against too restrictive fiscal rules and a decline of productive public spending due to fiscal rules. They suggest exemptions for public investment and implementation of institutions that are responsible for identifying productive public spending (see also Guerguil et al., 2017 and Ardanaz et al., 2021).

However, multiple empirical approaches come to opposite results, especially when broadening the view by including other explanatory variables. Delgado-Téllez et al. (2022) analyze the decline in public investment by systematically contrasting the *too restrictive fiscal rules for public investment theory* to the *social dominance hypothesis*. They find strong support for the social dominance hypothesis and no effect of fiscal rule flexibility. Perée and Vålilä (2005)

argue that the embodied rule is not responsible for declining public investment in the European Monetary Union (EMU) but rather other factors, like national income, the budgetary situation or fiscal sustainability considerations. Accordingly, long-term fiscal sustainability is key to support public investment. De Haan et al. (1996) test seven economic and political factors that could influence public investment. The results reveal a significant correlation of fiscal austerity, frequency of government change and private investment on public investment. Vålilä and Mehrotra (2005) report that the two independent variables most relevant to our research question – financing costs and fiscal rules – do not significantly affect the long-term downtrend of public investment in EU countries. Heinemann (2006) analyzes the decline in public investment as well. His panel dataset consists of 20 OECD countries for 41 years (1961 to 2001). The results reveal a significant effect of decreasing yields of public capital formation, increasing public debt and factor mobility on public investment decline. EU fiscal rules, however, do not significantly affect public investment.

Blesse et al. (2023) review 20 empirical studies on the effect of fiscal rules on public investment. They do not find a systematic negative effect of fiscal rules on public investments. Rule design itself but also the approach to measure public investment lead to different empirical outcomes. The authors state that more empirical research is needed in order to disentangle the effects of institutional settings on public spending properly.

From a political economics perspective, Gupta et al. (2016) analyze the electoral cycle's influence on public spending priorities. They show that the peak in public investment growth is on average 28 months before the upcoming election. The closer the election date gets, the more politicians favor consumption over investment expenditures. The authors find some preliminary evidence that fiscal rules mitigate this effect. Mancini and Tommasino (2023) provide evidence that public executives in Italian municipalities systematically overestimate planned public investment which leads to large distortions between the planned budget and execution. The introduction of fiscal rules mitigates investment overestimation significantly, both in terms of statistical significance and economic magnitude. The rule limits politicians' ability to make great promises on future investment by introducing institutional boundaries.

For the Swiss case, Burret and Feld (2018b) differentiate between intended effects of fiscal rules on targeted variables and unintended consequences beyond legal guidelines. In this framework, they focus on the effect of cantonal debt brakes on public investment and further investigate whether labelling consumption expenditures as investment is a pervasive strategy to circumvent fiscal rules. In a generalized difference-in-difference design, Burret and Feld

reject the hypothesis that a debt brake has a dampening effect on public spending. They find some hints that current consumption may be relabeled as public investment, but these results are not robust. Feld et al. (2021) confirm the constraining effect of cantonal fiscal rules on public deficits and debt, but they cannot find different reactions in cantons' investment decisions depending on the degree of fiscal constraints following an interest rate shock. Hence, they do not find evidence that cantons with looser fiscal rules have higher flexibility for expanding public investment in a low interest rate environment.

Taking all these theoretical arguments together leads to the following hypotheses:

- *H₁: More stringent fiscal rules reduce public debt and deficits.*
- *H₂: More stringent fiscal rules lead to lower public investment.*
- *H₃: Decreasing interest rates lead to increasing public debt and deficits.*
- *H₄: Decreasing interest rates lead to increasing public investment.*
- *H₅: With strict fiscal rules, interest rates have a weaker effect on public debt and deficits.*
- *H₆: With strict fiscal rules, public investment expands less after a negative interest rate shock.*

3. Data & Descriptive Statistics

All fiscal data are provided by the Swiss Federal Finance Administration (FFA). All cantonal financial statements are standardized by the FS Model, a Swiss specific public accounting model that is inspired by the International Public Sector Accounting Standards (IPSAS). As such the fiscal dataset contains a *statement of financial position* (assets, debt, and equity), a *statement of financial performance* (expenditure and revenue) and a *financing statement* (investment expenditure and investment revenue). Fiscal data in the FS model is available for all cantons from the year 1990 to 2021. We begin with a 31-year observation period but later, to focus our analysis on the functionality of fiscal rules in a low interest rate environment, we narrow our observation period to the years 2010 to 2019.

Fiscal variables

The fiscal variables we are most interested in are cantonal *debt*, *deficits*, and *investment*. The definition of all fiscal variables is, whenever possible, based on definitions by the Harmonized Accounting Model for the Cantons and Communes (HAM2). This means that the *deficits* variable is defined as the difference between expenditure and revenue in the statement of financial performance. It is positive if expenditure exceeds revenue, indicating a deficit. A second deficit variable builds upon the first one by additionally considering the difference between investment expenditure and investment revenue from the financing statement

(*financial deficits*). Different results between the two deficit variables could indicate an observable influence of fiscal rule stringency on cantonal investment. The deficit variable can be split into different types of deficits. The FFA defines three types of deficits, namely *operational deficits*, *capital deficits* and deficits from unusual expenditures or revenues (*unusual deficits*). Figure 1 displays the relative share of each type on total expenditure and revenue. It is not trivial to deduce shares of deficit right away because some types of expenditure and revenue regularly result in surpluses. Hence, we display cantonal expenditure and revenue instead. Operational expenditure and revenue contribute with more than 80% - by far the highest share - to cantonal finance, providing therefore the largest leverage for any deficit adaptations.

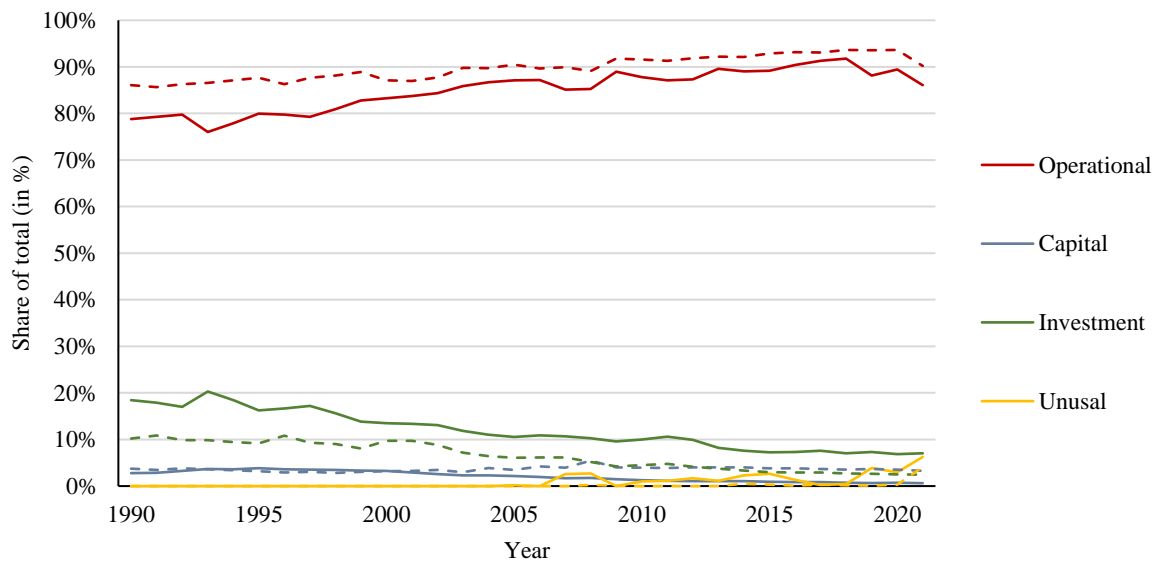


Figure 1: Average composition of cantonal expenditure and revenue.

Since multiple observations reveal a surplus rather than a deficit, it is not trivial to display the share of different deficit types to total deficit, respectively. Instead Figure 1 displays the corresponding types of expenditure (solid lines) and revenue (dashed lines) with the following color scheme: operational (red), investment (green), capital (blue), and unusual (orange). All values are calculated as share of total expenditure (revenue).

Our *debt* variable is the sum of three accounts, namely *liabilities*, *short-term financial debt*, and *long-term financial debt*. Outside capital accounts contain many other accounts which do not qualify as debt, most notably accruals, prepayments, and deferred income. Even the three accounts that qualify as debt need to be treated with caution. Following the HAM2 definitions for gross and net debt, the short-term and the long-term debt accounts, both, record some entries that do not qualify as debt from an economic perspective. Unfortunately, the relevant sub-accounts are not available in the FS model dataset and hence a correction is not possible. Most of our estimations use per capita normalization for fiscal variables. In these cases, we consider debt observations in log form.

	Obs.	Mean	Std. Dev.	Min	Max
Investment Expenditure	832	1.1279	0.7388	0.1993	5.5004
Change in Administrative Property	806	0.1697	1.0201	-2.5229	19.9081
Changes in Capital Assets	806	0.2345	1.0826	-2.4865	16.9619

Table 1: Descriptive statistics of public investment parameters (in 1.000 CHF per capita).

For cantonal *investment* we begin with *investment expenditure* from the financing statement. Alternatively, we will also consider the *annual change in cantonal assets* in the robustness checks. The HAM2 differentiates assets between *administrative property* and *financial assets*.² In our analysis, we focus on changes in administrative property and as a second-best alternative consider changes in capital assets. Table 1 summarizes the three investment variables.

Interest Rate

Data on interest rates in Switzerland is provided by the Swiss National Bank (SNB). Swiss monetary policy has mostly been in line with other major monetary policy institutions of industrialized countries over the last three decades. Interest rates show a steady negative trend from 1990 to 2021 with two temporal trend reversals between 1999 and 2009 (Figure 2).

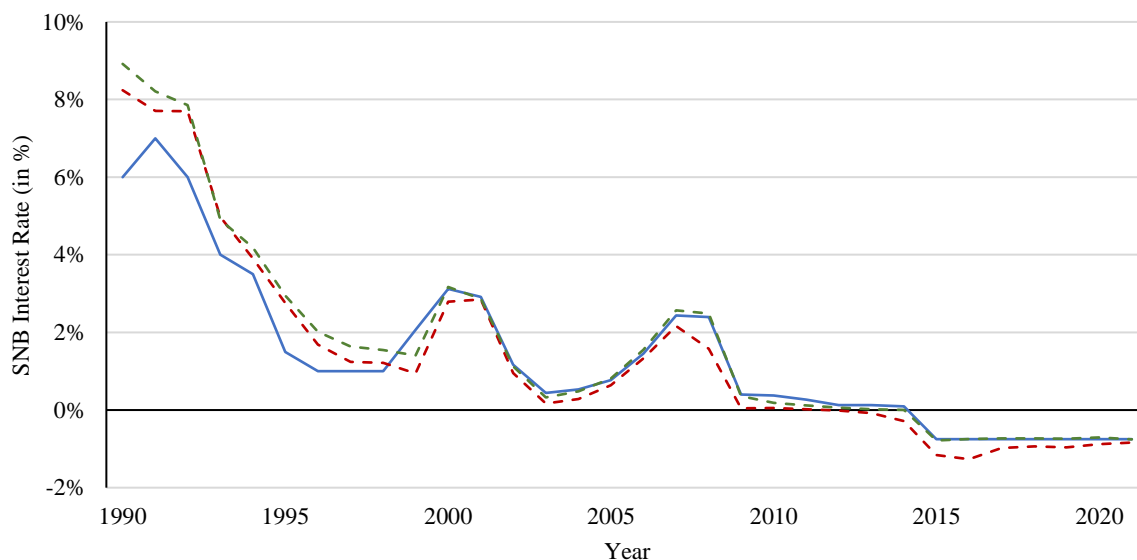


Figure 2: Policy rate and money market rate.

The graph displays the SNB policy rate (blue line) and the respective overnight interest rate (red dashed line) and three months LIBOR in Swiss France (green dashed line).

After the beginning of the Global Financial Crisis (GFC), central banks around the world dropped interest rates rigorously, including the SNB. Between 2009 and 2016, central banks in

² Financial assets are divided into *capital assets* and *current assets*.

industrialized countries kept their interest rate band relatively constant at a very low level.³ In early 2015, however, the SNB was the only bank in this peer group that dropped interest rates once again substantially (84.38 basis points) due to the termination of the Swiss Franc-Euro peg on 15th January 2015 (see Figure A-1 in the Appendix). This decision came unexpectedly for market participants and no prior expectation adaptation was observed. In order to avoid an excessive currency appreciation of the Swiss Franc, the central bank had to decrease interest rates. With two interest rate changes in quick succession the Swiss National Bank executed an additional strong interest rate change in the low interest rate period. The 84.38 basis points interest rate drop has been by far the sharpest interest rate decline in non-crisis years for at least 25 years. After this drop the interest rate remained on this low (even negative) level for the rest of our observation period.

This substantial interest rate drop in 2015 and its consequences for debt financing could have influenced cantonal treasuries' budget plans or their medium-term refinancing structure. We use this unexpected interest rate drop as exogenous variation when we focus explicitly on the low interest rate period between 2010 and 2019.

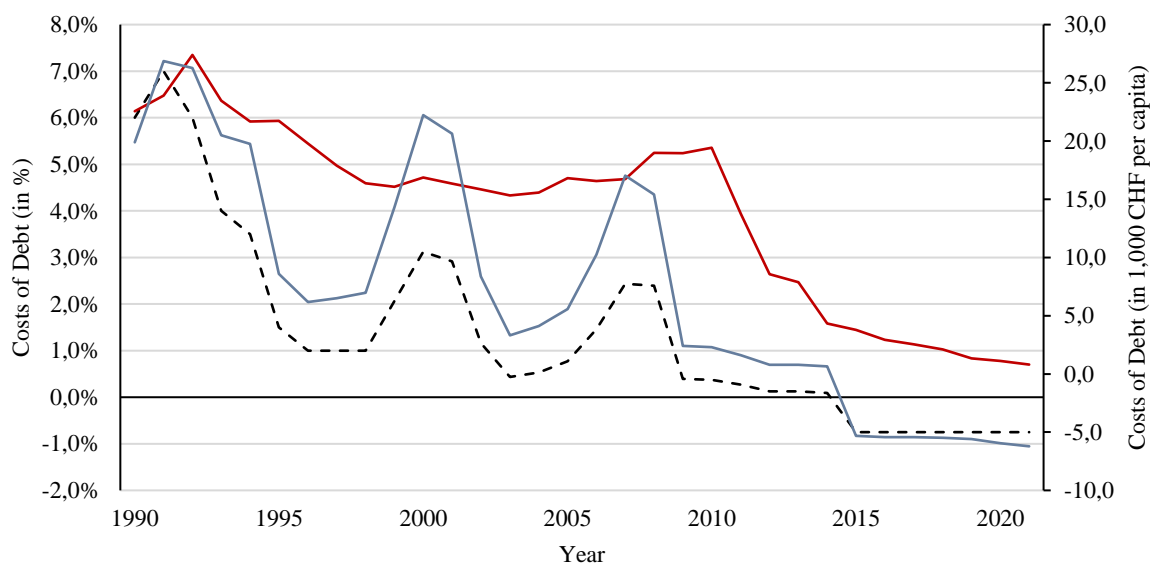


Figure 3: Real costs of government debt (red line, left y-axis, in percent) and real interest costs (blue line, right y-axis, in 1,000 CHF per capita). The SNB interest rate (black dotted line, left y-axis, in percent) is only depicted as a reference point.

The lasting trend in decreasing interest rates can be observed in fiscal variables as well. The cantons' average real costs of debt (interest rate payments divided by long-term liabilities) consistently decreased during our observation period (Figure 3, red line, left y-axis) with a

³ The *European Central Bank*, the *Bank of England* and the *Bank of Japan* even kept the interest rate low until inflation increased in early 2022. Only the *Federal Reserve* increased interest rates between late 2016 and the COVID-19 outbreak in 2020.

particularly sharp drop after 2011. While the average costs of debt were almost 6 % in the mid-1990s, they decreased down to less than 1 % in 2018. To emphasize the direct link between the central bank's interest rate and cantonal fiscal policy, we multiply cantonal per capita debt by the interest rate (Figure 3, blue line, right y-axis, in 1,000 CHF per capita). This approximation is supposed to account for canton-specific consequences of interest rate changes because cantons with high public debt may be more strongly affected by these changes than cantons with low public debt. This approximation is used as an alternative explanatory interest rate variable in the robustness checks.

Fiscal Rule Index

All cantons but Appenzell Inner Rhodes introduced fiscal rules between 1929 and 2007 (Weber, 2024). Throughout the entire observation period, the canton of Schwyz has had rather loose fiscal rules, while Fribourg and St. Gallen adhered to strict rules. Rule stringencies for all other cantons are within that range and vary over time. Weber (2024) provides a thorough descriptive analysis of the composition of cantonal fiscal rules. For this paper, the fiscal rule variable is methodologically based on Burret and Feld (2018a) since it consistently covers most of our observation period (Burret and Feld provide data for the years 1990 to 2011). For the remaining years, we extend the fiscal rule variable with information provided by Weber (2024). To avoid structural breaks, we extrapolate the variable by nominal changes in the rule design reported by Weber (2024). We only consider changes with regard to the rule elements that are considered by Burret and Feld (2018a). Their index scale follows the definition proposed by Feld and Kirchgässner (2001b). The four-scale index assigns one point for every characteristic which can be affirmed and equals zero otherwise. The three characteristics are: (1) *link between budgeting and execution*, (2) *numerical constraints* and (3) *non-discretionary sanctions* in place for accruing deficits. Figure 4 displays the development of rule stringency for the six cantons with the highest and lowest index values during the observation period as well as the average constraining level over time.

The fiscal rule sets in Fribourg and St. Gallen contain constraining elements on all three characteristics for the entire observation period (blue solid line). Solothurn also meets all three characteristics from the year 2008 onwards (blue dashed line). Fiscal rules in Schwyz, Geneva and Zug have comparably low constraining effects during the entire observation period. Appenzell Inner Rhodes is the only canton with no fiscal rule in place for the entire observation period. The average index value across all cantons has a positive trajectory, with a consistent increase between 2000 and 2018 (black dashed line).

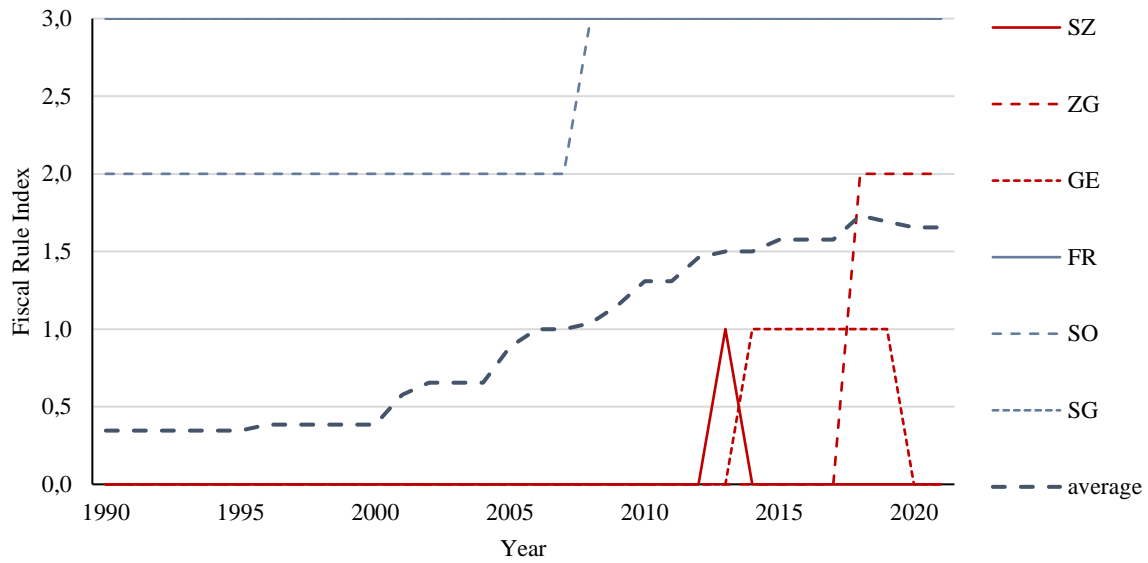


Figure 4: Fiscal Rule Index for Schwyz (SZ), Zug (ZG), Geneva (GE), Fribourg (FR), Solothurn (SO), and St. Gallen (SG). Black dashed line displays the trajectory of average rule stringency.

Other variables

Our estimations are complemented by common control variables that are frequently used in the literature (e.g., Feld and Kirchgässner, 2008, Burret and Feld, 2018a, Berset and Schelker, 2020). Most of them, namely *net transfers*, *population*, *age structure*, and *unemployment rate*, are gathered from the FFA and the Federal Statistical Office (FSO) and do not require any special treatment. The other three variables, *fiscal policy preferences*, *tax potential* and *cantonal GDP*, require some preparation before we can use them.

Fiscal policy sentiments are a major source of endogeneity which needs to be targeted appropriately (Poterba, 1996, Debrun et al., 2008, Krogstrup and Wälti, 2008, Heinemann et al., 2014). We do this by adapting the *fiscal policy preferences* approach from Funk and Gathmann (2013) for our own observation period with voting data provided by the FSO. We use this data to calculate the canton-specific deviation from national results on federal referenda concerning fiscal policy. If there is more than one referendum per year, we use the annual average deviation, and if there is no referendum in the respective year, we interpolate missing values. The considered referendums only contain fiscal issues on the federal level, and since the variable describes the cantonal deviation from the national result, the general opinion on the respective topic is preserved as well.

Fiscal data in the FS model contain revenue accounts for property tax and income tax revenue for private households and corporations alike. However, because of institutionalized and well-established tax competition between cantons (Feld et al., 2010), we cannot simply compare cantonal tax revenue. Tax rate multipliers are the primary element for the tax competition between cantons, while the tax base is mostly defined by the tax harmonization law. We therefore divide tax revenue by year and canton-specific tax multipliers to gauge the cantonal tax base. We then sum up the four tax bases to a single *tax potential* variable.

Cantonal GDP is only provided from the year 2008 onwards by the FSO. We need information on the cantonal economic strength not just as a control variable but also to contextualize fiscal variables in the robustness check. To estimate cantonal GDP, we calculate a canton's share in Swiss productivity by dividing its tax potential (see above) by the sum of tax potentials for all cantons and then multiply it by national GDP.⁴ Table 2 summarizes all our control variables.

	Obs.	Mean	Std. Dev.	Min	Max
Population	832	294,044	306,614	13,573	1,564,662
Transfers received (in 1,000 CHF per capita)	832	0.39	0.61	0.00	2.50
Tax potential (in 1,000 CHF per capita)	832	2.90	2.16	0.20	14.50
Estimated cantonal GDP (in 1,000 CHF)	832	20,300,000	27,700,000	27,035	170,000,000
Fiscal policy preference (in percentage points)	806	1.13	6.00	-25.46	29.58
Share of population older than 64 years (in %)	832	16.56	2.50	10.90	23.38
Unemployment rate (in %)	831	2.74	1.54	0.05	7.81

Table 2: Descriptive statistics of control variables.

4. Methodology

To examine the effects of fiscal rules and decreasing interest rates on fiscal variables, we use annual data of 26 Swiss cantons. We begin with a 30-year observation period (1990 to 2019) and shorten it later to the low interest rate period from 2010 onwards. Similar to previous

⁴ We utilize a similar procedure to derive the tax potential variable as explained above, with one modification: we exclude the personal income tax base to account for cross-cantonal commuters. Compared to the tax potential variable this cantonal productivity proxy increases the productivity share for the urban cantons (Basel City, Geneva, and Zurich) and decreases the share for more rural cantons. While the increase is substantial for urban cantons (almost 5 percentage points increase) it is more moderate for rural cantons (maximum around to 2 percentage points decrease) because it is distributed over more cantons.

research, we apply panel estimation to assess the effects of fiscal rules on our outcome variables (Badinger and Reuter, 2017, Burret and Feld, 2018b, Bergman et al., 2016).

4.1 Dynamic Model with bias-corrected Least Square Dummy Variable Estimator

Government finance decisions are inherently dynamic, with past decisions contributing to shaping present choices. Consequently, to accurately capture this temporal influence, we include a lagged dependent variable in our model. The bias-corrected least square dummy variable estimator (LSDVC) addresses the inconsistencies introduced by the lagged dependent variable (Nickell, 1981) and has been shown to be efficient when N is relatively small (Judson and Owen, 1999).

The regression specification:

$$Y_{it}^k = \beta_0 Y_{it-1}^k + \beta_1 \text{Fiscal Rule}_{it}^j + \beta_2 \text{Interest}_{it} + \partial \text{Controls}_{it} + \sigma_i + \mu_t + \varepsilon_{it}$$

with the indices i and t referring to cantons and years, respectively. The index k denotes the different fiscal outcome variables (debt, deficits, and public investment). Y_{it-1}^k represents the lagged dependent variable, it addresses persistency in fiscal policy. All specifications include the controls discussed above (net transfers, tax potential, unemployment rate, population, age structure, and fiscal policy preferences) plus cantonal (σ_i) and time (μ_t) fixed effects, so that comparisons are within canton-year cells. The controls net transfers and tax potential are considered as share of GDP; population is used on a log scale. As we expect the errors to be correlated within a canton, we cluster the standard errors at the cantonal level, as it is common practice (Burret and Feld, 2018b, Lüchinger and Schaltegger, 2013). This approach addresses hypotheses one to four.

Next, we include an interaction term between the SNB policy rate and the fiscal rule variable. This allows us to detect a possibly heterogeneous effect of decreasing interest rates, contingent upon the fiscal rule stringency. This specification addresses our fifth and sixth hypothesis.

The regression specification is determined by:

$$Y_{it}^k = \beta_0 Y_{it-1}^k + \beta_1 \text{Fiscal Rule}_{it}^j \times \text{Interest}_{it} + \partial \text{Controls}_{it} + \sigma_i + \mu_t + \varepsilon_{it}.$$

We group the cantons into four groups for this specification, based on their fiscal rule stringency. We hold these groups fixed, in order to address the potential reverse causality or simultaneity that could arise. Also, due to the restricted N in our sample (26 cantons), grouping the variables could improve the power of the regression.

4.2 Forecasted Treatment Effects

Given the exogenous and unexpected interest rate variation in January 2015 and the different fiscal rule designs, it is not far to seek for exploitation in a quasi-experimental design. However, a short review of the well-established alternatives reveals that this is not as straightforward as it may seem. We have no proper control group and no quasi-random treatment. All cantons are treated by the interest rate shock and all cantons except Appenzell Inner-Rhodes have some sort of fiscal rule established. Furthermore, the parallel trend assumption does not hold and we could not find a suitable instrumental variable. We considered all these alternatives carefully with no satisfying solution.

To address these challenges, we employ a novel econometric method proposed by Botosaru et al. (2023). They introduce forecasted counterfactuals for heterogeneous treatment effects that provide consistent and asymptotically normal *forecasted average treatment* (FAT) effects. This method substitutes the need for a control group by utilizing forecasted counterfactuals derived from pre-treatment observations. For the unbiased forecasts, the authors emphasize the importance of assuming the correct time series properties of pre-treatment outcomes, suggesting the use of a polynomial basis function in the presence of deterministic trends.

The estimator for the average treatment effect on the treated (ATT), denoted as the forecasted average treatment effect estimator, is defined as follows:

$$\widehat{FAT}_h := \frac{1}{n} \sum_{i=1}^n [y_{i\tau+h} - \hat{y}_{i\tau+h}(0)]$$

Where $\hat{y}_{i\tau+h}(0)$ represents the forecast for the individual counterfactual. The forecast is obtained through basis function regressions. The counterfactual forecast at period $\tau + h$ is defined as:

$$\hat{y}_{i\tau+h}^{(q_i, R_i)} := \sum_{k=0}^{q_i} \hat{c}_{ik}^{(q_i, R_i)} b_k(\tau + h)$$

Where R_i denotes the pre-treatment period that is used in the forecast, defined as $R_i \in \{q_i + 1, \dots, \tau\}$, q_i is the order of the polynomial, h is the post-treatment period, and k denotes the sequence number of basis function regressions, for the pre-treatment outcomes for example denoted $\{b_k(t)\}_{k=0}^{q_i}$. For each individual i , the forecast is estimated via individual-specific regressions of pre-treatment outcomes on the basis functions:

$$\hat{c}_i^{(q_i, R_i)} := \underset{c \in \mathbb{R}^{q_i+1}}{\operatorname{argmin}} \sum_{t \in T_i} (y_{it} - \sum_{k=0}^{q_i} c_k b_k(t))^2,$$

where $c_i = (c_{i0}, \dots, c_{iq_i})$ is a $q_i + 1$ vector of individual-specific coefficients.

Since the true order is unknown, we are faced with a bias-variance trade-off where a large polynomial degree ensures unbiasedness but increases variance at the same time. To visualize whether this problem applies to our case, we set the values of polynomial degree from 0 to $\tau - 1$, allowing for the largest estimation window possible, which is set to $R_i = q_i + 1$. We narrow our sample to the years 2010 to 2019 to minimize confounders introduced by the aftermath of the GFC from 2007 to 2009 and the COVID-19 pandemic. In our observation period, aside from the significant shock in 2015, only small changes in the SNB policy rate occurred. We set τ to 2019, allowing for a long post-treatment period.

There are some limitations to this identification strategy and issues we need to be aware of when interpreting the results: First, heterogeneity in the fiscal rule stringency index over time cannot be accommodated, as the method does still not allow for group changes.⁵ Second, although the interest rate remains stable for quite some time before and after the 2015 interest rate shock (Figure A-1 in the Appendix), the pre-treatment period has a negative interest rate already. Thus, the interest rate shock 2015 is not a conventional reduction in costs of capital.

5. Results

5.1 Dynamic Model with Bias-Corrected Least Square Dummy Variable Estimator

We first investigate both explanatory variables, *interest rates* and *fiscal rules*, individually in the dynamic model (Table 3 and 4), estimated with bias-corrected least square dummy variables and the set of controls introduced in Sections 3 and 4 in order to begin with an individual test for every corresponding null hypothesis of our hypotheses H_1 to H_4 . Thereafter, we consider both variables of interest simultaneously in the same estimation in Table 5. In all baseline estimations the dependent variables and the respective coefficients are considered in 1,000 CHF per capita (debt is considered as log debt per capita). For the observation period 1990 to 2019 the average population in a canton is almost 300.000 people.

⁵ There are fiscal rule changes in 15 out of 26 cantons during our observation period (2009 to 2019). However, only five cantons change groups by more than one step and cross the median.

	(1) Debt	(2) Deficit	(3) Exp.	(4) Investment Exp.	(5) Debt	(6) Deficit	(7) Exp.	(8) Investment Exp.	(9) Debt	(10) Deficit	(11) Exp.	(12) Investment Exp.
fiscal rule (continuous)	-0.0221*** (0.00814)	-0.00605 (0.0338)	-0.0795** (0.0391)	-0.000593 (0.0161)								
fiscal rule (median split)					-0.0644*** (0.0136)	-0.0233 (0.0574)	-0.0662 (0.0650)	0.00528 (0.0258)				
low rule stringency									-0.0923*** (0.0239)	-0.0271 (0.0959)	0.0294 (0.109)	-0.00134 (0.0508)
medium rule stringency									-0.0490** (0.0218)	-0.0252 (0.0897)	-0.0855 (0.100)	0.0143 (0.0441)
strong rule stringency									-0.0681*** (0.0262)	0.000323 (0.109)	-0.349*** (0.131)	-0.0270 (0.0526)
lagged dependent variable	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	806	806	806	806	806	806	806	806	806	806	806	806
Number of Cantons	26	26	26	26	26	26	26	26	26	26	26	26
Joint Significance Chi2-test Prob > chi2	7.363 0.00666	0.0320 0.858	4.144 0.0418	0.00136 0.971	22.37 2.25e-06	0.165 0.685	1.039 0.308	0.0417 0.838	28.13 3.41e-06	0.248 0.970	7.725 0.0520	0.523 0.914
<i>Robust standard errors in parentheses</i>												
<i>*** p<0.01, ** p<0.05, * p<0.1</i>												

Table 3: Effect of fiscal rules on fiscal parameters, dynamic model, estimated with a bias-corrected LSDV estimator, fiscal variable per capita.

We find a highly significant and consistently negative effect of fiscal rule stringency on cantonal debt (Table 3). Cantons with strict constraints have lower debt per capita compared to those with less strict rules. The joint significance test indicates significance at the 1% level across various fiscal rule variable specifications.⁶ Fiscal rules have no statistically significant effect on cantonal deficits. However, when we disentangle the accounting identity of deficits, we find a negative effect of fiscal rules on cantonal expenditures. The effect is only statistically significantly different from zero for the continuous index variable but not for the median split. A more detailed analysis with the factor variable reveals that the effect is primarily driven by cantons with the strictest fiscal rules (jointly significant at the 5%-level). We cannot confirm this effect for the investment expenditure variable. Fiscal rules have no statistically significant effect on investment spending in any specification.

With these results we arrive at the following results:

- R_1 : *More stringent fiscal rules reduce public debt.*
- R_2 : *More stringent fiscal rules do not lower public deficits.*
- R_3 : *More stringent fiscal rules do not lead to lower public investment.*

Next, we proceed with an isolated investigation of interest rates. Interest rate variation correlates positively with cantonal debt and negatively with public expenditure. Decreasing interest rates come with lower levels of debt and more public expenditure (Table 4).

	(1) Debt	(2) Deficit	(3) Exp.	(4) Invest. Exp.	(5) Financial Deficit	(6) Operational Deficit	(7) Capital Deficit	(8) Unusual Deficit
SNB interest rate	0.0260*** (0.00949)	0.0387 (0.0407)	-0.174*** (0.0544)	0.0144 (0.0199)	0.0170 (0.0433)	-0.061*** (0.0216)	0.0507*** (0.0116)	0.0631* (0.0356)
lagged dependent variable	yes	yes	yes	yes	yes	yes	yes	no
controls	yes	yes	yes	yes	yes	yes	yes	yes
Observations	806	806	806	806	806	806	806	806
Number of Cantons	26	26	26	26	26	26	26	26

Robust standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 4: Effect of interest rate variation on fiscal parameters, dynamic model, estimated with a bias-corrected LSDV estimator, fiscal variable per capita.

⁶ We report the results for the fiscal rule index variable in three distinct ways. We consider the index as continuous variable, factor variable and as a dummy variable which equals 1 if rule stringency is above the median index value and 0 otherwise. Interaction terms between interest rates and fiscal rule stringency are only feasible with the index factor variable and median split.

We do not observe any significant effects of interest rate variation on cantonal deficits. When we disaggregate the deficit variable, we have opposing effects on different types of deficits: a significant negative effect on *operational deficits*, but a positive effect on *capital deficits*. Capital deficits mostly contain interest expenditures but also revenues which are related to a canton's corporate shares, real estate, and provided loans. In addition to interest rate payments, the expenditure side contains various expenses for capital assets. Both sides of the accounting identity are corrected for value adjustments. The results are significant at a 1% level and the dynamic effect of the respective dependent variable is confirmed as well.

One plausible way to look at this phenomenon is that rising interest rates result in increasing interest rate expenses, driving up capital deficits. To refinance this change, expenses need to be cut back in other parts of the budget, leading to a decreasing effect on operational deficits. Overall, both effects cancel each other out which is why we cannot find an effect on overall deficits. This interpretation could also explain the rather counter-intuitive results of a negative impact of the interest rate on total cantonal expenditure. Even though it is premature to draw any conclusions, the strong constraining effect of fiscal rules on public debt suggests that this substitution effect is driven by fiscal rules.

The effect of interest rates on cantonal debt is statistically significantly different from zero. However, the coefficient sign contradicts what H₃ states. Contrary to theoretical expectations, decreasing interest rates have a decreasing effect on public debt, not an increasing effect. The statement that the public sector should increase its debt when interest rates are decreasing cannot be observed in this first assessment. While we cannot reject the null hypothesis that interest rates would affect public deficits, we find a statistically significant effect for public expenditure that points in the direction proposed by our hypotheses. We, however, cannot replicate this effect for investment expenditure. This leads to the following results:

- *R₄: Decreasing interest rates do not lead to increasing public debt (but to decreasing public debt).*
- *R₅: Decreasing interest rates do not lead to increasing deficits.*
- *R₆: Decreasing interest rates do not lead to increasing public investment.*

The results for both explanatory variables remain valid when we consider both variables in one estimation (Table 5 and 6). The only exception is that the interest rate coefficient is no longer significantly different from zero when we estimate debt with a factor fiscal rule variable, but this is the only relevant difference. Interestingly, fiscal rules have virtually no significant effect on any deficit variable, even when we isolate different deficit types (Table 6).

	(1) Debt	(2) Deficit	(3) Exp.	(4) Investment Exp.	(5) Debt	(6) Deficit	(7) Exp.	(8) Investment Exp.	(9) Debt	(10) Deficit	(11) Exp.	(12) Investment Exp.
SNB interest rate	0.0190** (0.00964)	0.00301 (0.0414)	-0.238*** (0.0555)	-0.00326 (0.0195)	0.0170* (0.00923)	0.00204 (0.0398)	-0.223*** (0.0531)	-0.00266 (0.0189)	0.0150 (0.00935)	0.00293 (0.0411)	-0.239*** (0.0553)	-0.00475 (0.0194)
fiscal rule (continuous)	-0.0221*** (0.00814)	-0.00605 (0.0338)	-0.0795** (0.0391)	-0.000593 (0.0161)								
fiscal rule (median split)					-0.0644*** (0.0136)	-0.0233 (0.0574)	-0.0662 (0.0650)	0.00528 (0.0258)				
low rule stringency									-0.0923*** (0.0239)	-0.0271 (0.0959)	0.0294 (0.109)	-0.00134 (0.0508)
medium rule stringency									-0.0490** (0.0218)	-0.0252 (0.0897)	-0.0855 (0.100)	0.0143 (0.0441)
strong rule stringency									-0.0681*** (0.0262)	0.000323 (0.109)	-0.349*** (0.131)	-0.0270 (0.0526)
lagged dependent variable	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	806	806	806	806	806	806	806	806	806	806	806	806
Number of Cantons	26	26	26	26	26	26	26	26	26	26	26	26
Joint Significance Chi2-test Prob > chi2	7.363 0.00666	0.0320 0.858	4.144 0.0418	0.00136 0.971					28.13 3.41e-06	0.248 0.970	7.725 0.0520	0.523 0.914
<i>Robust standard errors in parentheses</i> *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$												

Table 5: Effect of interest rate variation and fiscal rules on fiscal parameters, dynamic model, estimated with a bias-corrected LSDV estimator, fiscal variable per capita.

	(1) Financial Deficit	(2) Operational Deficit	(3) Capital Deficit	(4) Unusual Deficit	(5) Financial Deficit	(6) Operational Deficit	(7) Capital Deficit	(8) Unusual Deficit	(9) Financial Deficit	(10) Operational Deficit	(11) Capital Deficit	(12) Unusual Deficit
SNB interest rate	-0.0343 (0.0437)	-0.0647*** (0.0212)	0.0555*** (0.0123)	0.0239 (0.0364)	-0.0360 (0.0421)	-0.0662*** (0.0204)	0.0549*** (0.0118)	0.0264 (0.0351)	-0.0347 (0.0434)	-0.0678*** (0.0210)	0.0556*** (0.0122)	0.0286 (0.0361)
fiscal rule (continuous)	-0.0237 (0.0356)	-0.0245 (0.0176)	-0.000791 (0.00978)	0.0264 (0.0291)								
fiscal rule (median split)					-0.0656 (0.0604)	-0.0635** (0.0301)	-0.00750 (0.0165)	0.0794 (0.0492)				
low rule stringency									-0.0659 (0.102)	-0.0799 (0.0524)	-0.0101 (0.0280)	0.116 (0.0823)
medium rule stringency									-0.0698 (0.0945)	-0.0529 (0.0473)	-0.00884 (0.0261)	0.0585 (0.0771)
strong rule stringency									-0.0406 (0.115)	-0.0738 (0.0564)	0.00860 (0.0315)	0.0791 (0.0942)
lagged dependent variable	yes	yes	yes	no	yes	yes	yes	no	yes	yes	yes	no
controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	806	806	806	806	806	806	806	806	806	806	806	806
Number of Cantons	26	26	26	26	26	26	26	26	26	26	26	26
Joint Significance Chi2-test Prob > chi2	0.445 0.505	1.944 0.163	0.00654 0.936	0.823 0.364					1.307 0.728	5.156 0.161	0.602 0.896	3.430 0.330
<i>Robust standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$</i>												

Table 6: Effect of interest rate variation and fiscal rules on different types of deficits, dynamic model, estimated with a bias-corrected LSDV estimator, fiscal variable per capita.

Finally, we investigate the conjoint effects of interest rates and fiscal rule stringency. To do this in a dynamic model framework, we need to incorporate interaction terms between interest rate and fiscal rule stringency. With the bias-corrected time and canton fixed effects the results conform to generalized difference-in-differences results. The interaction terms, however, provide no new information. The results remain stable for the independent variables reported in Table 5 but there are hardly any significant findings for the additional interaction terms. The non-findings are reported in Table A-1 in the Appendix.

Given these results, and the lack of a profound analysis of the low interest rate period and the functionality of fiscal rules in this environment, we specifically address these issues with the following FAT identification strategy.

5.2 Forecasted Treatment Effects

The implementation of the FAT method offers a nuanced understanding of the impact of the negative interest rate shock on cantonal fiscal parameters across varying levels of fiscal rule stringency. By categorizing cantons into distinct groups based on the constraining power of fiscal rules, we can discern differential effects on various fiscal parameters. The results are depicted in Table 7 and Figure 6. In contrast to the two-way fixed effects (TWFE) approach that primarily focuses on controlling for time-invariant unobserved heterogeneity, FAT delves into the heterogeneity of treatment effects, providing insights as to how cantons respond differently to interest rate shocks contingent on their fiscal policy framework. With this approach, FAT is much better suited to address hypotheses five and six than the previously used dynamic model estimated with year and canton fixed effects. Note that the coefficients in Table 7 need to be interpreted as deviations from forecasted observations (similar to the interpretation of difference-in-differences results). They are *not* regression coefficients describing the effect of changes in the independent variables of interest (in our case a negative interest rate shock).

Our estimates are consistent across different polynomial orders. The confidence intervals for the FAT decrease with increasing degree of the polynomial which might seem counterintuitive at first. Normally, higher-degree polynomials can overfit the data, leading to lower bias but higher variance. In context of our results, the model is still within a range where the reduction in bias does not yet lead to problematic increases in variance, or the increase in variance is counterbalanced by increased model fit, resulting in more precise estimates. As shown in Figure

5, the number of polynomials with the smallest confidence intervals varies for different outcome variables. In the following, we report the results for $q_i = 3$.

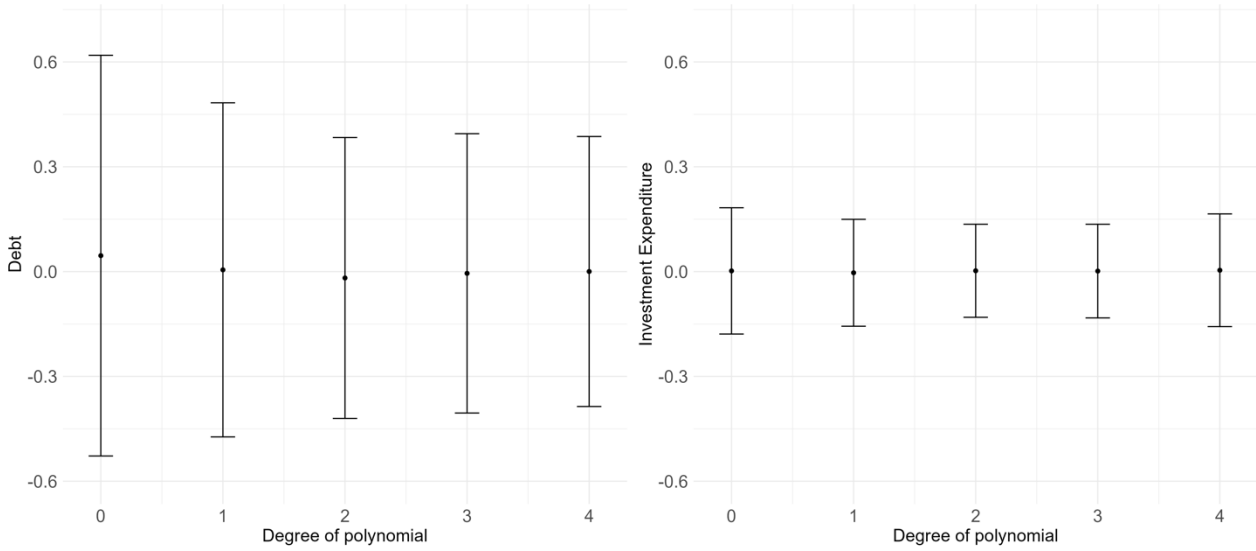


Figure 5: FAT with variable number of pre-treatment time periods for Debt and Investment Expenditure. The dots show the FAT estimates with the intervals representing the 95% confidence interval around them.

To evaluate the overall impact of the unexpected interest rate cut, we examine the average effect over the post-treatment period. Following the unexpected interest rate shock, we primarily observe negative coefficients for the fiscal parameters *debt*, *expenditure*, and *investment expenditure* (the actual observations are lower than the forecast).

Identical to the TWFE results above, all dependent variables are nominated in 1,000 CHF per capita, revealing moderate to small economic effects. The interest rate cut causes an additional debt reduction and cantonal expenditures are further reduced in all rule stringency groups, except for cantons with very loose fiscal rules (Table 7). This reduction could be attributed to lower interest rate expenditures. Expenditures in cantons with the strictest fiscal rules decrease in total by an average of 1.3 million CHF. Investment expenditures are also lower than forecasted but the economic effect is negligible. An 84.38 basis points interest rate drop causes 218 CHF lower investment expenditures for the total cantonal budget in cantons with the strictest fiscal rules.

The coefficients' negative trajectory for cantonal *expenditure* and consequently (*financial*) *deficits* suggests that the interest rate drop has an expenditure (deficit)-enhancing effect on cantons with loose fiscal rules but a dampening effect for cantons with stricter fiscal rules. These trajectories suggest that cantons react differently to a negative interest rate shock, depending on the fiscal rule's constitution. However, we cannot find any trend for investment expenditures in this regard (see Figure A-3 in the Appendix). The trajectory is not distinct enough for any interpretation.

Index	qi	Debt	Deficit	Expenditure	Investment Expenditure
0	3	-0.00595 (0.04316)	0.03532 (0.08342)	0.02659 (0.07827)	-0.00190 (0.02009)
1	3	-0.00229 (0.06347)	0.04224 (0.05296)	-0.00099 (0.03184)	-0.01221 (0.02169)
2	3	-0.01030 (0.04065)	0.000284 (0.02483)	-0.01745 (0.02071)	0.01190 (0.01773)
3	3	-0.00139 (0.06603)	-0.04545 (0.05949)	-0.06070 (0.05785)	-0.000005 (0.03808)

Table 7: FAT for cantons grouped by index value with corresponding standard errors for the polynomial-regression FAT of degree 3 (selected results)

Note that the standard errors reported in Table 7 in parentheses, while providing valuable information about the variability of our estimates, should be interpreted cautiously. The challenge of limited observations, particularly in the post-treatment period, undermines the reliability of methods like standard errors and p-values, given the minimal variability in the data. Moreover, the complexity of the FAT model and its focus on estimating treatment effects rather than testing individual parameters further complicates interpretation. To address these challenges, we adopt robustness checks, exploring variations in polynomial order and observation periods to validate our findings across diverse assumptions and data scenarios.

Figure 6 visualizes selected results from Table 7.⁷ It presents the dynamic forecasted average treatment effects for all cantons, grouped by their rule stringency for the selected variables, *expenditure* and *deficits*. The dashed lines represent the trajectory of the expected deficit and expenditure outcome in absence of the external shock. Groups with the lowest and second-lowest fiscal rule stringency show a smaller surplus (deficit with negative sign) than anticipated absent the interest rate shock. This is remarkable since the interest rate drop should theoretically increase surpluses. Conversely, the group with most stringent fiscal rules displays a larger decrease in deficits compared to what would have occurred without the external shock. Regarding *expenditure*, a mirrored pattern emerges, particularly noticeable in the highest and lowest index groups immediately after the treatment: cantons with very loose fiscal rules expand their public expenditure more than expected and cantons with very strict fiscal rules have sharper expenditure decreases than forecasted (see also Figure A-2 in the Appendix).

⁷ All FAT results are visualized in Figure A-2 and A-3 in the Appendix.

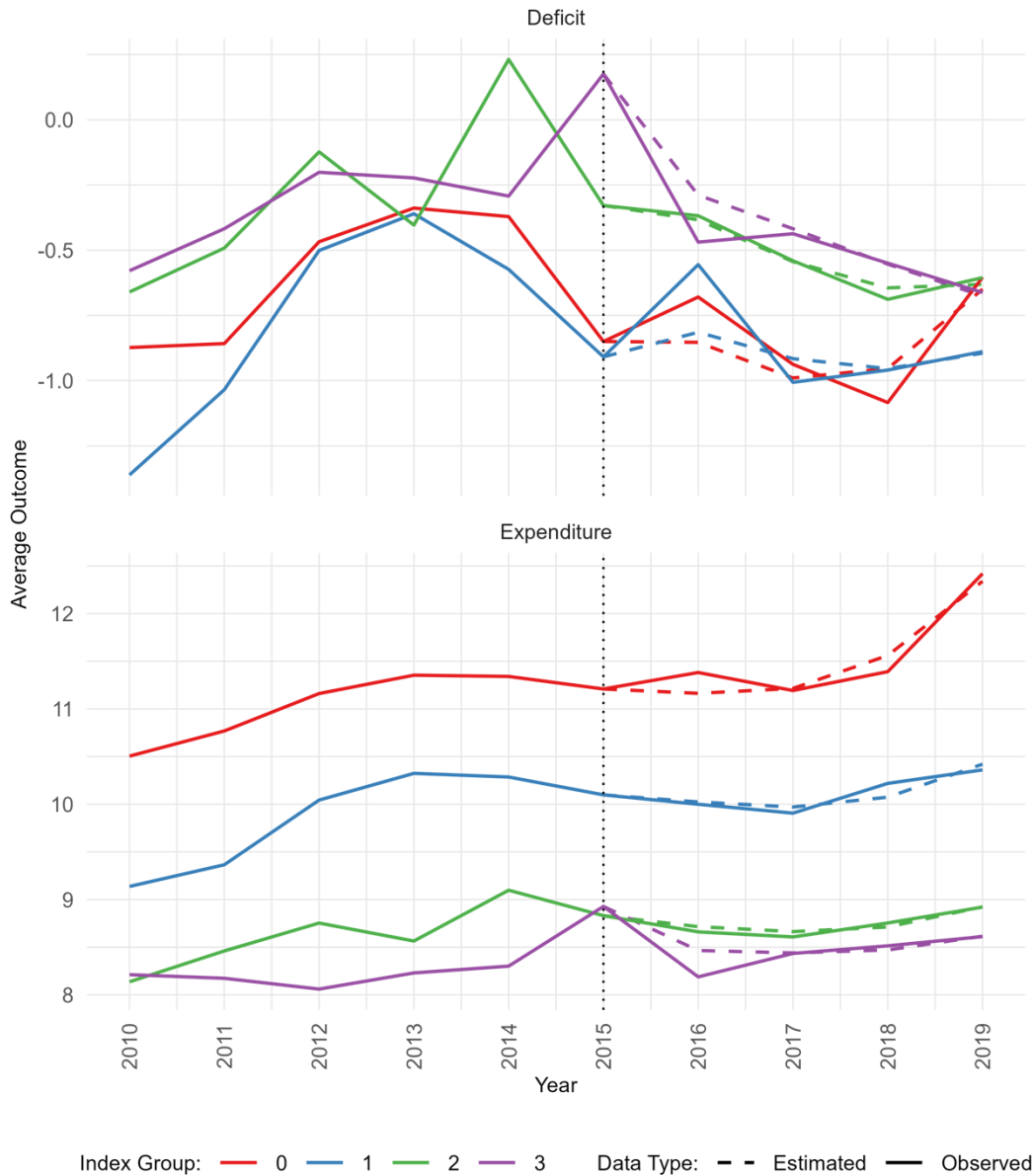


Figure 6: FAT for deficits (upper graph) and expenditure (lower graph) for cantons grouped by index value. The vertical dotted line represents the unexpected interest rate shock on 15th January 2015. The four colored lines represent four groups of cantons, sorted according to their rule stringency at the beginning of the observation period with red (0) averaging observations for cantons with the least stringent fiscal rules, blue (1) and green (2) medium strict fiscal rules and purple (3) averaging observations for cantons with the most stringent fiscal rules. The colored dashed lines visualize forecasts, solid lines depict actual observations.

The consistently positive coefficients for *operational deficits* and negative coefficients for *capital deficits* (Table 7 cont.) support our substitution theory from the dynamic model results. We argued above that the results in Table 4 reveal a substitution of decreasing *capital deficits* with increasing *operational deficits* (and vice versa). After the interest rate shock in January 2015, capital deficits are lower than forecasted, while operational deficits are higher than expected. The effect on operational deficits seems stronger for cantons with strict fiscal rules but fiscal rules do not

systematically affect the trajectory of capital deficits. The negative effect on capital deficits, except for the group with the least strict fiscal rules, underscores the assumption that cantons with lax fiscal rules may adopt a more lenient stance, allowing for greater capital expenditure.

Index	qi	Financial Deficit	Operational Deficit	Capital Deficit	Unusual Deficit
0	3	0.028835 (0.08725)	0.004007 (0.04259)	0.003871 (0.01048)	0.026062 (0.08590)
1	3	0.049232 (0.09628)	0.017586 (0.02294)	-0.00135 (0.00552)	0.025903 (0.03831)
2	3	0.007152 (0.03248)	0.01511 (0.01509)	-0.00075 (0.00558)	-0.01408 (0.02203)
3	3	-0.04745 (0.05756)	0.026596 (0.01862)	-0.00701 (0.00998)	-0.06503 (0.05641)

Table 7 (cont.): FAT for cantons grouped by index value with corresponding standard errors for the polynomial-regression FAT of degree 3 (selected results)

6. Robustness Checks and Discussion

Swiss cantons are characterized by very sound fiscal conditions. This introduces challenges as to our two variables of interest. First, the fiscal soundness of the cantons raises the question of whether they are genuinely constrained by fiscal rules. Fiscal conditions could be so strong that cantons never approach legally binding limits, and cantonal politics are effectively not constrained. A similar argument arises for interest rates. If the level of debt is very low, debt financing costs may not impact cantonal policies. The reputation of fiscal prudence could allow cantons a privileged treatment as creditors or, in other situations, cantons may function as safe havens.

We propose two alternatives to address the issue of (too) sound fiscal conditions. First, we substitute the variable *interest rate* with *real interest rate costs* derived in Section 3. This variable does not take the same interest rate for all cantons but rather considers canton-specific levels of debt and therefore addresses the varying importance of interest rate changes between cantons. We substitute the central bank interest rate with our own proxy for canton-specific costs of debt: $(debt/population) \cdot interest\ rate$. We can only use this explanatory variable to analyze *deficits* and *expenditure* variables because *debt* estimations would suffer from an endogeneity problem.

With this substitution we address another concern at the same time which arises from using one national interest rate for all 26 cantons in the baseline specification of the dynamic model. Using one observation for all 26 units means that changes in the interest rate should be fully captured by time fixed effects, leading to an omitted interest rate variable. However, to display a coefficient

for the interest rate variable in the baseline results, we omit time fixed effects for one year instead. The issue is less critical for the costs of debt variable because it has between-unit variation.

The second alternative to account for sound fiscal conditions properly is a more pronounced consideration of debt sustainability, usually assessed by considering fiscal variables as share of GDP. Because employing GDP ratios is a common practice in the related literature, we include this robustness check in our analysis as well. We recalibrate our model by expressing all fiscal variables as share of GDP. We therefore divide all fiscal variables by the cantonal GDP approximation we derived in Section 3.

However, we need to treat this robustness check with caution because fiscal variables expressed as ratio to GDP raise two major methodological concerns. First, control variables measured as share of GDP introduce multicollinearity, possibly inflating the variance of coefficient estimates, leading to potentially misleading statistical significance levels. Second, the interest rate as explanatory variable is inherently related to macroeconomic conditions, which increases the risk of endogeneity.

Following these two robustness checks to gain a better understanding of the consequences of sound fiscal conditions, we apply two more robustness checks to challenge our results. Since our contribution focuses particularly on the investigation of how fiscal rules and low interest rates affect public investment, we want to further test the respective results in a third robustness check.

Given the theoretical possibility that cantons may relabel public consumption as investment expenditure (Burret and Feld, 2018b) and due to the different characteristics of public investment, we want to ensure that our respective results hold true when using alternative investment variables. We therefore substitute the dependent variable *investment expenditure* with the two alternatives of annual asset variation from Section 3: annual change in *administrative property* and *capital assets*.

Finally, we apply two different robustness checks on the novel FAT approach. We explore the effects of using different polynomial orders and we conduct a placebo estimation using an alternative observation period without any exogenous variation.

In Section 5.2, we demonstrated that the optimal value of q_i , which results in the smallest interval size, varies across different dependent variables. By examining the impact of varying polynomial orders, we aim at verifying the stability of our results across different model specifications. Additionally, conducting a placebo estimation involves assessing our model's performance within an observation period devoid of any significant external shocks, such as a negative interest rate

shock. This exercise ensures the robustness of our methodology by confirming that our model's predictions align with observable outcomes when no shock is present.

6.1 Robustness Checks

Substituting interest rate with real interest rate costs

The results do not change when we substitute the SNB interest rate with canton specific real interest rate costs. All significant findings from the baseline estimation reported in Table 5 can be replicated and no new significant effects emerge (Table A-2 in the Appendix, all result tables for robustness checks are provided in the Appendix)⁸.

Table 8 reports the estimation results for real interest rate costs without considering fiscal rules in the same estimation. All results remain robust, and the substitution effect between operational and capital deficits is still significant. The interaction term between real interest rate costs and fiscal rules (median split) is statistically significantly negative for deficits (given more stringent fiscal rules, increasing real interest rate costs come with lower deficits). However, this is a singular observation. Real interest rate costs do not consistently provide significant results for interaction terms.

	Deficit	Exp.	Investment expenditure	Financial Deficit	Operational Deficit	Capital Deficit	Unusual Deficit
real interest rate costs	0.00108 (0.00259)	-0.00793*** (0.00239)	0.000416 (0.00136)	-0.00163 (0.00267)	-0.00265* (0.00137)	0.00410*** (0.000837)	-0.00325 (0.00214)
lagged dependent variable	yes	yes	yes	yes	yes	yes	no
controls	yes	yes	yes	yes	yes	yes	yes
Observations	806	806	806	806	806	806	806
Number of Cantons	26	26	26	26	26	26	26

Robust standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 8: Effect of real interest rate cost variation on fiscal parameters, dynamic model, estimated with a bias-corrected LSDV estimator, fiscal variable per capita (Robustness Check)

⁸ Note that Table A-2 only provides estimation results for deficits, expenditure, and investment expenditure but not for debt. This is because debt is incorporated in the real interest rate costs variable and estimation results for debt could be biased due to endogeneity.

Estimation with fiscal variables as share of GDP

When we estimate the dynamic model with fiscal variables as share of GDP, the results are mostly aligned with those from the baseline estimations (Table A-3). Fiscal rules still have a consistent and statistically significant negative effect on cantonal debt but basically no consistent effect on other variables. There is a notable increase in significant findings for the effect of interest rates on various fiscal variables (an interesting exception is capital deficits which are no longer significant).

Unlike in the baseline results, there is now a significant negative effect of interest rate variation on investment expenditure and a significant positive effect on all deficit variables except for capital deficits and unusual deficits (Table A-4). These results are somewhat counterintuitive as the direct channel between interest rate variation and the public budget would typically be via capital expenditures affecting capital deficits. For all other types of deficits (where we actually find a significant positive relationship), the channel is less clear. One possible explanation could be a poor cantonal GDP approximation (described in Section 3) or an insufficient model fit. The latter is suggested by the finding of a significant positive effect of very strict fiscal rules on deficits, despite the lagged dependent variable not being significant at the same time. Finally, when we estimate fiscal variables as share of GDP, we find a weakly significant negative effect of the most constraining fiscal rules on investment expenditure.

Alternative measures for public investment

Alternative measures for cantonal investment policy are not affected differently by fiscal rules or interest rate variation compared to the dependent variables we used so far. Both explanatory variables have no significant effects on changes in administrative property or capital assets (Table A-5). These non-findings support our baseline conclusions that public investment is not systematically affected by fiscal rules or interest rate fluctuation.

When we estimate our dynamic model with fiscal variables as share of GDP, we find a negative effect of fiscal rules on changes in administrative property and capital assets as well as on investment expenditure. Only the coefficient for the most stringent fiscal rules is statistically significantly different from zero, and only at the 10% significance level.

In contrast to the SNB interest rate, real interest rate costs also have a statistically significant positive effect on changes in both administrative property and capital assets. This suggests that decreasing real interest rate costs come with negative changes in both asset types. However, the lagged dependent variable is insignificant indicating a bad fit for this specification. Furthermore, all fiscal rule coefficients remain robust regarding the results in Table A-5 when we consider

interaction terms between real interest rate costs and fiscal rules (all insignificant) for both types of assets. We therefore do not report these results as they have minor relevance for this paper.

Variation in polynomial orders and forecast windows

In order to assess the robustness of our findings, we conduct a sensitivity analysis by varying the polynomial orders and forecast windows. Specifically, we examine the results for $q_i=2$, as shown in Table 9.

Index	qi	Debt	Deficit	Expenditure	Investment Expenditure
0	2	-0.04461 (0.05812)	-0.04266 (0.12190)	0.00351 (0.02438)	-0.01187 (0.12868)
1	2	0.009436 (0.07284)	-0.04411 (0.05416)	0.032756 (0.04736)	0.025175 (0.05855)
2	2	-0.00886 (0.05099)	-0.04948 (0.03170)	0.001719 (0.02215)	-0.02604 (0.04196)
3	2	0.069224 (0.06840)	-0.08885 (0.07914)	-0.01082 (0.04337)	-0.05569 (0.08198)

Table 9: FAT for cantons grouped by index value with corresponding standard errors for the polynomial-regression FAT of degree 2 (selected results)

Index	qi	Financial Deficit	Operational Deficit	Capital Deficit	Unusual Deficit
0	2	-0.01301 (0.13107)	-0.00316 (0.04906)	0.008004 (0.01149)	-0.01838 (0.12587)
1	2	0.075595 (0.09347)	0.012851 (0.02482)	-0.00027 (0.00662)	0.012504 (0.04300)
2	2	-0.02692 (0.04135)	0.010138 (0.02329)	-0.00022 (0.00655)	-0.03618 (0.03565)
3	2	-0.05429 (0.08319)	0.036188 (0.02347)	-0.00498 (0.01030)	-0.0869 (0.07888)

Table 9 (cont.): FAT for cantons grouped by index value with corresponding standard errors for the polynomial-regression FAT of degree 2 (selected results)

We find that the observed effects remain largely consistent with our previously reported results. One noteworthy difference is the consistently negative effect on deficits across all index values. However, this divergence from the baseline results does not necessarily imply a lack of robustness in our model specifications. For one, the result is in line with the theoretical expectation, suggesting that it may reflect underlying economic realities. Additionally, given the increased fit of the model with increasing polynomial, the results of a high-order polynomial may be considered more conservative.

Additionally, we conducted a placebo test to further test the robustness of our model. For this test, we selected the time period from 2000 to 2007, with 2004 as the designated treatment timing. Conducting a placebo test presents challenges, particularly in identifying a period devoid of external shocks. We select this period due to relatively minimal changes in cantonal fiscal rules and macroeconomic conditions.

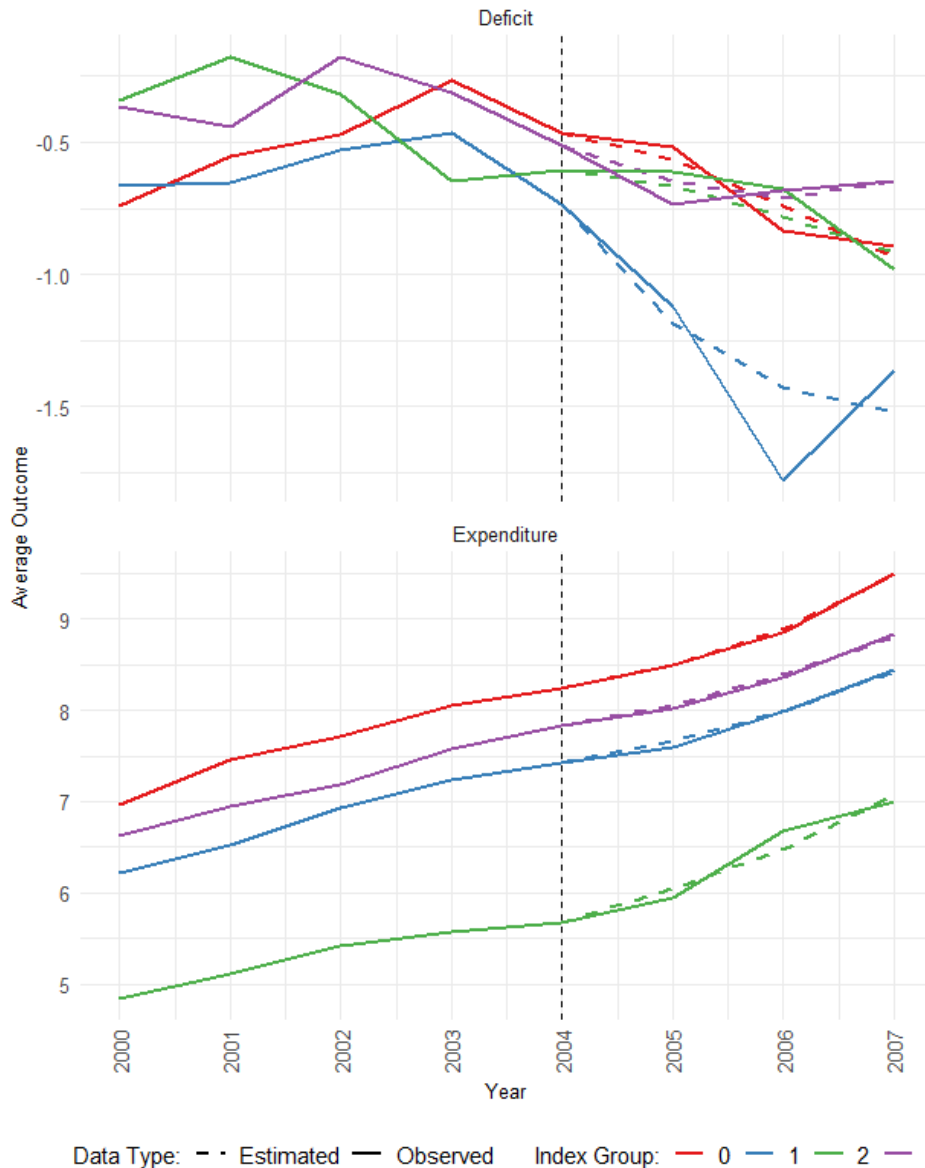


Figure 7.: Placebo treatment period 2000-2007, with 2004 as year of treatment, and $q_i=3$. FAT for cantons grouped by index value.

Figure 7 illustrates the results of the placebo test, showing minimal impact on expenditure and a non-systematic effect on deficits following the treatment year of 2004. Importantly, there is no discernible trend contingent on the strength of the fiscal rule, validating our baseline results that the treatment year of 2015 exhibits a systematically different impact on fiscal parameters.

6.2 Discussion

While our results are mostly consistent and robust over multiple identification strategies and varying specifications, we need to discuss two potential caveats which are quite common for empirical literature in this field: first, an insufficient amount of variation in the considered variables, and second, econometric limitations regarding causal inference.

Recent studies, such as Mummolo and Peterson (2018), have highlighted variance reduction that is associated with employing fixed effects. Several outcome variables either suffer from similar variance problems or follow a monotonous trend further complicating the analysis. Limited variation in the data might be amplified by losing small variations in highly aggregated data. This is particularly relevant for the fiscal rule index where different elements of the rule design are expressed in one number, and minor adaptations can offset each other.

The same holds true for our dependent variables. They are aggregates with multiple specific accounts summarized within them, and changes in rules or interest rates could adversely affect these accounts. An estimation of deficits basically estimates the accounting identity between expenditure and revenue. To gain a better understanding of potential effects on deficits or to carve out correlations that might be obscured in net values, an additional analysis on cantonal revenue might be beneficial. The *debt* variable displays the sum over various accounts that also contain very different fiscal procedures. The relationship between short-term and long-term debt may especially explain some unidentified effects since the aggregated view disguises debt restructuring operations in the low interest rate period. Future research may benefit from disentangling these aggregated variables. This is potentially promising for both, a more detailed look into the composition of fiscal parameters and the construction of fiscal rules.

TWFE remains widely used in the literature despite significant theoretical criticisms, primarily because these estimators typically require the strict exogeneity assumption (Imai and Kim, 2019, 2021, Imai et al. 2023).⁹ This assumption is often unrealistic in real-world settings. Another important assumption is that past treatments do not influence current outcomes and past outcomes do not affect current treatment (often violated in practice). This is likely the case in our study.

Another disadvantage of TWFE is that it only considers within-unit variation, thus time-invariant variables cannot be included in the model. There are some approaches that modify the TWFE to allow for taking this variation into account. Most prominent are *mixed effects models*. An approach

⁹ Imai and Kim (2019, 2021) show that for the TWFE model to be able to adjust for the two types of unobserved confounders (time- and unit-specific) it relies on the assumption of linear additive effects.

in line with this idea is the *fixed effect vector decomposition* proposed by Plümper and Troeger (2007, 2011) allowing for time-invariant or rarely changing variables. However, this method is quite convincingly heavily criticized by Greene (2011) and Breusch et al. (2011). A more commonly used method to include both between and within variation is the so-called *hybrid method*, which embeds a fixed effects estimator within the framework of a random effects (mixed) model (Allison, 2009 and Schunck and Perales, 2017). This model has a poor fit to our data.

We also explored an alternative approach by estimating a model in first differences, thereby moving away from the dynamic model with TWFE altogether. If the strict exogeneity assumption holds, whether we use the FE estimator, or first differencing depends on the idiosyncratic errors. The FE estimator is more efficient with serially uncorrelated errors, while first differences are preferable if the errors follow a random walk. Under conditions of only contemporaneous exogeneity, FE estimation is to be favored (Wooldridge, 2010). Given the less restrictive assumptions of FE, we opted for this approach.

Following similar research designs in the literature, we explored a *Generalized Method of Moments* (GMM) design, following the recommendations by Roodman (2009), Kiviet (2020), and Breitung et al. (2022). However, GMM is susceptible to misspecifications and the quality of the instruments, especially with smaller sample sizes, which may affect the validity of the results. Due to the procedure of selecting GMM restrictions, which is often described as arbitrary, we were not persuaded by the methodology and decided against further pursuing this approach.

7. Conclusion

This paper contributes to the empirical literature on fiscal rules' functionality in three ways. First, we introduce the forecasted average treatment effect as proposed by Botosaru et al. (2023) to the fiscal rule literature. This allows us to exploit an exogenous variation in absence of a control group by estimating a forecasted control group. Second, the empirical literature on the effects of fiscal rules so far lacked a distinct analysis of the exceptionally low interest rate period in the last decade. We aim at closing this gap by specifically analyzing conjoint effects of fiscal rule stringency and decreasing interest rates. Third, we contribute new insights to the inconclusive debate on the effect of fiscal rules on public investment. This debate is not exclusive for the low interest rate period, but it has been discussed particularly fiercely during this time and it is probably going to last given multiple structural changes in industrialized countries.

Our hypotheses are based on well-established theoretical arguments for implementing fiscal rules and they furthermore target the theoretical concerns that fiscal rules may have a negative impact on public investment. The existing empirical investigations on fiscal rules and public debt and deficits do not only suggest a constraining effect on fiscal rules but also a marginal effect depending on rule design and stringency. Empirical evidence on a negative effect of fiscal rules on public investment has been mixed so far. The theoretical arguments for higher public debt in a low interest rate period further increase the relevance of the questions targeted in this paper.

Our dataset covers all 26 cantons and up to 30 years of observation. Most data come from Swiss administrative databases and are provided annually. We begin with a dynamic generalized difference-in-differences approach with a bias-corrected least square dummy variable estimator in order to avoid distortions due to the Nickell bias. We find a consistent and robust constraining effect of fiscal rules on cantonal debt but no significant effect on public deficits. We furthermore find a constraining effect on cantonal expenditure but only for cantons with the most stringent fiscal rules. Notably, this effect does not extend to investment expenditure in any specification.

Lower interest rates affect cantonal debt positively and expenditure negatively (decreasing interest rates come with increasing expenditures). Lower interest rates have no significant effect on deficit. Disaggregating deficits, we uncover a positive effect on capital deficits and a negative effect on operational deficits, suggesting a substitution effect. The pronounced constraining effect of fiscal rules on cantonal debt suggests that this substitution is driven by fiscal rules.

To further investigate the conjoint impact of rule stringency and decreasing interest rates, we employ the FAT method. The FAT method focuses the low interest rate period and analyzes a possibly heterogeneous impact of a negative interest rate shock on the fiscal parameters conditional on fiscal rule stringency. This approach eliminates the need for a control group by using forecasted counterfactuals derived from pre-treatment observations. Following the negative interest rate shock on 15th January 2015 (determination of the Swiss Franc Euro peg), we observe that deficits are amplified in cantons with loose fiscal rules while a dampening effect is observed for cantons with stricter fiscal rules. This suggests that cantons react differently to a negative interest rate shock, depending on the fiscal rule's design. The same effect can be observed for public expenditure but not for investment expenditure. We can furthermore confirm the substitution effect between operational and capital deficits.

We subject our findings to a battery of robustness checks, which mostly confirm our results. We substitute the SNB interest rate variable with an approximation of real interest rate cost and replace per capita normalization with variables as share of GDP. Both robustness checks aim at specifically

addressing the sound fiscal conditions in Swiss cantons. We also challenge our results with alternative measures for public investment activities and various FAT specifications.

To summarize, fiscal rules do what they are supposed to do by constraining public debt. Interest rate variations have an effect on fiscal variables but there is no indication that fiscal rules would function abnormally in a low interest rate environment. While very strict fiscal rules constrain public spending, there is no indication of a negative impact of fiscal rules on public investment, neither in the long term nor after a negative interest rate shock. These findings contrast the view that fiscal rules were causal for low debt-financed public investment during the low interest rate period in the 2010s. Future research should apply a similar approach to specific elements in fiscal rule design to gain a better understanding of economically efficient rule design.

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Appendix

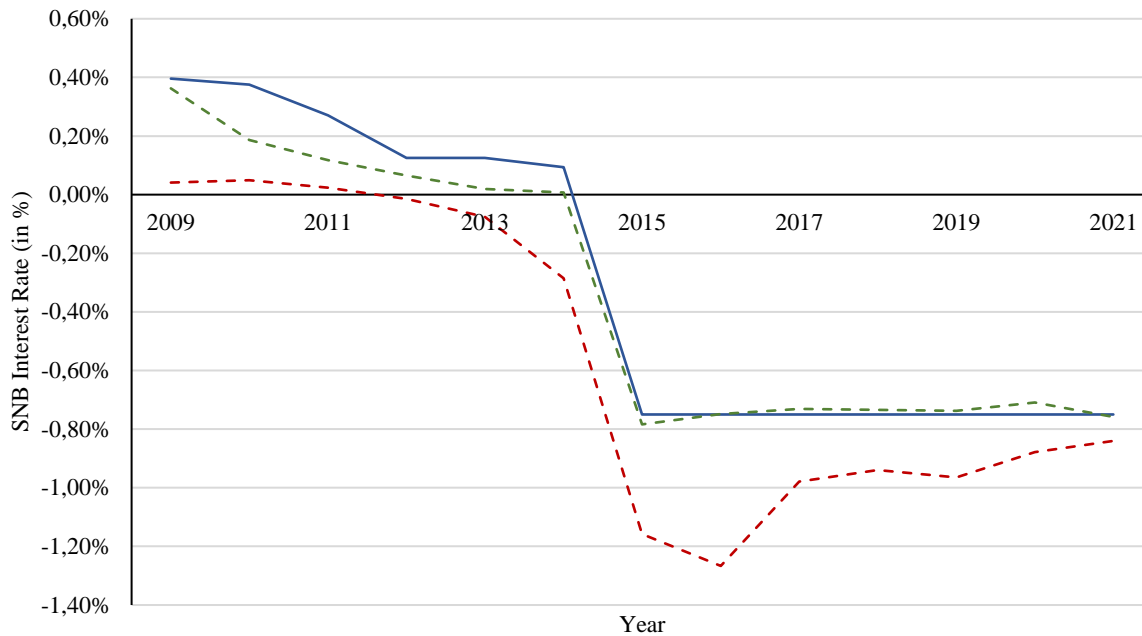


Figure A-1: Policy rate and money market rate (2009 to 2021).

The graph displays the SNB policy rate (blue line) and the respective overnight interest rate (red dashed line) and three months LIBOR in Swiss Franc (green dashed line). The unexpected and substantial interest rate drop due to the determination of the Euro-Swiss Franc-Peg in the year 2015 is clearly visible. The 84.38 basis points interest rate drop has been the sharpest interest rate decline in non-crisis years for at least 25 years.

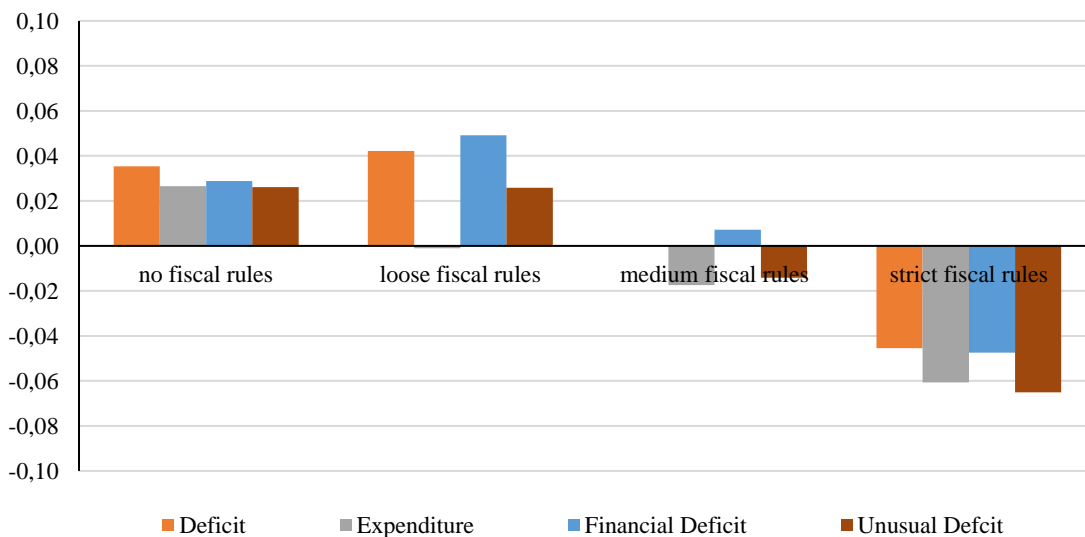


Figure A-2: Visualized FAT results, difference between forecasted and observed values (1/2)

Results for $q_i = 3$, the depicted ATTs are calculated as forecasted values minus observed values (in 1.000 CHF per capita), all observations are averaged values over the entire post-treatment period. A negative value indicates that the actual observation was lower than the forecast. After the negative interest rate shock, deficits, expenditure, financial deficits and unusual deficits increase more than expected in cantons with no or very loose fiscal rules, while the opposite occurred in cantons with very strict fiscal rules. Given very strict fiscal rules, the negative interest rate shock lowered deficits, expenditure, financial deficits and unusual deficits more than expected.

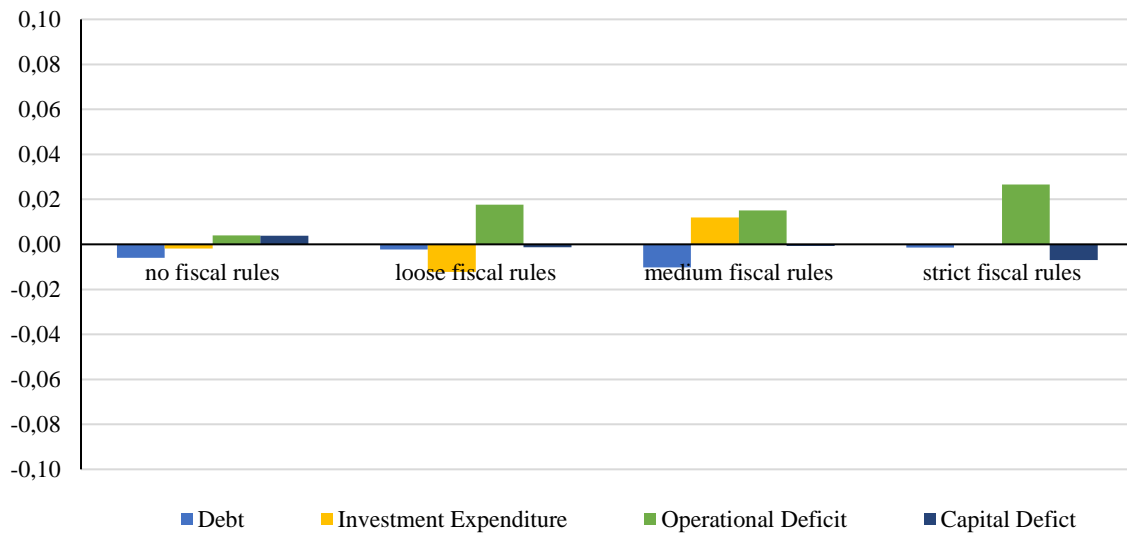


Figure A-3: Visualized FAT results, difference between forecasted and observed values (2/2)

Results for $q_i = 3$, the depicted ATTs are calculated as forecasted values minus observed values (in 1.000 CHF per capita), all observations are averaged values over the entire post-treatment period. A negative value indicates that the actual observation was lower than the forecast. After the negative interest rate shock, there is hardly any observable deviation from the forecast for *debt*, *investment expenditure*, *operational deficits* and *capital deficits*. In this context, it is particularly relevant that while fiscal rule stringency had an impact on expenditure (Figure A-2) after the interest rate shock, this result cannot be found for *investment expenditure*.

	Debt	Deficit	Expenditure	Investment expenditure	Debt	Deficit	Expenditure	Investment expenditure
SNB interest rate	0.0171 (0.0112)	0.00272 (0.0468)	-0.226*** (0.0586)	0.00546 (0.0227)	0.0151 (0.0113)	0.00372 (0.0479)	-0.242*** (0.0600)	0.00382 (0.0231)
fiscal rule (median split)	-0.0638*** (0.0209)	-0.0210 (0.0848)	-0.0725 (0.0961)	0.0313 (0.0403)				
low rule stringency					-0.0908*** (0.0281)	-0.0267 (0.110)	0.0352 (0.125)	0.0269 (0.0565)
medium rule stringency					-0.0469* (0.0275)	-0.0232 (0.112)	-0.0954 (0.125)	0.0374 (0.0551)
strong rule stringency					-0.0671** (0.0285)	-0.00734 (0.119)	-0.306** (0.142)	0.00188 (0.0569)
<u>Interaction terms: SNB Interest rate with</u>								
## fiscal rule (median split)	-0.000320 (0.00927)	-0.00138 (0.0361)	0.00420 (0.0400)	-0.0226 (0.0188)				
## low rule stringency					-0.00334 (0.0109)	0.0145 (0.0455)	-0.0842* (0.0483)	-0.0439** (0.0215)
## medium rule stringency					-0.00257 (0.00940)	-0.00362 (0.0355)	0.0255 (0.0379)	-0.00576 (0.0187)
## strong rule stringency					0.00191 (0.0134)	-0.00893 (0.0535)	0.0299 (0.0582)	-0.0255 (0.0270)
lagged dependent variable	yes	yes	yes	yes	yes	yes	yes	yes
controls	yes	yes	yes	yes	yes	yes	yes	yes
Observations	806	806	806	806	806	806	806	806
Number of Cantons	26	26	26	26	26	26	26	26
Joint Significance Chi2-test	0.00119	0.00146	0.0110	1.442	89	0.314	24.74	12.15
Prob > chi2	0.972	0.969	0.917	0.230	0	0.999	0.000382	0.0587

Robust standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A-1: Effect of the interaction term interest rate with fiscal rules on fiscal parameters, dynamic model, estimated with a bias-corrected LSDV estimator, fiscal variable per capita.

	Debt	Deficit	Exp.	Investment Exp.	Debt	Deficit	Exp.	Investment Exp.	Debt	Deficit	Exp.	Investment Exp.
real interest rate costs		0.00106 (0.00260)	- (0.00234)	0.000410 (0.00137)		0.00104 (0.00261)	- (0.00242)	0.000415 (0.00137)		0.00107 (0.00266)	- (0.00254)	0.000343 (0.00140)
fiscal rule (continuous)		-0.00585 (0.0339)	-0.0911** (0.0394)	-0.000508 (0.0162)								
fiscal rule (median split)						-0.0223 (0.0579)	-0.0926 (0.0664)	0.00570 (0.0261)				
low rule stringency										-0.0242 (0.0977)	-0.0145 (0.112)	-0.000368 (0.0519)
medium rule stringency										-0.0254 (0.0897)	-0.102 (0.100)	0.0142 (0.0443)
strong rule stringency										0.00218 (0.110)	-0.403*** (0.133)	-0.0264 (0.0531)
lagged dependent variable		yes	yes	yes		yes	yes	yes		yes	yes	yes
controls		yes	yes	yes		yes	yes	yes		yes	yes	yes
Observations		806	806	806		806	806	806		806	806	806
Number of Cantons		26	26	26		26	26	26		26	26	26
Joint Significance Chi2-test		0.0298	5.355	0.000981						0.229	9.436	0.512
Prob > chi2		0.863	0.0207	0.975						0.973	0.0240	0.916
<i>Robust standard errors in parentheses</i>												
<i>*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$</i>												

Table A-2: Effect of real interest rate cost variation and fiscal rules on fiscal parameters, dynamic model, estimated with a bias-corrected LSDV estimator, fiscal variable per capita (Robustness Check).

	Debt	Deficit	Exp.	Investment Exp.	Debt	Deficit	Exp.	Investment Exp.	Debt	Deficit	Exp.	Investment Exp.
SNB interest rate	-0.0239*** (0.00675)	0.00378*** (0.00104)	-0.0267*** (0.00667)	-0.0135*** (0.00440)	-0.0239*** (0.00662)	0.00360*** (0.00102)	-0.0268*** (0.00654)	-0.0134*** (0.00431)	-0.0256*** (0.00674)	0.00393*** (0.00104)	-0.0279*** (0.00674)	-0.0143*** (0.00443)
fiscal rule (continuous)	-0.0157** (0.00613)	0.000405 (0.000959)	0.00304 (0.00607)	0.00152 (0.00400)								
fiscal rule (median split)					-0.0379*** (0.0122)	-0.00229 (0.00189)	0.00625 (0.0120)	0.00463 (0.00789)				
low rule stringency									-0.0710*** (0.0188)	-0.00359 (0.00284)	-0.0186 (0.0185)	-0.0114 (0.0122)
medium rule stringency									-0.0122 (0.0169)	-0.00351 (0.00265)	0.0250 (0.0170)	0.0179 (0.0112)
strong rule stringency									-0.0838*** (0.0190)	0.00844*** (0.00295)	-0.0250 (0.0189)	-0.0219* (0.0124)
lagged dependent variable	yes	no	yes	yes	yes	no	yes	yes	yes	no	yes	yes
controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	806	806	806	806	806	806	806	806	806	806	806	806
Number of Cantons	26	26	26	26	26	26	26	26	26	26	26	26
Joint Significance Chi2-test Prob > chi2	6.571 0.0104	0.178 0.673	0.250 0.617	0.144 0.704					26.61 7.11e-06	19.16 0.000253	5.533 0.137	7.723 0.0521
<i>Robust standard errors in parentheses</i> *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$												

Table A-3: Effect of interest rate variation and fiscal rules on fiscal parameters, dynamic model, estimated with a bias-corrected LSDV estimator, fiscal variable as share of GDP (Robustness Check).

	Financial Deficit	Operational Deficit	Capital Deficit	Unusual Deficit	Financial Deficit	Operational Deficit	Capital Deficit	Unusual Deficit	Financial Deficit	Operational Deficit	Capital Deficit	Unusual Deficit
SNB interest rate	0.00353*** (0.00105)	0.00349*** (0.00104)	0.000450 (0.000312)	-0.000240 (0.000336)	0.00336*** (0.00103)	0.00330*** (0.00102)	0.000452 (0.000306)	-0.000240 (0.000329)	0.00367*** (0.00105)	0.00364*** (0.00104)	0.000455 (0.000316)	-0.000251 (0.000340)
fiscal rule (continuous)	0.000312 (0.000968)	0.00147 (0.000950)	-0.00092*** (0.000298)	0.000132 (0.000306)								
fiscal rule (median split)					-0.00229 (0.00190)	6.66e-05 (0.00188)	0.00209*** (0.000565)	0.000293 (0.000583)				
low rule stringency									-0.00369 (0.00292)	-0.00152 (0.00284)	-0.00174* (0.000897)	3.14e-05 (0.000945)
medium rule stringency									-0.00332 (0.00272)	-0.00106 (0.00263)	-0.0023*** (0.000838)	0.000471 (0.000857)
strong rule stringency									0.00751** (0.00299)	0.0112*** (0.00295)	-0.00200** (0.000907)	5.14e-05 (0.000973)
lagged dependent variable	yes	no	yes	no	yes	no	yes	no	yes	no	yes	no
controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	806	806	806	806	806	806	806	806	806	806	806	806
Number of Cantons	26	26	26	26	26	26	26	26	26	26	26	26
Joint Significance Chi2-test	0.104	2.405	9.444	0.186					15.48	20.29	13.67	0.330
Prob > chi2	0.747	0.121	0.00212	0.666					0.00145	0.000148	0.00339	0.954
<i>Robust standard errors in parentheses</i> *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$												

Table A-4: Effect of interest rate variation and fiscal rules on different types of deficits, dynamic model, estimated with a bias-corrected LSDV estimator, fiscal variable as share of GDP (Robustness Check).

	Exp.	Investment Exp	admin. Property	Capital Assets	Exp.	Investment Exp	admin. Property	Capital Assets	Exp.	Investment Exp	admin. Property	Capital Assets
SNB interest rate	-0.238*** (0.0555)	-0.00326 (0.0195)	-0.0177 (0.0712)	-0.0323 (0.0736)	-0.223*** (0.0531)	-0.00266 (0.0189)	-0.0239 (0.0721)	-0.0388 (0.0745)	-0.239*** (0.0553)	-0.00475 (0.0194)	-0.0667 (0.0718)	-0.0923 (0.0742)
fiscal rule (continuous)	-0.0795** (0.0391)	-0.000593 (0.0161)	-0.0515 (0.0790)	-0.0784 (0.0818)								
fiscal rule (median split)					-0.0662 (0.0650)	0.00528 (0.0258)	-0.152 (0.166)	-0.204 (0.173)				
low rule stringency									0.0294 (0.109)	-0.00134 (0.0508)	-0.228 (0.150)	-0.314** (0.156)
medium rule stringency									-0.0855 (0.100)	0.0143 (0.0441)	-0.106 (0.198)	-0.122 (0.206)
strong rule stringency									-0.349*** (0.131)	-0.0270 (0.0526)	-0.170 (0.228)	-0.321 (0.235)
lagged dependent variable	yes	yes	no	no	yes	yes	no	no	yes	yes	no	no
controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	806	806	780	780	806	806	780	780	806	806	780	780
Number of Cantons	26	26	26	26	26	26	26	26	26	26	26	26
Joint Significance Chi2-test	4.144	0.00136	0.425	0.920					7.725	0.523	2.943	4.889
Prob > chi2	0.0418	0.971	0.514	0.338					0.0520	0.914	0.401	0.180
<i>Robust standard errors in parentheses</i>												
<i>*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$</i>												

Table A-5: Effect of interest rate variation and fiscal rules on different public investment parameters, dynamic model, estimated with a bias-corrected LSDV estimator, fiscal variable per capita (Robustness Check).