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# Banking Regulation and Sovereign Default Risk: How Regulation Undermines Rules

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# Banking Regulation and Sovereign Default Risk: How Regulation Undermines Rules

## Abstract

Banking regulation invites banks to gamble when buying government bonds that regulators consider to be risk-free. The adverse effects on financial stability are known. In turn, this study shows that governments have an incentive to use banking regulation in order to enhance their fiscal leeway. We examine an unintended side-effect of banking regulation, namely the zero-risk weighting of sovereign bonds, which leads to lower costs of borrowing, encourages over-borrowing, and undermines constitutional fiscal rules. Our empirical analysis, by estimating local projections, examines the reaction of the fiscal balance in euro area periphery countries to a restrictive macroprudential capital regulation shock. We find that, unlike in the US, euro area banks' share of domestic government bond holdings increases after the shock. This feeds into cheaper and more government borrowing laying bare the undesired interaction between banking regulation and constitutional rules. By comparing the US with the European Union, there is plausibility that the US implemented regulatory treatment and fiscal constitutional rules in a fashion that is better able to minimize the negative spillovers from banking regulation on sovereign borrowing. By contrast, the EU would benefit from more risk-based macroprudential regulation and a more credible constitutional no-bailout regime for sub-federal entities.

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# 1 Introduction

Banks are subject to banking regulation, which routinely classifies certain assets as safe for which no capital is required to be held to protect against losses on these assets. Typically, domestic government bonds are regarded as safe asset. However, there are numerous examples of domestic government bonds being classified as *safe* despite a clear default risk. This allows banks to gamble with depositors' funds by purchasing such risky government bonds and closely correlated assets, as the risk of these assets is not recognized. As a consequence, the banks' interconnectedness with their sovereign rises, reinforcing the so-called sovereign-bank nexus, which was seen as one of the main causes of the European sovereign debt crisis that hampered economic growth by causing financial instability (Acharya et al., 2014a; Bocola, 2016).

This study examines the sovereign-bank nexus from a different perspective. It demonstrates that designating certain sovereign assets as safe encourages banks to shuffle more domestic government bonds into their portfolio which leads to lower borrowing costs for the government and ultimately overborrowing. As a consequence, a sovereign may be invited to overspend in such situation and to run higher deficits. This has legal and institutional implications. Legally, bank regulation interacts with fiscal rules, neither of them can pursue goals in isolation. The financial stability focus of bank regulation must account for solvency concerns of fiscal rules, and vice versa. The legal arrangement must either curtail the effect of banks' gambling on the regulatory side (by raising core capital requirements), or, on the fiscal side, rules must increase the political costs of taking advantage of 'cheap' borrowing (or simply prohibit it). Institutionally, the problem is that the government plays two critical roles: it regulates the banking sector and borrows to finance budget deficit. Banking regulation takes the form of risk-weighted capital adequacy requirements. And the government decides to spend and to run budget deficits. If the borrower and the regulator are the same entity (the government), that entity has an incentive to ignore the riskiness of sovereign bonds. Lower cost of borrowing creates a potential moral hazard on behalf of the regulator, if the regulator is also the borrower. In this case,

the true gambling party is the government, rather than the banks. Consequently, an institutional separation of banking regulation and fiscal regulation is key.

Our empirical analysis studies the interaction between banking regulation and fiscal rules. We highlight how banking regulation (through macroprudential regulation) changes the incentive scheme for the government acting within the boundaries of constitutional fiscal rules. The key insight from the analysis is that macroprudential regulation governing banks creates spillovers for budgetary conduct of states and compliance with fiscal rules. A regulatory decision can shift the burden of adaptation on fiscal rules in mitigating the side effects of banking regulation. By extension, the same holds in the other direction. The sovereign solvency risk associated with fiscal rules decisions (such as the politicized US debt ceiling or the lenient EU fiscal rules) impact on financial stability and may cause risk of bank default (IMF, 2023), (Gori, 2023).

Our empirical strategy builds on one remaining perennial flaw in banking regulation which is the privileged treatment of sovereign exposure. Basel capital rules require banks to hold capital for all asset classes based either on a given regulatory risk weight or internally modeled default probabilities. However, while this principle of the Basel Accord has been rigorously applied to lending to corporations, its application in relation to sovereigns is generally much softer. In the US, while federal government bonds are treated as zero weights, bonds of US states and municipalities are assigned a weight of 20%. In the EU, regulatory treatment is more benign than in the US with banks even permitted to assign a zero-risk weight for sovereign debt of all EU member states. European banks thus do not hold capital against any of their sovereign exposures. The rationale of zero-risk weights for sovereign states is that when a country like the US has its own currency, the federal government can, in extremis, order the central bank to print money to sufficiently service its debt. Hence, the government repays its debt, at least in nominal terms; such nominal debt should be riskless. However, this rationale does not account for the situation of states being members to a currency union when the debtor governments, such as US states or euro area member states, are unable to control monetary policy and to print money to service their debt. Consequently, if government fiscal authorities

are at a subordinate level to the monetary authority, the default risk on sovereign debt is not zero (Gros, 2013).

This analysis reasons (and empirically shows) that macroprudential regulation may usher into banks buying more government bonds, thus reducing borrowing costs and inviting government overborrowing. This may conflict with constitutional fiscal rules that enshrine principles of fiscal discipline. Both under the US and the EU rules, a no-bailout clause applies the logic of market pressure on sovereigns for sovereigns to have an incentive to pursue fiscal discipline. In addition to no-bailout clauses, further layers of fiscal rules exist such as debt limitations in US states constitutions or EU fiscal regulations. The research question is: In comparative perspective between the EU and the US, does the risk-weight regulatory privilege given to banks leads to the effect that sovereigns lower fiscal discipline and undermine the purpose of fiscal rules? Our hypothesis is that zero-risk weight undermines fiscal discipline (and hence fiscal rules) in times of fiscal distress.

In our empirical analysis, we estimate local projections to examine the response of fiscal policy to a tightening of macroprudential capital regulation. We focus on the euro area periphery countries, which fell into fiscal distress during the EU sovereign debt crisis (Ongena et al., 2019). Investigating the adjustment of fiscal policy in US states to a macroprudential shock is barely possible, because the availability of individual state fiscal data is severely restricted.[1] However, by comparing how differently US and EU banks react to a macroprudential shock, we can rationalize why US banks produce less spillovers to US state governments that would invite overborrowing than in the EU.

Our results show that banks in the euro area periphery countries increase their exposure to domestic government debt after a restrictive macroprudential capital regulation shock, while US banks hold their exposure constant at lower levels. The effect of this reaction yields very different consequences for fiscal rules. In the EU,

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[1]First, US states' data on the fiscal position, such as the primary balance, as well as bond yields are – to the best of our knowledge – not systematically reported on a quarterly basis. Second, to the extent that US states publish fiscal data, these data are inconsistent across states. Some states' definitions of deficit and revenue vary greatly, as they tend to separate the sections on expenditures and revenues. In addition, revenue structure is often complex because of the use of endowment funds, or the so-called "rainy days" funds, which can be drawn upon, thereby limiting the information on the primary balance.

the rise in banks' demand for domestic government bonds contributes to an increase in borrowing of peripherial euro countries in response to the shock. The government balance ratio deteriorates. Moreover, fiscal stress increases, suggesting that sovereign risk rises due to higher borrowing. Hence, the constitutional no-bailout clause loses credibility. This result contrasts with the US. The US do not encounter the same magnitude of spillovers from a shock in banking regulation, with fiscal conduct not affected. We reason two factors: First, the US regulatory treatment of sovereign bonds is more risk-oriented than the zero risk approach under EU rules. This leads US banks not to flee into domestic government bonds. Second, the US have a more credible fiscal regime in place, one which effectively deters the US States from taking advantage of the cheap borrowing induced by banking regulation.

The study is structured as follows: Section 2 highlights the connection of the study to different strands of literature. Section 3 outlines the legal framework. Section 4 presents our empirical model and the data. Section 5 discusses the empirical results. Section 6 summarizes the legal implications of our empirical findings. Finally, Section 7 presents the conclusion.

## 2    Literature review

Our study connects to three strands of literature: the banking regulation literature focusing on the sovereign-bank nexus, the constitutional law literature on fiscal federalism, and the literature discussing the link between politicians and regulators. First, our study builds on a number of empirical studies that explore the bidirectional interaction between banking regulation and sovereign budgetary conduct. Acharya and Steffen (2015), Gropp et al. (2019) and Hristov et al. (2021), among others, document a significant increase in banks' holdings of domestic government bonds in the euro area periphery countries following a tightening of macroprudential capital regulation, which reflects an unintended side-effect of bank capital regulation that is associated with the zero-risk weight (Acharya et al., 2014b).[2] Hristov et al. (2024)

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[2]In addition, Gropp et al. (2019) show that particularly banks with low capitalization tend to increase their capital ratio in response to higher capital requirements by reducing their risk-weighted assets rather than raising the level of equity.

report that governments in the periphery countries increase their borrowing after a restrictive capital-based macroprudential policy measure. In line with this finding, we show that the increase in public debt comes along with a temporary drop of the government bond rate and a rise in fiscal stress. In opposite direction, Gori (2018) demonstrates how the bank-sovereign contagion can start in fiscal conduct – demonstrated for the US – and how it migrates into credit risks for banks and thus undermining banking regulation that aims at financial stability. Our analysis primarily seeks to prove causality from the regulation to fiscal conduct, but the logic extends in opposite direction as well. If the US runs higher fiscal sovereign risk, which leads to higher sovereign bond interest rates, there is an impact on banks' balance sheets ushering into financial instability.

Second, our analysis connects to the legal literature on fiscal federalism that examines the design of constitutional no-bailout clauses. Both in the US and the EU, the financial crisis gave rise to a discussion on how no-bailout regimes should be applied to financially distressed US states and euro area member countries. In the US, fiscal federalism is determined by the historical experience of sovereign solvency crisis of the 1840s which gave rise to a regime of fiscal rules that extends until today (Schleicher, 2023; Greve, 2012), while Europe is characterized by its own sovereign debt crisis and the fiscal governance crafted as response to it. The legal literature discusses how the market logic of the no-bailout principle can be reconciled with various instruments granting fiscal support in federal relationships (Peterson and Nadler (2012) and Johnson and Young (2012) for the US, and Steinbach (2013) and Palmstorfer (2012) for the EU). This literature takes very heterogeneous approaches to fiscal constraints. They largely deal with the challenge to reconcile rigidity in enforcing fiscal rules to maintain market logic, on one hand, and the flexibility necessary to avoid the exacerbation of financial instability as result of rigid enforcement. The US experience with enforcing a no-bailout regime of the federal level visa-vis the US states has been controversially discussed, with more recent developments in US fiscal federalism as an indication of this provision being relaxed (Schleicher, 2023; Conti-Brown and Skeel, 2012). However, since "California is not Greece" (Greve, 2012), US States do comparatively effective contain negative

spillovers from banking regulation on fiscal conduct while maintaining overall small government debts. In any case, the interaction between banking regulation and fiscal federalism is a blind spot in the legal literature. While legal scholarship discusses the role of macroprudential regulation from a doctrinal perspective (Keller, 2020; Amorello, 2018), the connection between macroprudential regulation and fiscal rules has not been adressed.

The third connection point is with the literature discussing the close link between politicians and regulators, which in our study unfolds to the extent that governments looking for fiscal leeway would seek lenient banking regulation in order for banks to buy government bonds. The literature analyzes opportunistic political cycles and how regulators are closely tied to politicians. The literature suggests that political pressures may limit the ability of regulators to "lean against the wind" (Müller, 2023). Akey et al. (2018) and Akey et al. (2021) show that politicians actively use their influence over lenders to reallocate credit in their interest. Relatedly, other contributions suggest that government owned banks is associated with political lending, particularly during election periods (Englmaier and Stowasser, 2017; Koetter and Popov, 2021). Moreover, moral suasion by a sovereign may prompt particularly state-owned banks to purchase additional domestic government bonds in times of fiscal distress (Ongena et al., 2019).

# 3 Fiscal rules and macroprudential regulation

## 3.1 Constitutional no-bailout rules and budgetary market exposure of sovereigns

Our analysis studies the effect of banking regulation on constitutional rules. We hypothesize that a zero-risk weight privilege is a regulatory treatment potentially conflicting with the market discipline concept of the no-bailout clause. Zero-weight privilege confers economic advantages to credit institutions to the extent that it exempts financial institutions from backing these loans with their own funds which undermines market pressure. Both the US and the EU have no-bailout clauses

in place. They can strengthen market pressure in different ways – through debt ceilings and no-bailout clauses, or both, like in the US. No-bailout clauses play a pivotal role in federations where interlinkages exist both horizontally between sub-federal units as well as vertically between the sub-federal and the federal level. The US constitution does not stipulate an explicit no-bailout clause, but there is an established and credible regime of not bailing out US States and municipalities (Peterson and Nadler, 2012). This implicit no-bailout regime exposes US states and municipalities to market pressure, incentivizing them to maintain fiscal discipline (Johnson and Young, 2012). The importance of this implicit no-bailout regime can be understood in historical perspective. US states increased their debt levels since the mid-1820s, mainly because to heavy investments in infrastructure, creating a bubble that finally burst in 1837 (Schleicher, 2023). The federal level intervened for some time, buying up a great deal of the states' bonds but finally pursued a strict no-bailout policy. Since Congress allowed several states to default in the 1840s, its no-bailout commitment has been perceived as highly credible (Johnson and Young, 2012). The recent financial crisis revived the debate on the US federal government stepping in to bail out US states at risk of default, but overall the US no-bailout regime, despite its lack of explicit address in the US constitution, has been viewed as largely effective and credible.[3]

Similar to the US, the EU Treaties built on the notion of fiscal responsibility and market exposure of sovereign states. The historical evolution of the EU from an internal market towards an Economic and Monetary Union was characterized by establishing a currency union subject to a fiscal regime. Introducing a common currency was made conditional on the implementation of a bailout prohibition and a tight fiscal regime. Unlike in the US, there is an explicit ban on member states to assume the debt of a member state.[4] However, EU treaty-makers did not only see the risk of sovereigns bailing out other sovereigns, but they acknowledged, which is relevant for our analysis, that financial institutions may likewise be able to grant non-

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[3]State and Municipal Debt: The Coming Crisis? Hearing before the Subcommittee on TARP, Financial Services and Bailouts of Public and Private Programs of the House Committee on Oversight and Government Reform, 112th Cong, 1st Sess 1 (2011) ("State and Municipal Debt Hearings") (Rep Patrick McHenry).

[4]Article 125 Treaty on the Functioning of the European Union

market conditions to EU Member States. On more granular level, the prohibition explicitly laid down in the EU Treaties bans EU Member States from enjoying privileged access to financial institutions.[5] In other words, financial institutions must not lend to EU member states at non-market rates in order to allow markets to exert budgetary pressure on the sovereign entity. Hence, EU rules forbid any measure that establishes privileged access by EU institutions and the central government.

Thus, US and EU constitutional rules share the notion of enforcing market logic to incentivize budgetary discipline. They let market forces work, with lower interest rates rewarding fiscal soundness and rising interest rates signaling budgetary caution. To render these constitutional rules effective, financial markets assessments should assess the default probability of each member state individually. Granting economic advantages to financial institutions, which in turn create or are intended to create advantages for the public sector on the financial market in the private sector, is forbidden. Apart from direct bailouts, other indirect and regulatory ways undermine the logic of market exposure, as discussed in the next subsection.

## 3.2   The zero weight (un)logic

The empirical question is whether banking regulation, when granting a preferential treatment to some government bonds, undermines the constitutional fiscal principle. The regulatory treatment of sovereign bonds is governed by Basel capital requirements. The Basel requirements provide an international regulatory accord that introduced a set of reforms designed to mitigate risk within the international banking sector. They require banks to maintain certain minimum leverage ratios and to observe certain levels of reserve capital on hand. Member States participating in the Basel accord are obliged to implement these rules in their domestic legal orders. As a consequence of the Basel rules, banks must hold capital for all asset classes, either based on a given regulatory risk weight under the standardized approach or internally modeled default probabilities. The rationale behind these capital requirements is to ensure that higher risks are backed by stronger collaterals. Depending on the risk assessment by rating agencies, risk weights vary between 0% and 150%

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[5]Article 124 Treaty on the Functioning of the European Union

and are applicable to the standardized approach.[6] The underlying logic is that a good debtor creditworthiness results in low capital requirements, whereas low creditworthiness leads to high capital requirements; in theory, this regulatory approach follows the fiscal logic of no-bailout described above. However, as a deviation from this principle, Basel rules establish a special regime for sovereign bonds distinct from corporate bonds by subjecting the former a privileged set of rules. Capital requirements determine the regulatory treatment of sovereign bonds by reference to the standardized approach. Under this approach, banks can determine risk weights for (sovereign) exposure in a standardised manner based on external ratings from credit rating agencies. If sovereign credit ratings are available, a weighting range from 0% to 150% exists. If sovereign ratings are not available, a risk weight of 100% is applied to sovereign exposures. However, the rules offer leeway at national implementation level that lower risk weight can be applied to banks' sovereign exposures, or exposures to their central bank, if they are denominated and funded in domestic currency.[7] The zero-risk weight of sovereign bonds hence does not follow the otherwise mandatory risk-based valuation requirement.[8]

The US and EU have implemented Basel capital requirements differently in their respective macroprudential rules (as the Basel rules are themselves non-binding, they require implementation domestically). We are interested in the treatment of subfederal entities (euro area member states and US states), as they have no control over their currency and cannot simply print money to service their debts. This implies that when monetary and fiscal authorities are separate entities, the default risk of sovereign debt is not zero. Under US banking regulation, obligation exposures to US states, municipalities, and other political subdivisions of the US have a weight of 20%.[9] In contrast, the EU constitutional rules implementing the Basel

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[6]Basel Committee on Banking Supervision, Basel III: Finalising post-crisis reforms, December 2017, paragraph 7.

[7]Basel Committee on Banking Supervision, Minimum capital requirements for market risk, January 2019, paragraph 22.7.

[8]By contrast, the internal model approach requires banks to assess the default risk of sovereign bonds in the trading book. This requirement also applies to government bonds that are denominated in the sovereign's domestic currency (BCBS, 2019, paragraph 33.21). Hence, under the Basel rules, the internal model approach does not grant privileged treatment to sovereign bonds.

[9]§ 217.32 of Reg. Q, 78 FR 62157, 62285, Oct. 11, 2013 General risk weights. Federal Financial Institutions Examination Council, FFIEC 051 RC-R-35, p. 43

framework assign a 0% risk weight to exposures vis-à-vis member states denominated and funded in the domestic currency.[10] Hence, unlike in the US, exposure to EU member states is considered risk free regardless of the ratings assigned by rating agencies.[11] Sovereign bonds receive a zero risk weight in capital regulation, they are exempted from the large exposure requirements, and they are also classified as highly liquid in the liquidity regulation framework (Sterzel, 2020). Therefore, even if a bank's internal risk model determines the risk weight of these exposures to be above zero percent, the credit institution may assign a 0% in the EU risk weight. This makes investing in sovereign bonds more attractive compared to other asset classes. It is this privileged treatment in implementing the Basel rules, that is, the more favorable conditions for sovereign bonds (both in the EU and the US) that motivate our analysis and which we claim to have an empirical effect on the relevant macroeconomic indicators.

# 4 Model specification, data and macroprudential policy shock

In this section, we present the empirical model used for our analysis, the data feeding into the model, and the strategy to derive macroprudential capital regulation shocks. This empirical exercise allows us then to infer the effect of capital regulation on the fiscal conduct.

## 4.1 Empirical model

Following Jordà (2005), we estimate local projections to generate impulse responses to a capital-based macroprudential policy shock. Since we use panel techniques, the

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[10]Article 114 paragraph 4 of EU Regulation 575/2013.

[11]Furthermore, even credit institutions that apply the Internal Ratings Based Approach (that is, allowing credit institutions to apply their own rating models to calculate the default risks) may apply the standardized approach for exposures to central governments, if these exposures are assigned a 0% weight (Article 150 paragraph 1 (d) (ii) of Reg. 575/2013 with reference to Article 114 of Reg. 575/2013).

linear model is given by:

$$X_{i,t+h} = \theta_h \text{MPS}_t + \phi'_h(L)Z_{i,t-1} + \alpha_{i,h} + u_{i,t+h} \qquad (1)$$

where $X_{i,t+h}$ is the variable of interest, subindex $i$ denotes the country, $\text{MPS}_t$ is an exogenous capital-based macroprudential policy shock, $Z_{i,t-1}$ is a vector of control variables, $\phi_h(L)$ is a polynomial in the lag operator, $\alpha_{i,h}$ captures country fixed effects, and $u_{i,t+h}$ is an error term.[12] The variables of interest are the banks' exposure to domestic sovereign debt, which is measured by the domestic government bond holdings ratio, the government bond rate, the government bond rate spread, the government's cyclically adjusted primary balance ratio, the government balance ratio as well as an indicator of fiscal stress. In the specification for the banks' domestic government bond holdings ratio, the vector of control variables includes lags of the domestic government bond holdings ratio, the bank capital ratio, the government debt ratio, the loan rate spread, and a short-term interest rate.[13] In the specifications for the variables of interest related to fiscal policy, the vector of control variables includes the same set of variables, but with the difference that the lag of the log of real output is used instead of the bank capital ratio. Moreover, a measure for fiscal stress is used to replace the loan rate spread. In the specifications for the government bond rate and interest rate spread, the vector of control variables includes lags of the banks' domestic government bond holdings ratio, the government balance ratio, a measure of fiscal stress as well as the government bond rate and the government bond rate spread, respectively. For every control variable, we impose a lag order of three.[14]

The response of $X$ at time $t+h$ to a capital-based macroprudential policy shock at time $t$ is given by the estimated coefficient $\theta_h$. Thus, the impulse responses are derived by estimating a series of single regressions for each horizon $h = 0, 1, 2, 3...H$ to generate a sequence of the $\theta_h$'s. We use the method of Driscoll and Kraay (1998)

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[12]The panel approach allows us to pool diverse information from the countries while controlling for heterogeneity across the units by taking account of country-fixed effects. An advantage of the approach is that it increases the efficiency of statistical inference.

[13]In the specification for the banks' domestic government bond holdings ratio, we also include a linear trend.

[14]Note that the results are robust against the choice of alternative lag orders.

to calculate standard errors to account for the serial correlation in the error terms induced by the successive leading of the dependent variable (Ramey and Zubairy, 2018). As in Tenreyro and Thwaites (2016), we set the maximum autocorrelation lag to $H + 1$.

## 4.2 Euro area periphery data

Our data is obtained from the European Central Bank (ECB) and comprise quarterly time series.[15] The euro area periphery countries include Ireland, Italy, Portugal, and Spain.[16] We consider the period 2005Q1-2018Q4. During this period, the peripheral countries fell into fiscal distress.

The banks' domestic government bond holdings ratio is calculated as the share of the holdings of domestic government bonds in total assets. The fiscal policy data consist of the primary balance ratio, that is, the government primary deficit (-) or surplus (+) as a percentage of GDP, the government balance ratio, that is, the government deficit (-) or surplus (+) as a percentage of GDP, and the government debt ratio, which is the government debt as a percentage of GDP. As we seek to identify the discretionary decisions of fiscal policy after a macroprudential capital regulation shock, we adjust the primary balance ratio cyclically, which allows us to filter out business-cyclical effects.[17] The bank capital ratio is the capital position as a share of total assets. Real GDP is used as a measure for economic activity.[18] The government bond rate is a long-term yield with a ten-year maturity. The loan rate spread is calculated as the difference between the lending rate and the government bond rate. The Sovereign Composite Indicator of Systemic Stress (SovCISS) is used as an indicator of fiscal stress. The EURIBOR three-month rate is used as the short-term interest rate. Finally, the government bond rate spread is calculated as

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[15]See Appendix A for details on the data.

[16]We exclude Greece from our analysis because the country was severely affected by the European sovereign debt crisis and obtained external financing only through financial aid programs from May 2010 onwards.

[17]See Appendix B for a description of the cyclical adjustment.

[18]Note that the Irish GDP exhibits a shift of approximately 23% in 2015Q1 compared to the previous quarter. The shift in GDP was because the country's low corporate tax rates attracted cooperation from some large multinationals, which relocated their economic activity. We consider the structural break in Irish GDP by smoothing the series, that is, we retain the dynamics of the series but adjust for the shift.

the difference between the government bond rate and the EURIBOR three month rate.

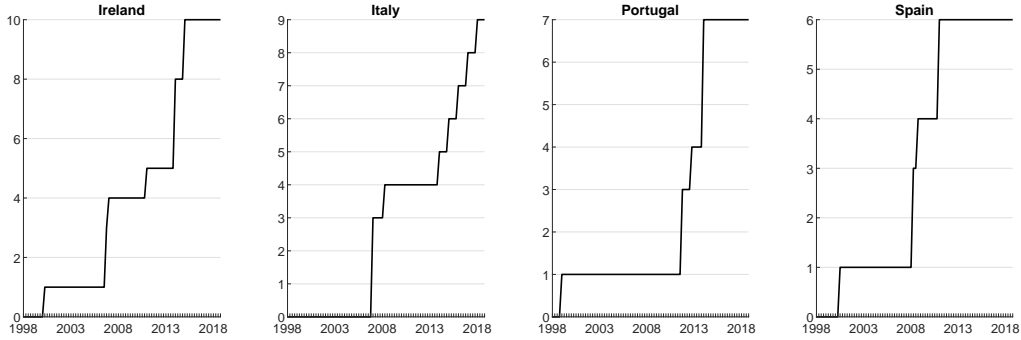## 4.3 Capital-based macroprudential policy shock

The use of local projections requires the shock to be exogenous. Thus, we estimate a panel vector autoregressive (VAR) model to derive structural innovations that can be interpreted as capital-based macroprudential policy surprises.

The panel VAR model is specified as follows:

$$y_{i,t} = \sum_{j=1}^{p} B_j y_{i,t-j} + c_i + \varepsilon_{i,t}, \tag{2}$$

where $y_{i,t}$ is a vector of endogenous variables for country $i$, $B_j$ is a matrix of autoregressive coefficients for lag $j$, $p$ is the number of lags, $c_i$ is a vector of country-specific intercepts that account for possible heterogeneity across the units, and $\varepsilon_{i,t}$ is a vector of reduced-form residuals. The vector of endogenous variables includes an indicator for capital-based macroprudential policy measures, hereafter denoted as *MPI*, the Basel gap, that is, the credit-to-GDP gap, the banks' domestic government bond holdings ratio, the spread between the loan rate and the EURIBOR three-month rate, and the Country-Level Index of Financial Stress (CLIFS) as an indicator of financial stress. We use the macroprudential policy indicator of Hristov et al. (2021), who derive country-specific indicators from the Macroprudential Policy Evaluation Database (MaPPED) provided by Budnik and Kleibl (2018), which summarizes information on changes in capital-based macroprudential policy measures. The indicators comprise adjustments in the MaPPED categories (i) "capital buffers", (ii) "loan-loss provisioning", (iii) "minimum capital requirements' and (iv) "risk weights". Each policy change is assigned a value of +1 if it is a tightening, -1 if it is a loosening, or zero if the intervention is characterized as "unspecified or with ambiguous impact" (Hristov et al., 2021). If a country reports more than one policy change in a particular quarter, associated discrete values are added. For every country, the *MPI* is computed as the cumulative sum of quarterly values. Figure 1 displays the respective indicators.

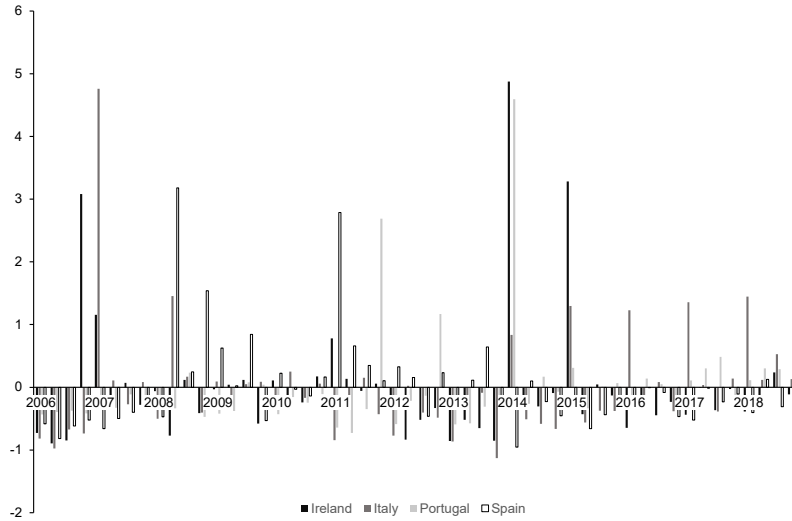**Figure 1:** Peripheral capital-based macroprudential policy indicators

The panel VAR model (2) is estimated with Bayesian methods using a Normal-Wishart prior for the parameters. Inference is based on 10,000 draws from the corresponding posterior distribution. The relationship between the structural shocks $\eta_{i,t}$ and the reduced-form residuals is governed by $\varepsilon_{i,t} = A_0 \eta_{i,t}$, which holds for each cross-sectional unit and $\Sigma = A_0 A_0'$. The structural shock related to capital-based macroprudential policy is identified by imposing a recursive ordering. This is implemented by assuming that the matrix $A_0$ corresponds to the lower triangular element in the Choleski factorisation of the variance-covariance matrix $\Sigma$ of $\varepsilon_t$. The *MPI* is ordered first and the corresponding orthogonal disturbance is interpreted as capturing the unsystematic component of capital-based macroprudential policy measures. The ordering implies that the *MPI* reacts only to its own shock, while the reaction to all other shocks occurs with a lag of at least one quarter. This identification scheme is based on the fact that macroprudential policy, unlike monetary policy, tends to be slow-moving. In particular, the adjustment of macroprudential instruments frequently suffers from inaction and delays in implementation (Knot, 2014; Arslan and Upper, 2017; Edge and Liang, 2022).

For the local projections, we extract the structural shocks from the estimated model (2) by calculating the mean of the single shock series of the 10,000 draws. The structural innovations are standardized to have a mean of zero and a standard deviation of one. Figure 2 displays the innovations. A positive value of the structural innovations indicates that macroprudential policy was tighter than expected, while a negative value indicates that policy was looser than expected. Thus, although

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**Figure 2:** Peripheral structural macroprudential policy innovations

our analysis refers to a period that was characterized by a sequence of tightenings in bank capital regulation (see Figure 1), the use of structural shocks allows us to examine the effects of macroprudential policy that was unexpected.
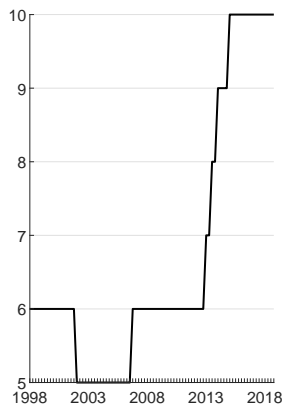
## 4.4   Model for the US

Our analysis focuses on the euro area periphery countries, as the availability of quarterly fiscal data for US states is – as mentioned above – severely restricted. However, we can examine how US banks adjust their exposure to US states government debt in response to a restrictive capital regulation shock. The intuition is that if US banks increase their demand for US state bonds following a macroprudential shock, this is likely to feed into fiscal lenient condition and cheaper access to borrowing for US states. For this purpose, we estimate model (1) using the banks' holdings of US state and municipal debt as a percentage of total assets, the bank capital ratio, aggregate US state public debt as a percentage of GDP, the loan rate spread, which is the prime loan rate minus the government bond rate, and the three-month interest rate, as a measure for the short-term rate.[19] A shortcoming is that the government bond rate refers to the federal level.

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[19]Since we estimate the model for a single country, we consider the period 2001Q1-2018Q4. It should be noted that aggregate US state public debt is – to the best of our knowledge – not available on a quarterly basis prior to 2001Q1.

At the same time, we estimate a VAR model for the US to derive a capital-based macroprudential policy shock. The model is specified as in (2), including an indicator for capital-based macroprudential policy measures, the Basel gap, the total domestic government debt holdings ratio, that is, the holdings of US treasury securities as well as US state and municipal debt relative to total assets, the spread between the prime loan rate and the three-month interest rate, and an indicator of financial stress. We construct a quarterly US *MPI* using the information provided by Budnik and Rünstler (2023), who apply a narrative approach to identify changes in macroprudential capital requirements. We assign each policy change a value of +1 if it is a tightening, -1 if it is a loosening, and a zero if no intervention is reported. The US *MPI* is computed as the cumulative sum of quarterly values. Figure 3 displays the indicator.
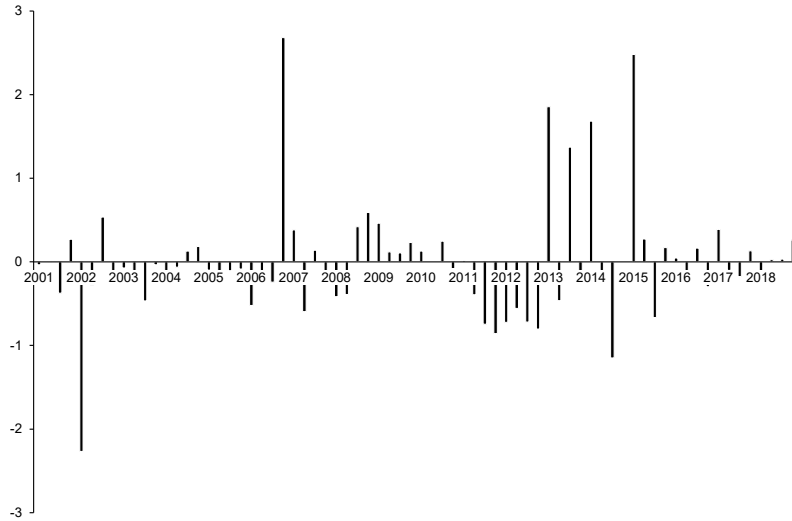
**Figure 3:** US capital-based macroprudential policy indicator



*Notes:* The figure shows the US capital-based macroprudential policy indicators derived from Budnik and Rünstler (2023), which measure the cumulative changes in capital-based macroprudential policy.

The VAR model for the US is estimated with Bayesian methods using a Normal-Wishart prior for the parameters. Again, inference is based on 10,000 draws from the corresponding posterior distribution. The US *MPI* is ordered first and the corresponding orthogonal disturbances are interpreted as the unexpected component of capital-based macroprudential policy measures. The US structural shock is extracted from the estimated model by calculating the mean of the shock series of the 10,000 draws. The structural innovations are standardized to have a mean of zero and a standard deviation of one. Figure 4 shows the innovations.

**Figure 4:** US structural macroprudential policy innovations

*Notes:* The figure shows structural capital-based macroprudential policy shocks that measure the unsystematic component of macroprudential capital regulation.

# 5 Empirical results

Our empirical analysis unfolds in two steps. First, we examine the reaction of the banks' exposure to domestic sovereign debt to a restrictive macroprudential capital regulation shock. Second, we investigate the reaction of fiscal policy to changes in banks' demand for public debt in response to an unanticipated tightening of macroprudential capital regulation.

**Results of first step.** For the euro area periphery countries, Figure 5 summarizes the results. The dashed lines represent the estimated impulse responses. The dark grey shaded areas display the 90% error bands, while the light grey shaded areas represent the boundaries of the 95% error bands.

We observe that banks in the periphery increase their exposure to domestic government debt in response to a restrictive macroprudential capital regulation shock. The domestic government bond holdings ratio increases gradually. Thus, the share of domestic government bond holdings in total assets rises. The empirical literature developed in Acharya et al. (2014b), Acharya and Steffen (2015), Gropp et al. (2019) and Hristov et al. (2021) reports a similar finding by showing that peripheral banks shift their portfolios toward a higher share of domestic sovereign bonds after a tightening in capital-based macroprudential policy. Our finding enhances the result of

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**Figure 5:** Periphery impulse responses to a restrictive capital regulation shock
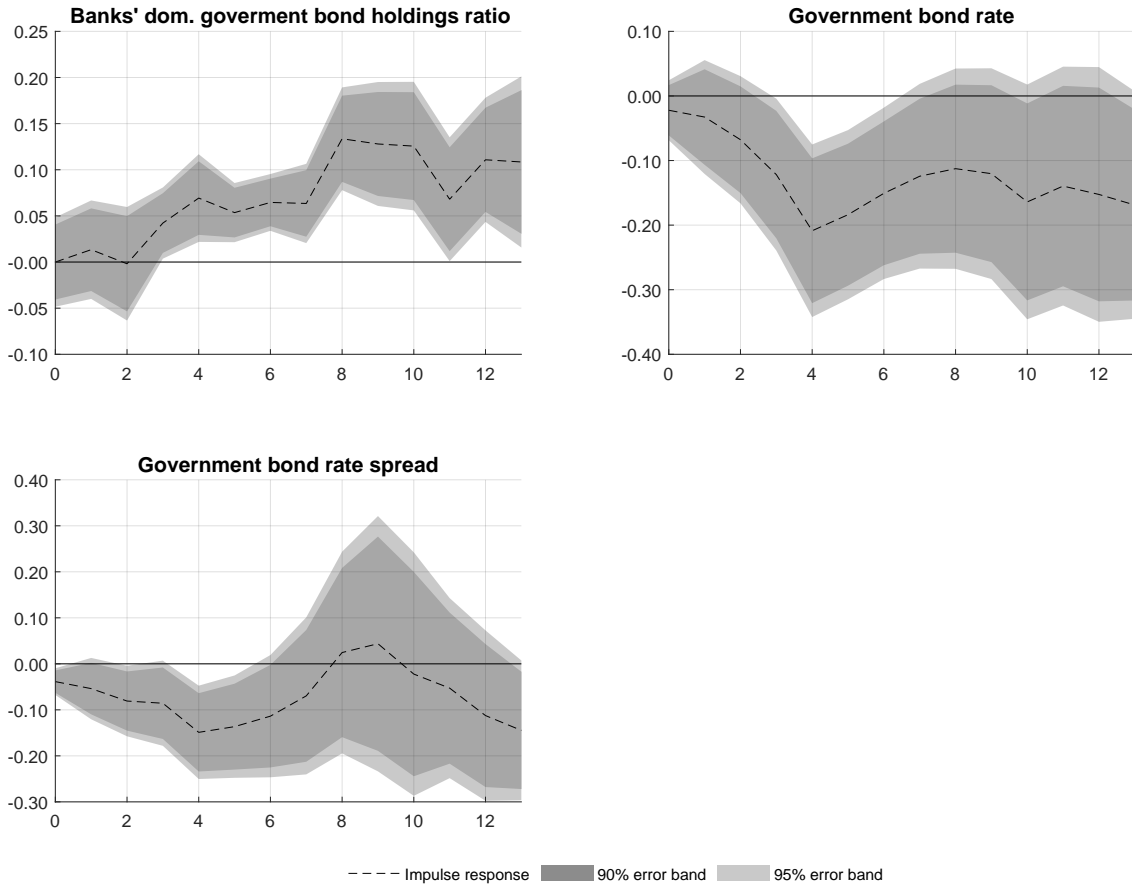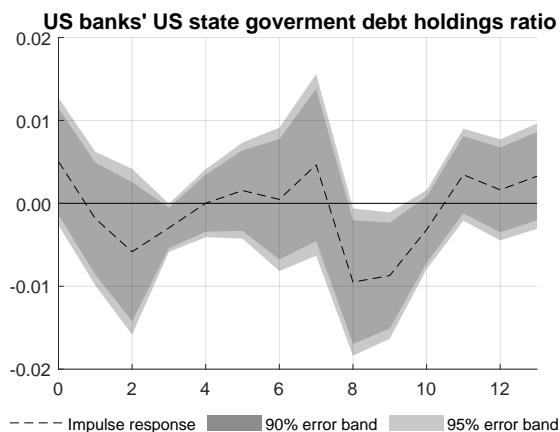


*Notes:* The figure shows impulse responses to an exogenous restrictive capital-based macroprudential policy shock. The dashed lines denote the estimated impulse responses. The shaded areas reflect the 90% error bands and 95% error bands, respectively. The reaction of the banks' domestic government bond holdings ratio is measured in percent. The reactions of the government bond rate and the spread are measured in percentage points.

this literature by showing that the government bond rate declines significantly after the shock. The maximum drop is about 20 base points. The government bond rate spread, that is, the spread between the government bond rate and the EURIBOR three month rate, also drops, which indicates that the decline in the long-term rate, that is, the government bond rate, exceeds that of the short-term rate.

Overall, we find that the peripheral banks' share of domestic government bond holdings in total assets moves in opposite direction to the sovereign yield spread after the macroprudential shock. This suggests that changes in banks' demand for public debt contribute to bringing down the government bond rate. Since banks are important investors in domestic government debt (Arslanalp and Tsuda, 2014; BCBS, 2017), the shift toward higher sovereign exposure may exacerbate the adverse effect of the sovereign-bank nexus to the extent that sovereign risk increases.

In contrast, the reaction of US banks to a restrictive shock to macroprudential capital regulation differs considerably. Figure 6 displays the impulse response of the US states government bond holdings ratio to the innovation. The finding indicates that the ratio barely changes – if at all, it declines temporarily. Thus, US banks do not appear to adjust their US state government debt portfolio following a sudden tightening of macroprudential capital requirements.[20]

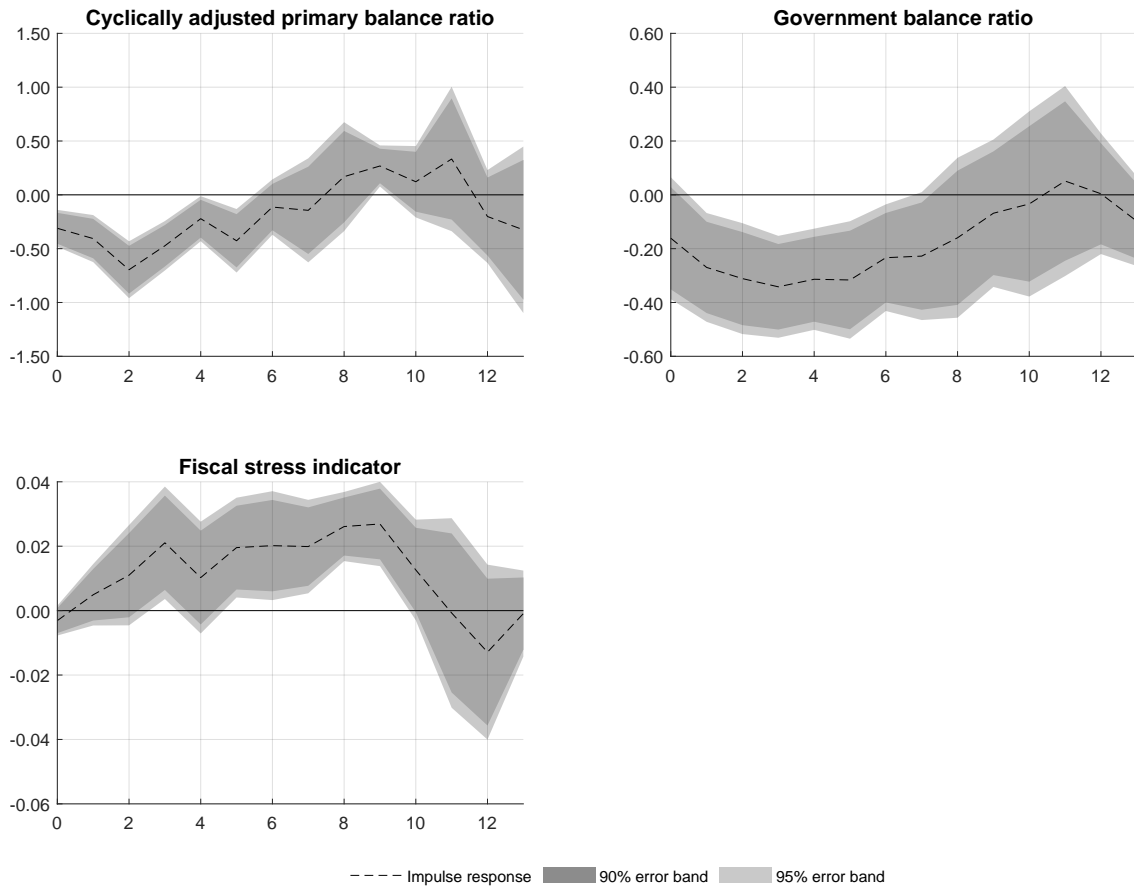**Figure 6:** US impulse response to a restrictive capital regulation shock



*Notes:* The figure shows the impulse response to an exogenous restrictive capital-based macroprudential policy shock. The dashed line denotes the estimated impulse response. The shaded areas reflect the 90% error bands and 95% error bands, respectively. The reaction of the banks' US state government debt holdings ratio is measured in percent.

**Results of second step.** Next, we examine how fiscal policy in euro area periphery countries reacts to changes in banks' demand for domestic sovereign debt in response to an unanticipated tightening of macroprudential capital requirements. To this end, we compute impulse responses of the variables related to fiscal policy to a restrictive macroprudential capital regulation shock. Figure 7 documents the results.

The findings show that peripheral governments increase their debt at their own discretion in response to a sudden tightening in capital regulation. The cyclically adjusted primary balance ratio is in deficit after the shock, reaching a maximum decrease of approximately 0.7 percentage points, which may be associated with the incentive to increase borrowing because of the reduction in the government bond

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[20]Since we look at the aggregate holdings of US state government debt in the banks' portfolios due to data constraints, we cannot say to what extent the debt of the individual US states is re-balanced after a restrictive macroprudential capital shock.

**Figure 7:** Periphery impulse responses to a restrictive capital regulation shock



*Notes:* The figure shows impulse responses to an exogenous restrictive capital-based macroprudential policy shock. The dashed lines denote the estimated impulse responses. The shaded areas reflect the 90% error bands and 95% error bands, respectively. The reactions of the fiscal policy variables are measured in percentage points. The reaction of the fiscal stress indicator is measured in percent. A positive value of the cyclically adjusted primary balance ratio and the government balance ratio denotes an improvement, while a negative value reflects a deterioration.

rate. In addition, the government balance ratio deteriorates at the same time. Thus, the structure of the government budget is realigned toward higher public borrowing in response to a sudden macroprudential policy tightening. Finally, the fiscal stress indicator rises in response to the shock, suggesting that sovereign risk increases with higher debt.

The political economy of this chain of effects suggests that euro area peripheral governments have an incentive to tweak capital regulation to favor their own fiscal space. This exacerbates the time inconsistency problem that fiscal rules intend to address. Fiscal rules intend to prevent governments from short-term borrowing because governments tend to ignore the long-term negative effects of overspending. However, capital regulation may be an instrument in the hands of governments that is particularly powerful when governments control or are identical to regulators in

order to offset the desired effect of fiscal rules.

# 6 Reviewing the legal governance of zero weights

Our empirical analysis sought to illuminate the spillover channel from banking regulation to fiscal conduct and the conflict it engenders with constitutional fiscal rules. We showed that banks gamble if zero-risk weighted government bonds invite them to do and this gambling encourages government spending at inefficient high levels. Credit extensions to the government may become more attractive because of the zero-risk weight. We observe a deterioration of the cyclically adjusted primary balance in response to the shock, which comes along with a temporary fall in the government bond rate and an increase in fiscal stress. By extension, the reverse holds as well: states may handle their fiscal constraint in a way that translates sovereign risks into credit risks, as demonstrated by the European debt crisis (Acharya and Steffen, 2015) or the US fiscal ceiling debates show (IMF, 2023). Just as peripheral euro area banks gambled by fortifying the bank-sovereign nexus through buying excessively domestic sovereign bonds, the peripheral countries' governments continued the gamble by taking advantage of a restrictive shock to capital regulation by increasing borrowing.

Tying our empirical results back to the legal governance, we can draw several conclusions on why the regulatory or fiscal governance has an adverse interaction between regulation and fiscal stance. Implicitly, the results point at three core differences between the euro area peripheral countries and the US states. While both groups are sub-federal entities, they are subject to different regulatory and legal regimes. We argue that the US regimes is capable of avoiding undesired gambling of states leading to lower risk of creating solvency risks that might usher into credit risks and financial instability. In other words, the US manages better to constrain the adverse effects of regulation on fiscal conduct.

First, our empirical evidence highlights that zero weighting is at odds with the idea of market pressure on sovereigns as enshrined as foundational principle of constitutional no-bailout clauses. The problem is that regulatory privileged access by

central governments to financial institutions, by not requiring core capital for holding sub-national government bonds, lifts market pressure and reduces budgetary discipline. This is so because banks are induced by this regulatory treatment to buy sub-national state bonds irrespective of the solvency of the state. This points at a difference between the US and the EU currency unions. While the US incorporates its constitutional no-bailout clause into the macroprudential treatment by requiring a 20% risk weight for obligations of US states, the EU implements a zero risk weight. The zero risk treatment would be sensible if these bonds were risk free. Consider the intention that the drafters of EU zero-risk regulations had it mind. The legislator opined that "public debt paper is usually relatively liquid and the government is, in principle, a good debtor because of its prerogative to raise taxes, so that it is justified to make sure that financial institutions observe certain prudential measures leading to the holding of public debt paper" (European Commission, 1993, p. 15). While privileged access builds on the assumption that government bonds are risk free, this reasoning is - from both a theoretical and empirical perspective - not valid in the context of currency areas such as the US or the euro area, when the debtor government (US states or EU member states) has no power to create and print money to serve its debt, but where this authority lies with the federal or supranational level.[21] When monetary and fiscal authorities are separate entities, default risk on sovereign debt is not zero (Gros, 2013). Our analysis showed that this is a concern for fiscally distressed countries, like the euro area periphery. The zero-risk weight exacerbates the risk of fiscal instability and ultimately the risk of bailout. Ultimately, pressure to bail out EU member states increases considerably if a state default causes a European banking crisis. As long as the zero-risk weight privilege and thus the sovereign-bank nexus exists, the credibility of the no bailout clause is reduced (Hauser, 2020).[22]

Second, our analysis showed the euro area peripheral banks increase the share of domestic government bonds in their portfolios in response to a restrictive macro-

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[21]The ECB is forbidden to provide monetary financing to any government or even to EU authorities. In other constituencies, monetary financing is not prohibited. See Hülsewig and Steinbach (2021) for a discussion.

[22]Moreover, the finding is also at odds with the treaty-based rule, which bans privileged access to financial institutions (Article 124 Treaty on the Functioning of the European Union).

prudential shock, leading to cheaper government borrowing. A high share is risky because it increases the risk that credit risks spillover into solvency risks, which we observed empirically in our euro data in a rise in fiscal stress after the regulatory shock. In contrast, US banks barely adjust their US state government bond holdings ratio in response to a restrictive capital-based macroprudential policy shock (see Figure 6) – if at all, the ratio declines temporarily. Regarding the difference in banks' behaviour between both regions, Figure 8 illustrates that the US banks' share of US state government bond holdings is comparatively low. While this holds stable over time, it also extends to a restrictive shock to macroprudential capital regulation. This difference between the euro periphery countries and the US states may be due to several reasons. One is connected to the above mentioned regulatory treatment. US state bonds are not treated as zero risk bonds unlike in the EU. If not considered risk-free and thus binding core capital makes investment in these bonds less attractive. In addition and more generally, comparatively less appetite for domestic bonds reflects that these are considered less profitable for banks compared to other non-sovereign bonds. With the financial integration in the US far more advanced than in the EU, there is plausibility that banks have access to a more diversified and profitable assets than their European counterparts.

**Figure 8:** Banks' share of domestic government bond holdings
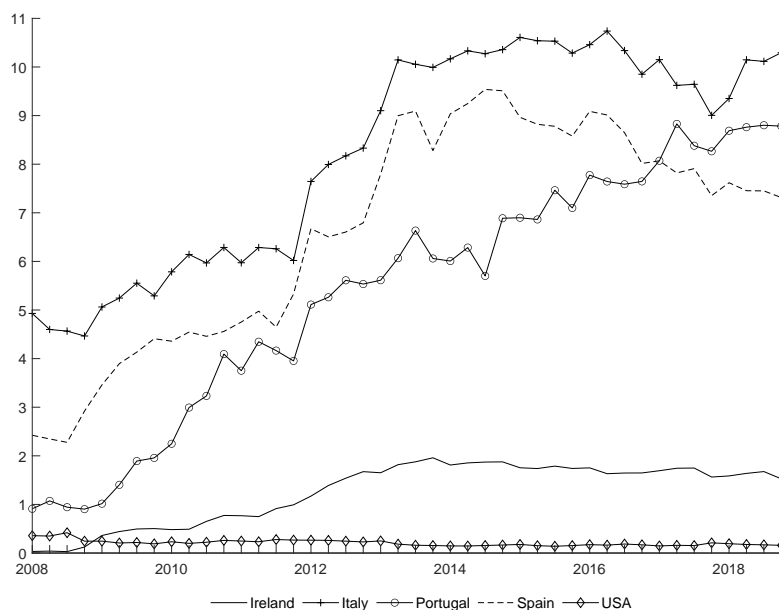


*Notes:* The figure shows the banks' holdings of domestic government bonds relative to total assets. For the US banks, the data refer to the holdings of US state and municipal debt as a percentage of total assets. The ratios are measured in percent.

Third, EU and US differ significantly as to the fiscal constitutional regime as well as the actual fiscal performance, with US states performing fiscally more solid than euro area member countries. First, the US has a more credible no-bailout clause in place than the EU. Historically, the US experience with insolvencies of US states in the 1840ies was decisive for a fundamental change in fiscal governance (Rodden, 2006). With the US federal government's decision not to bail out US states, a credible no-bailout regime was established. This contrasts with the EU, where the no-bailout clause enshrined in the EU Treaties has been considered weak and incredible, as the Euro debt crisis has shown (Gourinchas et al., 2023). Moreover, fiscal rules have been applied stricter in the US than in the EU. To guard against debt costs rising too high, many states in the USA have on their own initiative amended their constitutions to include debt limits of various kinds (Savage, 1998). The level of government debt between the states in the US illustrates that while balanced budget rules have not prevented states running high deficits on temporary basis, the overall debt of states has been contained (Fatas and Mihov, 2006). Aggregate US State debt as a percentage of GDP averaged 11% between 2005 and 2018. This stands in stark contrast to the euro area periphery countries, where the average public debt ratio was 72% in Ireland, 123% in Italy, 106% in Portugal and 98% in Spain, respectively, during the same period. European fiscal rules have in the past been applied in a lenient fashion that further undermined the credibility of the constitutional no-bailout rule. It is only after the sovereign debt crisis that several reforms were undertaken to strengthen implementation of these rules (Mileusnic, 2021).

Overall, the comparison between the US and the EU suggests that euro area countries could take US states as 'role model' in several regards. First, the EU domestic implementation of the Basel rules applied too much leniency engendering malincentives. The EU should eliminate the zero risk weight and introduce a risk weight of 20 per cent that is as high as for US states. Second, with a low share of domestic government bonds in the portfolio that reduces the negative spillover on government borrowing and preventing fiscal overborrowing, the EU should introduce regulatory measures to reduce holding of government bonds as share of overall

portfolio. Third, credible constitutional and sub-constitutional fiscal rules matter in order to offset any possible spillover from regulatory treatment to fiscal conduct. Strengthening the no-bailout clause and fortifying the deficit and debt constraints that have led US states to contain their debts at comparatively low levels would hinder euro countries to engage in overborrowing even if the zero weight regulatory treatment relaxes the fiscal constraints.

# 7   Conclusion

Banking regulation drew the attention of scholarship in particular from the perspective of financial stability and economic growth. This literature focuses on how banks can be regulated in a way that minimizes adverse effects on financial stability while fostering economic growth. Less attention has been paid to the unintended side effects of banking regulation and sovereigns' fiscal conduct. We hypothesize that banking regulation conflicts with constitutional rules to the extent that regulatory privileged treatment of sovereign bonds held by banks invites governments to be fiscally less prudent than they should. If fiscal rules cannot contain this effect, the result is overborrowing. This is particularly relevant with regard to the regulatory treatment of bonds of sub-federal entities in currency unions, as currency areas stipulate no-bailout regimes, establishing the primacy of market pressure on sovereign bonds.

We showed that awarding zero-risk to government bonds invites fiscally distressed governments to take advantage of the lower interest on government bonds. Put differently, (banking) regulation undermines (constitutional) rules. Our empirical results suggest that certain conditions exist under which this effect is more or less salient and comparing the euro countries with US states illustrative in this regard. We identified two relevant factors: First, banking regulation implementing zero risk weight for sub-federal levels such as US states or euro countries ignore possible solvency risks. They invite domestic banks to increase their holdings of government shares which ultimately leads to government overborrowing. In turn, requiring banks to hold capital for sub-federal state bonds reduces the likelihood

of banks shifting their portfolio towards state bonds following a restrictive macro-prudential shock. Second, we see that this effect is particularly strong pertaining to countries in fiscally difficult situation (the euro periphery countries) while not significantly affecting fiscally more stable countries (US states and the euro core countries). US states perform fiscally much better, which is largely a result of a credible no-bailout principle and more rigid fiscal restrictions. Yet, this comparative fiscal solidity cannot be taken for granted. Recent concerns about the sustainability of US debt, the debt ceiling as subject of political opportunism, as well as a vulnerable banking sector may create negative spillovers of the kind analysed in this paper. This extends to both the federal level, from where spillovers can incur to the regulated banking sector, and the state level, where some US states have recently seen signs of fiscal deterioration. As the experience with the US debt ceiling (Gori, 2018) or with the EU sovereign debt crisis show, fiscal rules can be the source of sovereign risks turning into credit risks and thus undermining financial stability. They indicate the reverse channel of our analysis to materialize: constitutional rules may undermine banking regulation.

With regard to adapting banking regulation, policy implications of our analysis are three-fold: A first is to remove the zero-weight privilege. There is widespread use of the zero-weight privilege (ESRB, 2015), prevalent with currency unions such as the US and euro area. Removing the privilege is not only imperative in view of the well-established repercussions of the privilege of sovereigns in macroprudential regulation on financial stability and economic activity (Hannoun, 2011). It is also necessary to avoid negative spillovers on fiscal conduct and to avoid undermining fiscal rules. A second recommendation is to strengthen constitutional no-bailout clauses to avoid governments to gamble by taking advantage of cheap borrowing that does not reflect fiscal sustainability risks. Finally, there is an important political economy implication to the fact that both the banking regulator and the fiscal decision-maker can be a government representative. If the regulator is also the borrower, there is a malincentive to remove the access to cheap money and to retain the zero-weight privilege. As a consequence, both banking regulatory and fiscal rule-maker should be institutionally separated in order to avoid an alignment of their

incentives.

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# A  Data

## Euro area periphery countries

*ECB Statistical data Warehouse:*

- MFIs' holdings of domestic government bonds, outstanding amount (stock) in millions of euro, monthly frequency

  `BSI.M.XX.N.A.A30.A.1.U6.2100.EUR.E`

  This is converted to quarterly data using end-of-period monthly values

- Banks' capital and reserves (banks' equity), outstanding amount, monthly frequency, end-of-period stocks

  `BSI.M.XX.N.A.L60.X.1.Z5.0000.Z01.E`

  This is converted to quarterly data using end-of-period monthly values

- Total assets of a country's MFIs, outstanding amount (stock) in millions of euro, monthly frequency

  `BSI.M.XX.N.A.T00.A.1.Z5.0000.Z01.E`

  This is converted to quarterly data using end-of-period monthly values

- Gross domestic product at market prices, chain linked volume

  `MNA.Q.Y.XX.W2.S1.S1.B.B1GQ._Z._Z._Z.EUR.LR.N`

- Government primary balance as % of GDP, deficit (-)/ surplus (+)

  `GFS.Q.N.XX.W0.S13.S1._Z.B.B9P._Z._Z._Z.XDC_R_B1GQ._Z.S.V.N._T`

- Government deficit/ surplus as a % of GDP, deficit (-)/ surplus (+)

  `GFS.Q.N.XX.W0.S13.S1._Z.B.B9._Z._Z._Z.XDC_R_B1GQ_CY._Z.S.V.CY._T`

- Government debt as % of GDP

  `GFS.Q.N.XX.W0.S13.S1.C.L.LE.GD.T._Z.XDC_R_B1GQ_CY._T.F.V.N._T`

- The lending rate is computed as the weighted average over the lending rates on NFC loans and loans for house purchase. The weights correspond to the respective share of NFC loans and loans for house purchase.

1. MFI volume of loans non-financial corporations (NFCs), monthly frequency, end-of-period stock,

   `BSI.M.XX.N.A.A20.A.1.U6.2240.Z01.E`

2. MFI volume of loans to households for house purchase, monthly frequency, end-of-period stock,

   `BSI.M.XX.N.A.A20.A.1.U6.2250.Z01.E`

3. Lending rate on loans to NFCs, new business, monthly frequency,

   `MIR.M.XX.B.A2A.A.R.A.2240.EUR.N`

4. Lending rate on loans to households for house purchase, new business, monthly frequency,

   `MIR.M.XX.B.A2C.A.R.A.2250.EUR.N`

These series were converted to quarterly averages based on the monthly observations.

- Government bond rate

  `IRS.M.XX.L.L40.CI.0000.EUR.N.Z`

  This was converted to quarterly data using monthly averages

- EURIBOR 3-month rate

  `FM.M.U2.EUR.RT.MM.EURIBOR3MD_.HSTA`

  This was converted to quarterly data using monthly averages

- Sovereign composite indicator of systemic stress

  `CISS.M.XX.Z0Z.4F.EC.SOV_CI.IDX`

  This is converted to quarterly data using monthly averages

- Financial stress indicator

  `CLIFS.M.XX._Z.4F.EC.CLIFS_CI.IDX`

  This is converted to quarterly data using monthly averages

In the series' codes XX is a placeholder for the country acronym: Ireland (IR), Italy (IT), Portugal (PT), and Spain (ES). Seasonally unadjusted data were seasonally adjusted using the IRIS Macroeconomic Modeling Toolbox.

*Bank of International Settlements:*

- Basel-gap

  Q:XX:P:A:B

*Capital-based macroprudential policy indicators:*

- Hristov et al. (2021)

# US data

*Federal Reserve Bank of New York:*

- US banks' holdings of US State and Municipal debt as % of total assets, quarterly frequency

- US banks' holdings of Treasury securities as % of total assets, quarterly frequency

- Banks' total capital ratio, all institutions. Total capital and total risk-based capital as % of risk-weighted assets, quarterly frequency

*Federal Reserve Bank of St. Louis:*

- Real gross domestic product, billions of chained 2012 Dollars, quarterly frequency

- Bank prime loan rate, percent, quarterly frequency

- Long-term government bond yields: 10-year: main for the US, percent, quarterly frequency

- 3-Month Treasury bill secondary market rate, percent, quarterly frequency

- Financial stress index, index, quarterly frequency

*Fiscal data:*

- U.S. Treasury Monthly Statement of the Public Debt: State and local government series total public debt outstanding, quarterly frequency

  https://fiscaldata.treasury.gov

*Bank of International Settlements:*

- Basel-gap

  Q:US:P:A:B

*Capital-based macroprudential policy indicator:*

- Budnik and Rünstler (2023)

# B    Cyclical adjustment

We adjust the primary balance ratio cyclically by estimating the following equation:

$$X_{i,t} = \beta_j \sum_{j=0}^{p} g_{i,t-j} + c_i + u_{i,t}, \tag{3}$$

where $X_{i,t}$ is the primary balance ratio of country $i$, $g_{i,t}$ is the output gap, $c_i$ is a constant, and $u_{i,t}$ is an error term. The output gap is calculated as the relative deviation of real GDP from the potential output, which is approximated by the real output trend. We use the Hodrick Prescott filter to calculate this trend. The lag order is set to $p = 4$.[23] The cyclical-adjusted primary balance ratio is derived from (3) using the error term.

# C    Panel VAR model set-up

For every element of the vector of endogenous variables $y_{i,t}$, we use a pooled set of $M \cdot T$ observations, where $M$ denotes the number of countries and $T$ the number

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[23]Note that the results of the cyclical adjustment are robust against different lag orders.

of observations. For each cross-sectional unit, the error terms are assumed to be normally distributed with a homogeneous variance-covariance matrix $\Sigma$, that is $\varepsilon_{i,t} \sim \mathcal{N}(0, \Sigma)$. After stacking the $\varepsilon_{i,t}$ into a vector $\varepsilon_t = [\varepsilon'_{1,t} \ldots \varepsilon'_{M,t}]'$, we have $\varepsilon_t \sim \mathcal{N}(0, I_M \otimes \Sigma)$, where $I_M$ is an identity matrix of dimension $M$.